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KAUPAPA MĀORI SCIENCE

A thesis
submitted in partial fulfillment
of the requirements for the degree
of
Doctor of Education
at
The University of Waikato
by
GEORGINA MARJORIE STEWART

Te Whare Wānanga o Waikato
2007

IHO/ABSTRACT

This thesis investigates how Māori knowledge and language articulate with current discourses of Pūtaiao education, and possible alternative articulations. A Kaupapa Māori version of critical discourse analysis methodology is developed and applied to discourses relevant to Pūtaiao, or Māori-medium science education. This topic represents an intersection between language, science, education, and culture - fields which are all highly politically charged. Therefore, it is essential that a politically robust Kaupapa Māori position be taken in relation to the research topic. Not only the issues being investigated but the underlying research paradigm must be interrogated using Kaupapa Māori theory at each stage of the project.

The goal is to study the range of possible meanings for the notions of ‘Pūtaiao’ and ‘Māori science’ by exploring the relevant dialectical issues, critiquing the assumptions and positions taken on language, knowledge, identity and ethos, in order to inform further Pūtaiao curriculum development. The research project is a narration of the larger story of Pūtaiao education: what is the current situation, how did it come about, what theoretical issues have been influential in this process, and what possibilities are there for further development of Pūtaiao curriculum and pedagogy?

The thesis research consists of a series of discourse analyses of varying levels of focus and intersection with Pūtaiao:

Wāhanga 1: Translated NCEA L1 science and mathematics examinations, and a traditional Taitokerau oral text;

Wāhanga 2: Māori science curriculum policy;

Wāhanga 3: Multicultural science education research;

Wāhanga 4: Curriculum politics, preventive linguistics, language of science;

Wāhanga 5: Mātauranga, rationality, philosophy of science.

Each analysis takes the form of a narrative history, based on a selected corpus of previously published scholarship (in Wāhanga 1, including numerical data and oral tradition) on the issue under examination, from a Kaupapa Māori perspective.

Mainly in the first two chapters, analysis at times also draws on ‘personal narrative’ accounts of previously unpublished details relating to Pūtaiao.

Additionally, an investigation of various qualified notions of ‘science’ is undertaken, beginning in Wāhanga 2, concluding in Wāhanga 5, in order to explore the nature and boundaries of science as a system of knowledge, and its relationship to other types or systems of knowledge.

Synopses are included of the following concepts and theoretical issues impacting on the discourses under analysis:

Wāhanga 1: Ethnicity, ‘race’, critical theory, Kaupapa Māori theory.

Wāhanga 2: Science, scientism, science ideology and anti-science.

Wāhanga 4: Identity, linguistic purism, the Sapir-Whorf hypothesis.

Informed by this research, in Wāhanga 5 an original model for the relationship between mātauranga and science is proposed, and the notion of Kaupapa Māori science/epistemology is explored. An analogy between the Sapir-Whorf hypothesis and multicultural science is used to draw together the cultural debates in language and knowledge, which are surmised to intersect at the level of discourse.

The final chapter presents a re-articulation of Pūtaiao as the notion of Kaupapa Māori science education, and some recommendations for language and content knowledge in further development of Pūtaiao curriculum policy.

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I would like to express my profound gratitude and appreciation to my supervisors, Professor Stephen May and Dr Nesta Devine, for their unerring guidance, as well as for their patience and belief in me, throughout the long haul it has taken to complete this thesis. They are superb teachers, and I am privileged to be their student.

I also acknowledge and thank Dr Elizabeth McKinley, who moved university, and so left my supervisory panel, part-way through. Liz is not only a friend and senior colleague of mine. She is also a tuakana in the collective effort to develop Pūtaiao education, as well as in the international community of CSSE (Culture Studies in Science Education). Acknowledgement is also due to Glen Aikenhead, Canada, who marked my thesis proposal, and gave me great encouragement in our discussion during his visit to Waikato at an early stage of this work.

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*Ki ōku mātua
For my parents*

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TĒNEI AU

This personal ‘whakapapa kōrero’ (T. Smith, 2000) illustrates some complexities, clashes and uncomfortable cultural, socio-economic and gender boundaries permeating contemporary Māori identity. These have been defining issues in my life, since well before it began. The title, borrowed from the traditional karakia (prayer, incantation) widely known in Kura Kaupapa Māori¹, reminds me of Peter McLaren’s thought that ‘where are you?’, not ‘who are you?’, is the most important ethical question (Borg, Mayo et al., 1998). I was born in Auckland in 1961, the middle child of three, of parents both having Māori as well as Pākehā heritage.

Born in 1927, my father, William Stewart (named after the Scottish seaman - see below) was among the first generation of Ngāti Kura children from Matauri Bay, Taitokerau Northland, to attend school under national state provision, where he and his peers were ‘given the supplejack’ for ‘swearing’, which was the term used by their teachers for speaking Māori. When he was 12 and in Standard Two his father required his help for a contract to break a road through to the next bay around the coast (Te Ngāere to Wainui) so he left school. My father is a native Māori speaker - he recalls being well into adulthood (married to my mother, his second wife) before he was able to think in English, without translating in his head.

His mother, my grandmother Tangiaranui, was born in around 1900 with no Pākehā ancestry. She could understand and speak only a small amount of English by the time I remember her in the 1970s, after decades of radio, television, tamariki and in-laws speaking it around her. Tangiaranui was a major inheritor of ancestral hapū land rights in the area, and her mother, Makanihi, disapproved of her choice of husband, my grandfather Nuku Stewart, whom she considered socially inferior in whakapapa terms. This was because Nuku Stewart’s father, Paraika, was the issue of a casual union between a Scottish ship captain’s son and Merekuia, from Tauranga, brought to Northland for early mission schooling opportunities. Furthermore, neither was Paraika married to Nuku’s mother, Ema,

¹ ‘Tēnei au, tēnei au, ko te hōkai nei...’ concerning Māori notions about the origins of human knowledge.

whose parents were a local woman and a Pacific Island tauivi (foreigner), perhaps a ship hand. In Pākehā terms, however, Nuku Stewart proved very successful, opening the first shop in Matauri Bay, running a trucking contract for the Tipene porcelain clay quarry, which is still in the family (operated today by my brother), and successfully turning part of his wife's land at Otoroa into a dairy farm, also still a whānau (extended family) operation today.

Probably due in part to this ongoing animosity with his mother-in-law, Nuku Stewart encouraged my father and his 15 siblings to 'marry Pākehā' in order to better themselves, and to disdain the aspects of traditional culture still operating around them. As a result of these attitudes, and his school experience, my father became reluctant to speak in Māori to his children, and traits of self-denigration indelibly marked his thoughts concerning society, norms and culture.

Born in 1936, my mother was the only child of a single professional woman, my grandmother Dorothy, who was a secondary teacher of English, French, Music, Sport, and the new subject Social Studies. Grandma Dorothy defied the norms of her upbringing by leaving her husband, rather than submit to his patriarchal ideas of marriage. Thus forced into independence, she taught for many years in Opotiki, receiving 2/3 the salary of her male peers, and it was there my mother became one of the first students of te reo Māori as a Scholarship subject (a 'foreign' language) in 1952, for which the school arranged a local kaumātua, Peter Baker, as teacher.

My mother earned a scholarship which enabled her to attend Auckland University in 1953, where she was the palest face in the inaugural kapa haka (or 'concert party' as it was termed). She boarded at O'Rorke Hall. In 1954, my mother met a girl from Matauri Bay (my father's sister), who eventually became my aunt. Though she passes for Pākehā, ('unmarked'; McKinley, 2003), my mother is 1/16 Māori, the fifth female in a maternal descent line from my ancestress, Merekaimanu, of the Coromandel hapū (Ngāti Hei, Ngāti Whanaunga) o Ngāti Maru ki Tainui.²

In marrying Merekaimanu, settler Edward Davis acquired her ancestral land, and hence wealth. One of their grandsons, Ned Hally, became the mayor of

² These proper nouns identify the kin groups of Merekaimanu, i.e. her two hapū ('sub-tribes'), iwi ('tribe'), and waka ('canoe' or 'confederation').

Cambridge, Waikato; and the Māori heritage was suppressed. Generations later, one residual acknowledgement was in the form of a racist patriarchal science family myth. The story, as told to my siblings and me, was that when our mother's father asked for Dorothy's hand in marriage, he was warned by her father of mental instability in the women of the family, caused by the 'mixed blood' - a useful explanation of why Dorothy's mother had committed suicide when Dorothy and her brother were teenagers.

So teaching was 'in my blood', but it was not my first career choice - that became to help save the Takahē from extinction, after reading *Two in the Bush* by Gerald Durrell. That idea eventually led to enrolling after Form 6 in a BSc at Auckland University, where I completed an MSc in Organic Chemistry. After that I worked in Auckland for several years, first as a research technician in the Cancer Research Laboratory in the Auckland Medical School, and later in sales and customer support of chemical analysis equipment. At the end of 1988, I left Auckland and my job and went to Matauri Bay to reconnect with 'my Māori side'. From there I went to live with Mangu Awarau in Waimanoni, near Kaitaia, where I heard about Kura Kaupapa Māori, and extended my limited earlier knowledge of te reo me ōna tikanga.

I returned to Auckland, needing to support myself and my pēpi Nuku, and completed secondary teacher training at Auckland College of Education in 1991. After one year teaching Te Reo Māori at Onehunga High School, in 1993 I became the first teacher of Pūtaiao and Pāngarau at Te Wharekura o Hoani Waititi Marae in Waitakere City, until a renewed wish to live in Te Taitokerau drew me in 1996 to the HOD Māori position at Tikipunga High School in Whangarei, where I have since resided.

Ko Whakarārā te maunga
Ko Matauri te moana
Ko Te Tāpui te marae
Ko Ngāti Kura te hapū
Ko Ngāpuhi-nui-tonu te iwi
Tēnā koutou, tēnā koutou, tēnā anō tātou katoa.

Starry-eyed mum & her daughter...



Mt Eden housewife, Mrs Trixie Stewart, and her 10-year-old daughter, Georgina, have become keen astronomers after attending an astronomy course in Auckland, run by retired secondary school science teacher, Lionel Warner. They're more starry-eyed than ever now. Georgina topped the girls in their end-of-term examination and Mrs Stewart was top mother and top parent. They are pictured above working on an assignment at home.

Teacher's dream

Mr Warner began his course in 1967. He knew he was close to retirement, yet he wanted to maintain the teaching contact. But there were three prerequisites for children wishing to attend. They had to be keen; they had to be from a "fairly superior intellectual stream"; they had to have a written character reference from a head teacher and be accompanied by an adult. It was a teacher's dream," he said. "And the first course was so successful that I continued."

Two years ago pictures and an article by Mr Warner on his project had a double-page spread in United States astronomy magazine, "The Sky and Telescope." Said Mr Warner: "They recognized the intellectual companionship between child and parent here as being of social significance." The pupil-parent course was held at the observatory in the Auckland War Memorial Museum once a week last term, and will continue this term.

Mrs Stewart has long been interested in astronomy. She used to take her three children to the Observatory on public viewing nights and has read as much as she could on the subject. "So when Georgie was keen to attend the course, it was a marvellous excuse for me to go too," she said. "It's such an all-embracing subject. It lifts you right out of everyday life." Son Charles (7) is mad keen to attend too - "he hopes the course will still be on when he's old enough to go," Mrs Stewart said.

Stars in Maori

She and Georgie work together on homework assignments, and Georgie prepared and delivered a lecturette to the class on the astronomy of the ancient Maori. She is part-Maori - her father is Bill Stewart, a garage and taxi business owner - and spent hours making diagrams and giving constellations on the star chart Maori names.

Astronomy is only one of many interests. Georgie plays the piano, takes creative dance lessons, is a Brownie, soon to graduate to a Girl Guide, and she likes to write. She took two years to save \$27 to buy a secondhand portable typewriter, to put out a children's magazine with the help of her sister Julie (13). She was one of the youngest at the astronomy course, generally for pupils from Form II to Form IV.

Extracted from 'The Auckland Star' newspaper, 17 May 1971, p.15.

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TĒNEI AU

This personal ‘whakapapa kōrero’ (T. Smith, 2000) illustrates some complexities, clashes and uncomfortable cultural, socio-economic and gender boundaries permeating contemporary Māori identity. These have been defining issues in my life, since well before it began. The title, borrowed from the traditional karakia (prayer, incantation) widely known in Kura Kaupapa Māori¹, reminds me of Peter McLaren’s thought that ‘where are you?’, not ‘who are you?’, is the most important ethical question (Borg, Mayo et al., 1998). I was born in Auckland in 1961, the middle child of three, of parents both having Māori as well as Pākehā heritage.

Born in 1927, my father, William Stewart (named after the Scottish seaman - see below) was among the first generation of Ngāti Kura children from Matauri Bay, Taitokerau Northland, to attend school under national state provision, where he and his peers were ‘given the supplejack’ for ‘swearing’, which was the term used by their teachers for speaking Māori. When he was 12 and in Standard Two his father required his help for a contract to break a road through to the next bay around the coast (Te Ngāere to Wainui) so he left school. My father is a native Māori speaker - he recalls being well into adulthood (married to my mother, his second wife) before he was able to think in English, without translating in his head.

His mother, my grandmother Tangiaranui, was born in around 1900 with no Pākehā ancestry. She could understand and speak only a small amount of English by the time I remember her in the 1970s, after decades of radio, television, tamariki and in-laws speaking it around her. Tangiaranui was a major inheritor of ancestral hapū land rights in the area, and her mother, Makanihi, disapproved of her choice of husband, my grandfather Nuku Stewart, whom she considered socially inferior in whakapapa terms. This was because Nuku Stewart’s father, Paraika, was the issue of a casual union between a Scottish ship captain’s son and Merekuia, from Tauranga, brought to Northland for early mission schooling opportunities. Furthermore, neither was Paraika married to Nuku’s mother, Ema,

¹ ‘Tēnei au, tēnei au, ko te hōkai nei...’ concerning Māori notions about the origins of human knowledge.

whose parents were a local woman and a Pacific Island tauivi (foreigner), perhaps a ship hand. In Pākehā terms, however, Nuku Stewart proved very successful, opening the first shop in Matauri Bay, running a trucking contract for the Tipene porcelain clay quarry, which is still in the family (operated today by my brother), and successfully turning part of his wife's land at Otoroa into a dairy farm, also still a whānau (extended family) operation today.

Probably due in part to this ongoing animosity with his mother-in-law, Nuku Stewart encouraged my father and his 15 siblings to 'marry Pākehā' in order to better themselves, and to disdain the aspects of traditional culture still operating around them. As a result of these attitudes, and his school experience, my father became reluctant to speak in Māori to his children, and traits of self-denigration indelibly marked his thoughts concerning society, norms and culture.

Born in 1936, my mother was the only child of a single professional woman, my grandmother Dorothy, who was a secondary teacher of English, French, Music, Sport, and the new subject Social Studies. Grandma Dorothy defied the norms of her upbringing by leaving her husband, rather than submit to his patriarchal ideas of marriage. Thus forced into independence, she taught for many years in Opotiki, receiving 2/3 the salary of her male peers, and it was there my mother became one of the first students of te reo Māori as a Scholarship subject (a 'foreign' language) in 1952, for which the school arranged a local kaumātua, Peter Baker, as teacher.

My mother earned a scholarship which enabled her to attend Auckland University in 1953, where she was the palest face in the inaugural kapa haka (or 'concert party' as it was termed). She boarded at O'Rorke Hall. In 1954, my mother met a girl from Matauri Bay (my father's sister), who eventually became my aunt. Though she passes for Pākehā, ('unmarked'; McKinley, 2003), my mother is 1/16 Māori, the fifth female in a maternal descent line from my ancestress, Merekaimanu, of the Coromandel hapū (Ngāti Hei, Ngāti Whanaunga) o Ngāti Maru ki Tainui.²

In marrying Merekaimanu, settler Edward Davis acquired her ancestral land, and hence wealth. One of their grandsons, Ned Hally, became the mayor of

² These proper nouns identify the kin groups of Merekaimanu, i.e. her two hapū ('sub-tribes'), iwi ('tribe'), and waka ('canoe' or 'confederation').

Cambridge, Waikato; and the Māori heritage was suppressed. Generations later, one residual acknowledgement was in the form of a racist patriarchal science family myth. The story, as told to my siblings and me, was that when our mother's father asked for Dorothy's hand in marriage, he was warned by her father of mental instability in the women of the family, caused by the 'mixed blood' - a useful explanation of why Dorothy's mother had committed suicide when Dorothy and her brother were teenagers.

So teaching was 'in my blood', but it was not my first career choice - that became to help save the Takahē from extinction, after reading *Two in the Bush* by Gerald Durrell. That idea eventually led to enrolling after Form 6 in a BSc at Auckland University, where I completed an MSc in Organic Chemistry. After that I worked in Auckland for several years, first as a research technician in the Cancer Research Laboratory in the Auckland Medical School, and later in sales and customer support of chemical analysis equipment. At the end of 1988, I left Auckland and my job and went to Matauri Bay to reconnect with 'my Māori side'. From there I went to live with Mangu Awarau in Waimanoni, near Kaitaia, where I heard about Kura Kaupapa Māori, and extended my limited earlier knowledge of te reo me ōna tikanga.

I returned to Auckland, needing to support myself and my pēpi Nuku, and completed secondary teacher training at Auckland College of Education in 1991. After one year teaching Te Reo Māori at Onehunga High School, in 1993 I became the first teacher of Pūtaiao and Pāngarau at Te Wharekura o Hoani Waititi Marae in Waitakere City, until a renewed wish to live in Te Taitokerau drew me in 1996 to the HOD Māori position at Tikipunga High School in Whangarei, where I have since resided.

Ko Whakarārā te maunga
Ko Matauri te moana
Ko Te Tāpui te marae
Ko Ngāti Kura te hapū
Ko Ngāpuhi-nui-tonu te iwi
Tēnā koutou, tēnā koutou, tēnā anō tātou katoa.

Starry-eyed mum & her daughter...



Mt Eden housewife, Mrs Trixie Stewart, and her 10-year-old daughter, Georgina, have become keen astronomers after attending an astronomy course in Auckland, run by retired secondary school science teacher, Lionel Warner. They're more starry-eyed than ever now. Georgina topped the girls in their end-of-term examination and Mrs Stewart was top mother and top parent. They are pictured above working on an assignment at home.

Teacher's dream

Mr Warner began his course in 1967. He knew he was close to retirement, yet he wanted to maintain the teaching contact. But there were three prerequisites for children wishing to attend. They had to be keen; they had to be from a "fairly superior intellectual stream"; they had to have a written character reference from a head teacher and be accompanied by an adult. It was a teacher's dream," he said. "And the first course was so successful that I continued."

Two years ago pictures and an article by Mr Warner on his project had a double-page spread in United States astronomy magazine, "The Sky and Telescope." Said Mr Warner: "They recognized the intellectual companionship between child and parent here as being of social significance." The pupil-parent course was held at the observatory in the Auckland War Memorial Museum once a week last term, and will continue this term.

Mrs Stewart has long been interested in astronomy. She used to take her three children to the Observatory on public viewing nights and has read as much as she could on the subject. "So when Georgie was keen to attend the course, it was a marvellous excuse for me to go too," she said. "It's such an all-embracing subject. It lifts you right out of everyday life." Son Charles (7) is mad keen to attend too - "he hopes the course will still be on when he's old enough to go," Mrs Stewart said.

Stars in Maori

She and Georgie work together on homework assignments, and Georgie prepared and delivered a lecturette to the class on the astronomy of the ancient Maori. She is part-Maori - her father is Bill Stewart, a garage and taxi business owner - and spent hours making diagrams and giving constellations on the star chart Maori names.

Astronomy is only one of many interests. Georgie plays the piano, takes creative dance lessons, is a Brownie, soon to graduate to a Girl Guide, and she likes to write. She took two years to save \$27 to buy a secondhand portable typewriter, to put out a children's magazine with the help of her sister Julie (13). She was one of the youngest at the astronomy course, generally for pupils from Form II to Form IV.

Extracted from 'The Auckland Star' newspaper, 17 May 1971, p.15.

WĀHANGA TUATAHI

Introduction and Methodology

1.1 Thesis outline

WĀHANGA TUATAHI: Introduction and Methodology (p.1-37)

This chapter introduces the research topic, then discusses and develops the research methodology. This is applied in two contrasting contexts, with the aim to further illuminate the research nexus: first, inspection of initial results (2002-4) for NCEA Level 1 Pūtaiao and Pāngarau examinations, and second, analysis of a traditional Taitokerau saying.

WĀHANGA TUARUA: He Aha te Pūtaiao? (p.38-67)

This chapter reviews debates over the nature of science, and the relationship between science and other types of knowledge, as a background against which to examine major phases of Māori science curriculum development in the 1980s and 1990s.

WĀHANGA TUATORU: Multicultural Science Education (p.68-89)

This chapter contains an account of the international debates in multicultural science education research literature, summarising the major unresolved issues, and discussing how these apply to Pūtaiao curriculum development.

WĀHANGA TUAWHĀ: Language, Identity and Representation in Science, Education and Pūtaiao (p.90-138)

This chapter explores the literature linking language and science, science and culture, and language, culture and representation. The fields of identity politics and language planning are reviewed from the perspective of Pūtaiao before discussion of two relevant language debates, namely linguistic purism and the Sapir-Whorf hypothesis. A linguistic examination of science discourse is related to the language (lexicogrammar) of Pūtaiao.

WĀHANGA TUARIMA: Mātauranga Māori Motuhake (p.139-196)

This chapter examines discourses of mātauranga Māori (traditional Māori knowledge) and its relationship to Western science knowledge. Notions of space-time and classification are used to explore the 'philosophy of Māori science' in order to develop and apply the notion of 'Kaupapa Māori science' to a critique of science and science curriculum.

WĀHANGA TUAONO: Pūtaiao Hei Kaupapa Māori Science? (p.197-206)

This chapter contains recommendations for Pūtaiao curriculum development, and key findings about Kaupapa Māori research, science, and science education.

1.2 Introduction: Knowledge and Language Issues in Pūtaiao

The word ‘pūtaiao’ has been accepted as the Māori term for science within the last few decades.³ Pūtaiao is understood to be translated Western science, or traditional knowledge (mātauranga Māori) equated with science, often with little or no distinction made between usage of the two meanings. The tension between Pūtaiao as ‘science in Māori’ and Pūtaiao as ‘Māori science’ forms the central dialectic with which this thesis is concerned, particularly as it impacts on learners, teachers, and curriculum policy in Pūtaiao for primary and secondary Māori-medium schooling.

Māori science education research constitutes a significant power/knowledge nexus (McKinley, 1995): each of these words, used to delineate the topic, represents a site of intense political and ideological struggle (Walker, 1996; Harding, 1998; Coxon, Jenkins et al., 1994; Tuhiwai Smith, 1999). From a global perspective, such research contributes to the ‘insurrection of subjugated knowledges’ (Foucault, cited in Webster, 1996), and to a cogent critique of Western knowledge, imperialism (Young, 1990) and the neo-liberal emphasis on economic and market theory in social and education policy (Apple, 2000).

Over the last 20 years or more, the increase in the number of children throughout Aotearoa New Zealand attending primary and secondary Māori-medium schools, particularly Kura Kaupapa Māori, has entailed a commitment by the state to support and resource Māori-medium education, a commitment mandated in statute by the section on Te Aho Matua in the Education (Amendment) Act 1999. In terms of curriculum policy, the production of curriculum statements in te reo Māori (marautanga Māori) was part of the development of the National Curriculum Framework/Te Anga Marautanga o Aotearoa⁴ in the 1990s, and included in subsequent curriculum initiatives. The development of Māori science

³ Coined in ca.1980, possibly by Toby Rikihana, from pū (essence) + taiao [=ao] (world, traditional, see Williams, 1971 *or* environment, modern, see Ryan, 1995). So in the word ‘pūtaiao’, ‘world/environment’ is adjectival to ‘essence’ (i.e. ‘essence of/from the world/environment’). Competing accounts include puta (to appear) + i ao (from the world) (Kapua, 1997). Another early term used by Rikihana for Science in the curriculum was ‘Te Ao Tūroa’ (the manifest world), a traditional term, unlike ‘pūtaiao’.

⁴ The National Curriculum Framework (Te Anga Marautanga o Aotearoa), published in 1993, was the first ‘national curriculum’ to be defined (and partially regulated) for Aotearoa New Zealand. It comprised 7 ‘essential learning areas’, each with a Māori ‘parallel’, as follows: Language and Languages (Te Reo me Ngā Reo), Mathematics (Pāngarau), Science (Pūtaiao), Social Science (Tikanga-ā-Iwi), Technology (Hangarau), The Arts (Ngā Toi), Health and Physical Well-being (Hauora). An 8th learning area of Languages (separated from English/Te Reo Māori) has been created in the updated draft NZC (M.O.E., 2006).

education as the subject 'Pūtaiao', and of the Pūtaiao document (M.O.E., 1996), have been part of this overall Māori-medium curriculum process. The re-development of the National Curriculum Framework/Te Anga Marautanga o Aotearoa is currently (2006) underway in the Curriculum Marautanga Project (www.cmp.ac.nz).

The problem with an undifferentiated dual concept of Pūtaiao is that it encourages and masks elision of the two meanings - Māori science, and science in Māori. As a result, the dialectical issues related to language, knowledge, philosophy and politics, which are inherent in the field of Māori science education, become less visible, and more difficult to address, in the design and implementation of Pūtaiao teaching/learning/assessment programmes. This thesis concerns itself with how Māori language and knowledge have been incorporated within past and current policies and practices in Pūtaiao education, and with possible alternatives.

To speak of 'knowledge and language issues' indicates the assumption that knowledge and language can be separated, at least to the extent that issues can be identified as one or the other. However, since knowledge is carried (in classrooms) mainly by language, and since any use of language involves knowledge, clearly any issue of language is also an issue of knowledge, and vice versa. But a language is a system of codification of meaning, **not** a system of knowledge, which is how the term 'a science' is generally understood (see p.39). At the same time, according to Michael Halliday,

[t]he grammar of every natural language is a theory of human experience: a theory that we hold unconsciously, but that is all the more potent for that very reason. (Halliday, 2004, p.9).

These are significant distinctions and inter-relationships in forming the nexus where this thesis research topic is located.

Based on my personal experience, and in common with other published views, (Gilbert, Hipkins et al., 2005; McPherson Waiti, 1990), I would describe Pūtaiao teaching as 'problematic', for several different reasons: knowledge and worldview clashes between 'science' and 'Māori'; the exploding number of kupu hou (science vocabulary) that teachers and students need to master as the class level increases, especially after about Year 8; and the lack of teaching resources, facilities, professional development, and so on - what I refer to below (p.61) as a

‘vacuum’ of professional practice. Low achievement in Science is reported as the only negative ‘key finding’ (out of 4) concerning the achievement of Māori-medium students, in a recent Ministry of Education (MOE) report based on NCEA data (Murray, 2005). This finding is consistent with the survey of Level 1 NCEA data for Pūtaiao and Pāngarau presented below in Wāhanga 1.4 (p.24).

My starting point, therefore, is that state-funded Pūtaiao policy development and implementation must be undertaken so as to provide every possible assistance to teachers and students of Pūtaiao, in order to improve and enhance successful teaching and learning. This thesis explores past, present and possible discourses from this perspective. At the same time, in adopting a Kaupapa Māori standpoint, I am also concerned with the interests of ‘authentic’ Māori knowledge (differentiating between this and translated ‘Pākehā knowledge’), and its role in Pūtaiao. One recent paper looks at this question through a narrative pedagogy lens, asking if and how stories can support science learning, based on analysis of some Pūtaiao readers (two MOE-funded ‘Tōtika’ series, one on birds, one on rocks). ‘How then can science be taught so that it *doesn’t* displace mātauranga Māori or continue the process of colonisation?’ (Gilbert, Hipkins et al., 2005, p.13, original emphasis). Analysis of the Tōtika readers exposes the narrative weakness of the science-based stories therein, with the suggestion the genre might be better termed ‘**faction**’ rather than ‘fiction’. Acknowledging the ‘trap’ of ‘relativism’ (see p.102) into which the Totika texts fall, by simply juxtaposing science narratives with examples from iwi traditions, the authors suggest

treat[ing] mātauranga Māori *and* science, not as ‘the facts’, but as discourses, *systems* of stories told in particular contexts for particular purposes, that - and this is important - construct *people* in certain ways. If we do this, then dealing with mātauranga Māori and Western science isn’t a problem. Having access to two different knowledge systems becomes a resource, an asset... (ibid, original emphases).

One response to this is to say that Māori people have ‘known about’ both mātauranga Māori and Western science for a long time, to no apparent advantage, but the suggestion is worth further exploration, as attempted in this thesis.

The Current Status of Pūtaiao

The Pūtaiao curriculum document has been in place for a decade (M.O.E., 1996). Since then, an increasing amount of science teaching material in te reo has become available, mostly at lower curriculum levels. At NCEA level, translated

science texts are starting to be made available via Te Kete Ipurangi (www.tki.govt.nz), a state-funded educational website. Pūtaiao can be assessed for certification with either Pūtaiao Unit Standards or translated NCEA assessments (www.nzqa.govt.nz). Since there are insufficient teachers of Pūtaiao, a state-funded video conferencing system (KAWM, see p.24) currently provides an important curriculum delivery option for NCEA-level Pūtaiao in Wharekura.

Despite these successes, greater difficulties in the provision of Pūtaiao, compared to the other Māori-medium curriculum areas (Irwin, 1999), are still commonly acknowledged. These have often been phrased in terms of lack: of vocabulary, teaching resources and teacher knowledge (McPherson Waiti, 1990); and are considered more severe at higher curriculum levels. While these issues in Pūtaiao are to some extent being addressed by Ministry and teacher training initiatives, the ‘language issue’ of science terminology remains a significant barrier to teachers of Pūtaiao, in terms of availability (lack of kupu hou or Māori terms for the science words required) as well as unfamiliarity (the requirement for Pūtaiao teachers to learn the kupu hou in order to teach with them). The current dominance of English as the language of science, and the links between this and the debates over revitalisation and modernisation of te reo, are the focus of Wāhanga 4.2 (p.109).

Besides the extra difficulties of teaching science in te reo, Pūtaiao teachers must also think about the dialectic between ‘Māori science’ and ‘science in Māori’, in order to clarify the nature of Pūtaiao, regarded here as a knowledge issue, represented by the question of whether or not the content of Pūtaiao teaching programmes is the same as the national norm of mainstream Science. The epistemological dominance (in worldview, philosophy and knowledge base) of science over mātauranga, or at a more general level, indigenous knowledge (IK), is able to be considered to some extent independently of language, although not entirely. These debates are also discussed in more depth in the following chapters.

Whika 1: Knowledge and Language Issues in Pūtaiao

ISSUE:	KNOWLEDGE CONTENT:	INSTRUCTION MEDIUM:	VOCABULARY POLICY:
Pūtaiao	<p style="text-align: center;"><</p> <p style="text-align: center;">‘other’ curriculum</p> <p style="text-align: center;">mainstream curriculum</p>	<p style="text-align: center;">English</p> <p style="text-align: center;"><</p> <p style="text-align: center;">Māori</p>	<p style="text-align: center;"><</p> <p style="text-align: center;">borrowing</p> <p style="text-align: center;">neologism</p>

In Kura Kaupapa Māori, language in the sense of ‘medium of instruction’ is usually treated as a non-issue, since te reo is the lingua franca of the kura (school). As indicated above, however, language is a crucial issue in secondary level Pūtaiao, particularly beyond Year 10. The issue of medium of instruction bears investigation at a more detailed level, as part of the question of whether Pūtaiao involves inherent language difficulties that are qualitatively or quantitatively different from other Māori-medium curriculum areas. So in Whika 1, ‘language issues’ are sub-divided into ‘medium of instruction’ and ‘vocabulary policy’.

In Whika 1, these three issues are heuristically posited as decisions to be made in Pūtaiao, in sequence from left to right, with either/or choices shown by vertical separation at each stage. This arrangement indicates these issues to be inter-related, but does not imply contingency – the possibilities shown could be arranged in many different ways. The trajectory of current praxis leads, in this diagram, towards the lower right option, namely: a lexical development policy of neologism, in order to develop te reo Māori into a medium of instruction suitable for mainstream Science curriculum delivery. The two bolded ‘end-points’ represent other alternative pathways for development of Pūtaiao, which this thesis will argue bear re-considering, in order to improve outcomes and to better align with the purposes of KKM. The fourth end-point (‘English’) on the diagram represents mainstream Science education. The questions raised in Whika 1 are returned to at the end of Wāhanga Tuatoru, in the case of ‘knowledge issues’, and the end of Wāhanga Tuawhā, in the case of ‘language issues’.

1.3 Methodology: Kaupapa Māori Discourse Analysis

One reason why so much research into the issues in Māori science education has been called for, but not yet completed (McKinley, 1992; McKinley, McPherson Waiti et al., 1992; McKinley, 1999), may be that the act of research, or the framing of research questions, is in itself an act arising from a modernist paradigm that is tauwi (alien) to mātauranga Maori. It is a challenge, therefore, to engage in research into epistemological issues in Māori-medium science education that moves beyond the limitations of modernist paradigms - a challenge to which a fruitful response may be found in the principles of Kaupapa Māori research.

Kaupapa Māori and Critical Theory

Kaupapa Māori research has emerged within the last few decades, as part of the 'Māori renaissance' (Bishop, 1996; but see Wāhanga 4.1, p.104), motivated by a quest for self-determination, and fuelled by the urgency of the need to retrench and revitalise te reo Māori me ōna tikanga as a living language and culture. Recent wider acknowledgement of historical injustices against Māori people, language, culture, and material economic bases, and wider knowledge about past and present institutional racism practices in Aotearoa New Zealand, such as in the education system, have contributed towards more conducive conditions for its development.

The term 'Kaupapa Māori' is best known in relation to Kura Kaupapa Māori, which is a school movement that began in approximately 1984, building on the success of Te Kohanga Reo (Nepe, 1991). More recently, the term 'Kaupapa Māori' has begun to appear in wider social discourse such as job advertisements and institutional policies, signalling pro-Māori policies and strategies in other spheres such as health, justice, media, etc (Smith, 1995, p.119).

The development of Kaupapa Māori research occurred when greater numbers of Māori people began to attain academic positions, particularly outside Māori Studies/Anthropology. To date, Education has been the most important discipline within which Kaupapa Māori research has developed. The following discussion draws on the scholarship of prominent Kaupapa Māori education researchers such as Russell Bishop (1996), Kathie Irwin (1999), Graham Hingangaroa Smith (2002), and Linda Tuhiwai Smith (1999).

While these authors emphasise its uniqueness compared with both traditional and contemporary approaches to research, Kaupapa Māori research aligns with other international research traditions such as indigenous, feminist and postcolonial social science. These traditions share an historical origin that includes a critical examination of how the notion of the ‘other’ in research reproduces the existing disparities in societal power of the historically-researched group, as a basis for emergence. Thus a critical, emancipatory stance is built into each of these traditions by virtue of its reason for being (Ladson-Billings, 2000).

Kaupapa Māori theory as a research paradigm is argued by some to be a localised **version of critical theory**:

Kaupapa Māori theory therefore aligns with critical theory in the act of exposing underlying assumptions that serve to conceal the power relations that exist within society and the ways in which dominant groups construct concepts of ‘common sense’ and ‘facts’ to provide ad hoc justification for the maintenance of inequalities and the continued oppression of Māori people. (Leonie Pihama, cited in Tuhiwai Smith, 1999, p.185-6)

In contrast, Bishop describes Kaupapa Māori as a ‘**resistance to critical theory**’, and a response to the ‘failure of critical pedagogy in relation to its emancipatory goals’ (cited in Tuhiwai Smith, 1999, p.186). This apparent contradiction possibly reflects varying individual perspectives on Marxism and critical theory.

The term ‘critical theory’ originated in the Frankfurt School, founded in 1923, and refers to a tradition of critique of modernity at all levels, including empiricism, positivism, and Marxism. Leading names in the Frankfurt School include Max Horkheimer (1895-1973), Theodor Adorno (1903-69) and more recently Jürgen Habermas (Honderich, 1995, p.290). Habermas (and others) argue that science already embodies value judgements, such as the desirability of technological domination of nature, and resulting ideological thinking. In response, Habermas introduced the notion of the ideal speech situation (ISS) as a ‘methodological standard of critique’ (Young, 1989, p.75). The ISS ‘is a critical reconstruction of the assumptions of everyday speech communication’. It was part of Habermas’ effort to ‘found critique in the postulation of a counter-factual process of reaching uncoerced consensus among inquirers’ (p.79). While later acknowledging its limitations (below), the ISS remains central in Habermas’ account of critical theory.

The ‘central problem for critical theory’ arises from ‘Habermas’ acceptance that the ISS cannot provide a basis for judging whole ways of life’ (p.170). To overcome this, Young argues, a ‘meta-decision’ must be made, through which an ‘aesthetic and moral vision [with] genuinely theological content might be reinstated. If so, the possibility of a Jewish, Christian or Muslim critical theory must be taken seriously’ (p.171). In this sense, Kaupapa Māori theory can be viewed as modifying the philosophical basis of traditional critical theory, limiting its scope, and hence strengthening its emancipatory potential. This interpretation accommodates the comments of both Pihama and Bishop, cited above.

According to Graham Hingangaroa Smith, Kaupapa Māori research:

- is related to ‘being Māori’;
- is connected to Māori philosophy and principles;
- takes for granted the legitimacy of Māori, the importance of Māori language and culture; and
- is concerned with ‘the struggle for autonomy over our own cultural well being’. (cited in Tuhiwai Smith, 1999, p.185)

Thus, Kaupapa Māori research is defined in terms of its political stance (rather than, say, data collection methods) in a very similar way to ‘standpoint theories in the USA for example African-American, El Movimiento Chicano, American Indian Tribal Nations, etc’ (López, 1998, p.226). The political orientation of Kaupapa Māori research is an anti-racist one of emancipation from the historical oppression of Māori people, knowledge and culture that is inherent in mainstream social science research philosophies and practices. As such, Kaupapa Māori research could be said to arise out of ethical and political concerns relating to traditional mainstream research on or about Māori people (Bishop, 1998). The emergence of Kaupapa Māori research is linked to the specific socio-historical circumstances described above, in that it is a response and a protest made by Māori against dominant detrimental stories told by Pākehā research about Māori.

One central principle of empowerment recognised in Kaupapa Māori research, then, is that Māori people ‘should regain control of investigations into Māori people’s lives’ (Bishop, cited in Tuhiwai Smith, 1999, p.185). Who, though, are ‘Māori people’? Does this mean only Māori researchers should conduct research

on Māori? Or does it mean that ‘iwi’⁵ should be in charge of all research on Māori? Or the people whose lives are being investigated? Tuhiwai Smith reflects, with the following two questions, on researcher positioning: ‘Can a Māori researcher who is anti-Māori carry out Kaupapa Māori research?’ for which the answer given is ‘definitely not’; and ‘can a non-indigenous researcher carry out Kaupapa Māori research?’ for which two possible answers are given: the ‘more radical’ (ibid) response: ‘by definition, no, Kaupapa Māori research is Māori research exclusively’; and the alternative response, which is a qualified yes, as long as there was collaboration with others, and on the condition that such a researcher had ‘ways of positioning themselves as a non-indigenous person’ (p.184).

According to some international scholars, who responded to Bishop’s (1998) description of Kaupapa Māori research, such discussion of who is authorised to conduct and control research is ‘essentialist’ in the tendencies both to ‘homogenize a population’ (López, 1998, p.227), and cling to ‘dualistic notions of insider and outsider’ (p.228).

Because a culture is not homogeneous, a society is differentiated, and a professional identity that involves problematizing lived reality inevitably creates a distance ... the extent to which anyone is an authentic insider is questionable. (Narayan, 2003, p.285)

These considerations highlight the need for discourses of Kaupapa Māori research to address the multiple positioning of individuals as Māori (McKinley, 2003), as Tuhiwai Smith does for non-Māori, in the paragraph above.

Ethnicity and Kaupapa Māori Research

With this in mind, Tuhiwai Smith’s question about Māori identity bears closer examination:

Can a Māori researcher who is anti-Māori carry out Kaupapa Māori research? (Tuhiwai Smith, 1999, p.184)

According to the principles of Kaupapa Māori research cited above (p.9), *anyone* who is ‘anti-Māori’ (putting aside the question of how, and by whom, being ‘anti-Māori’ might be decided), by definition cannot conduct Kaupapa Māori research. In this sense Tuhiwai Smith’s question is rhetorical, serving to provoke thought on the complexity of contemporary Māori identity. It also indicates a need to

⁵ The ‘scare quotes’ signal the debates over the definition of an iwi and the status of groups such as urban Māori. (C. Smith, 2000, p.47)

evaluate, rather than simply accept, claims made by Māori researchers (as well as non-Māori) to conduct Kaupapa Māori research. In later chapters, concerning claims that Māori knowledge has the status of science, some arguments will return to these pro-Māori/anti-Māori terms. In such matters, the methodology (i.e. Kaupapa Māori research) enables the analysis, but at the same time, the methods are (in my case at least) also learned and refined *through* conducting the research on discourses of Pūtaiao.

Being a Māori today inevitably entails grappling with the ‘primordial/situational dichotomy of ethnicity’ (May, 2003, p.107). The dissonance between these two positions, which are explained in the following paragraphs, is often experienced at a personal level as ‘fragmented subjectivities’, or conflicting aspects of self-identity (McKinley, 2003).

Primordialism views ethnicity as inherited, more or less immutable categories of identity, based ultimately on biological kin groups and evolutionary arguments. The relevance of ‘biological kin groups’ to Māori notions of identity based on whakapapa can hardly be denied. It is also the first mention of evolution, a science notion which develops a central role in this thesis. Stephen May (2001) notes that ‘the primordialist position has been widely dismissed’, due to its tendencies towards both **determinism**, i.e. where ethnicity determines group and individual behaviours (and therefore culture), and **essentialism**, which sees ethnic groups as internally homogeneous, and rigidly separated from each other. These views are contested (and closely linked to outdated notions of ‘race’, see p.20), because they tend to overlook the ubiquitous processes of cultural change, and underplay the role of individual choice. Nevertheless, the endurance and importance of such positions, in identity debates relevant to Māori (and hence Pūtaiao), is explored further in Wāhanga 4.1 below (p.98).⁶

Situational understandings of ethnicity, on the other hand, view the ethnic group, or **ethnie** (a synonym adopted in Fenton and May, 2002), as defined entirely by its sociohistorical relationship to others. According to this position, ‘shared culture

⁶ May (2001, Ch.1) cites, as examples of primordialism, the Herder - von Humboldt German Romantic tradition (influential on the Sapir-Whorf hypothesis, see p.117 below) and the sociobiology programme (a contemporary case of scientism, see p.50 below), both of which have relevance, of different sorts, for Pūtaiao, as discussed in later chapters.

[is] best understood as generated in and by the processes of ethnic-boundary maintenance, rather than the other way around' (May, 2001, p.31). These views, in turn, have been criticised for understating the social and cultural constraints on an individual's ethnic choices, choices which ultimately become reduced to those of 'a market, or cafeteria' (p.32). Situational views on ethnicity lead towards cultural and linguistic instrumentalism (in which identity choices are made on the basis of relative power), a key argument in cultural imperialism (see p.102), with its deleterious effects on many cultures and languages, including Māori. Taken to its extreme, the situational view on ethnicity appeals to social constructionists (e.g. Hanson, 1989; Rata, 2000), and rational choice theorists, linking these views to both postmodernism and the political new Right (Devine, 2001; Devine, 2004; May, 2001, p.38-9).

Thomas Eriksen (2002) discusses the 'deeply problematic' relationship between culture and ethnicity, noting the following four points:

- Even if ethnicity may be widely believed to express cultural differences, there is a variable and complex relationship between ethnicity and culture; and there is no one-to-one relationship between ethnic differences and cultural ones.
- Ethnicity is a relationship between two or several groups, not a property of a group; it exists *between* and not *within* groups. (Culture, of course, may perfectly well exist within groups.)
- Ethnicity is the enduring and systematic communication of cultural differences between groups considering themselves to be distinct. It appears whenever cultural differences are made relevant in social interaction, and it should thus be studied at the level of social life, not at the level of symbolic culture.
- Ethnicity is thus relational, and also situational: the ethnic character of a social encounter is contingent on the situation. It is not, in other words, absolute. (p.58, original emphasis)

This understanding of ethnicity is adopted in the research methodology of this thesis. These points also highlight the important issues of **representation** and **authenticity**, which will be further considered below, in relation to Pūtaiao curriculum.

May (2003) posits Pierre Bourdieu's notion of 'habitus' as a useful way to understand ethnicity, and overcome the apparent dichotomy between primordial and situational accounts of ethnicity. The habitus notion encompasses 'four key dimensions ... embodiment, agency, the interplay between past and present, and the interrelationship between collective and individual trajectories'.

‘Habitus’ refers to a set of embodied meanings that do not determine how individuals and groups might act, but nonetheless constitutes a powerful frame of reference, which influences and shapes, at least to some degree, how the world is seen. (May, 2003, p.107-8)

The multiple dimensions of habitus straddle what Eriksen (2002) refers to as ‘a fundamental duality in the social disciplines,’ reflected in the ethnicity dichotomy described above: the sociological versus the psychological perspective; or as Eriksen notes, ‘sometimes described as the distinction between a Weberian and Durkheimian view of social life’ (p.55). The contemporary consensus holds ethnicity choices in tension or balance between primordialist and situational explanations (Fenton and May, 2002) - ‘neither ascribed nor achieved: they are both. They are wedged between situational selection and imperatives imposed from without’ (Eriksen, 2002, p.56).

Smith (1997) noted the relevance of the habitus notion in the development of Kaupapa Māori theory, providing further support for this view of ethnicity as appropriate in Kaupapa Māori research and this thesis, to be returned to and refined in Wāhanga Tuawhā by employing a postmodernist perspective (p.95). The contours of this discussion on ethnicity are similar to those of inter-related debates in science and language, debates which will be examined in the course of the following chapters.

Cultural Knowledge in Kaupapa Māori Research

Bishop (1998) discusses the role of various participants in Kaupapa Māori research in terms of traditional Māori roles in society, such as the leadership of kaumātua, and the right to speak being dependent upon the social standing, in traditional Māori kinship terms, of the individual who wishes to speak. This emphasis on the role of old people with cultural standing also appears in descriptions by Native American researchers: ‘our Elders ... have been replacing the expected academic role of “informant” with a leadership role of directing research and teaching’ (Rains, Archibald et al., 2000, p.339); and ‘I am extremely aware of the cultural traditions that position the Elders as teachers and authorities’ (Hermes, 1998, p.161).

Several writers have suggested the importance of the concept of ‘whānau’ in Kaupapa Māori research, referred to by Bishop as a ‘research whānau of interest’ and by Irwin as a ‘whānau of supervisors’. Bishop argues that all stages of the

research are in the control of the research whānau, within which the researcher is a participant, not necessarily the leader. In a Native American analogy, Hermes also draws attention to the re-positioning of the researcher in cultural contexts: ‘in Elders’ meetings, at moments I was the “organizer” or facilitator and could control the agenda, but when it was time to eat I was just as easily a “waitress” or, at the meeting’s end, a “driver”’ (Hermes, 1998, p.163). Her research journal entries include other whānau references: ‘What’s it like to suddenly become “Auntie” to 300 kids and know that in three years I’ll have to write something about them?’ (ibid).

Hermes’ overall description of her ‘situated response’ research, however, stops short of Bishop’s assertion that Kaupapa Māori research must be conducted within existing culturally constituted practices and ‘hierarchically determined’ positioning, with the limits this would impose on research possibilities. In response to Bishop, African American scholar Linda Tillman (1998) notes ‘several unresolved issues’ and asks, ‘can we realistically expect that all power relations will be eliminated?’ Chicano scholar Gerardo López (1998), while ‘inspired by the potential for a group to direct the entire research process’, queries the absence of the voices of the research whānau: ‘your text offers no insight into how the text was actually co-constructed according to Kaupapa Māori’ (p.229).

Bishop (1998) draws parallels for various Māori cultural terms and concepts, including hui (gatherings), pōwhiri (formal welcome ceremony), koha (contribution towards running hui), harirū (greeting ceremony in hui setting), whakawhanaungatanga (mutual introductions, identifying genealogical links), mihi (oratory of greeting) and whakapapa (genealogy), within his outline of Kaupapa Māori research. In this way, he seeks to define its ‘culturally specific research practices’. Most of these parallels concern re-defining relationships in and organisation of a social science research investigation, in order to align them with Māori processes in traditional kinship groupings. While some of these analogies seem to risk distorting ‘authentic’ cultural meanings, the use of Māori terms, and the reference to Māori cultural items, is in itself a cultural self-assertion. A similar point is made by Latina scholar Margaret Montoya: ‘incorporating Spanish words, sayings, literature, and wisdom can have positive ramifications’ (cited in Gonzalez, 2001, p.645).

The positive effect on young Mexicana women of linking cultural practices to academic achievement is described by Francisca Gonzalez in her vision of a 'politically relevant education' for the Chicana/o youth in California (Gonzalez, 2001). Her analysis contrasts with the older 'deficit view of cultural knowledge' in the same way that Kaupapa Māori positions itself in opposition to the deficit model of Māori language and culture, which explicitly informed earlier mainstream educational policies for Māori education, and exerts ongoing 'latent' influence (Wetherell and Potter, 1992).

Bishop's description of the Kaupapa Māori research process bears most similarity to participatory action research, of all the recognized strategies for inquiry, although Bishop cautions against trying to pin an international research 'label' on Kaupapa Māori research. He focuses on the issue of distance or separation between researcher and researched, asserting that Kaupapa Māori research demands that this distance be completely dissolved into a larger, participatory mode of consciousness. He claims that issues of objectivity and subjectivity in research, along with notions of paradigm shift, are irrelevant in Kaupapa Māori research. According to Bishop, the appropriateness of all processes involved in Kaupapa Māori research can be evaluated by reference to *taonga tuku iho* (treasures from the ancestors), or traditional Māori wisdom. In this way Kaupapa Māori research practices and texts are judged according to Māori cultural criteria. As pointed out by his commentators, however, Bishop fails to give examples of how such criteria are applied in an 'actual research project' (Tillman, 1998).

These accounts lead me to conclude that Kaupapa Māori research methodology is mostly concerned with guiding (framing) the questions one is interested in and why, and oriented largely towards ethics and paradigm, rather than towards specifying the methods to be used for collection and analysis of empirical materials. This position is consistent with Irwin's description of her research design as 'based on kaupapa Māori [and] 'integrating research methods from qualitative and quantitative research paradigms' (Irwin, Davies et al., 1996), and with the tendency, if not the detail, of Bishop's delineations. The focus on contentious aspects of Bishop's description of Kaupapa Māori research, and the responses to Bishop's work from other postcolonial scholars, is useful in drawing

attention to aspects of greater and lesser importance, in developing a more robust understanding of the role for Kaupapa Māori theory and research in this thesis project.

Kaupapa Māori hei Tūrangawaewae

As indicated above, Kaupapa Māori research methodology is a recent construction in the academy by Māori, for Māori purposes, with each new writer contributing to its ongoing co-construction, focusing on certain aspects, and adding particular perspectives, as I attempt to do here. A metaphor for my coming to understand its relevance, and shift from former positivist-influenced research perspectives, is to say that Kaupapa Māori methodology is less like a machine technology of research, and more like a whare (house, building) within which to conduct research. One important advantage of Kaupapa Māori research to this study, therefore, is as a research position from which to speak, to which to belong. In this sense, I am regarding Kaupapa Māori research as a paradigm, tradition, school or community of scientists, in which to locate my own work.

Furthermore, Kaupapa Māori theory holds as one of its tenets the validity of mātauranga Māori. This is clearly vital in the research paradigm for this topic, in order to entertain the epistemological claims of the notion of ‘Māori science’.

Adopting Kaupapa Māori research methodology is consistent with the research context of Māori-medium science education, which is strongly associated with Kura Kaupapa Māori. There is an intention that the framework of philosophical and ethical assumptions and practices relating to culture, language and politics guiding the research, aligns with that of the context, in order to avoid ‘othering’ the research topic, since this is not intended as a comparative study of Māori-medium science education with something else, but rather as an evaluation of Māori-medium science education on its own terms and against its own purposes.

Kaupapa Māori research offers the further considerable advantage, in a topic as unavoidably interdisciplinary as this (May, 2001, p.xii), of providing a unifying viewpoint on the various debates, across a range of disciplines, which need to be considered.

Methods of Investigation: Critical Discourse Analysis (CDA) and Pūtaiao

Having argued above that the adoption of Kaupapa Māori research methodology does not determine the research methods to be used, this remains a question to be addressed. By what means can inquiry into Pūtaiao curriculum proceed? As the educational context under examination, Māori-medium science education is presently in a small, nascent state of development, which renders many forms of empirical data collection (e.g. quantitative or classroom studies) extremely problematic.

Concerning critical research methods, Young (1989) reminds English speakers that ‘the “theory” in critical theory is more like “method” – it is the method of critique’. Similarly, the Kaupapa Māori research literature does not clearly differentiate between theory and practice. Kaupapa Māori theory is described as ‘praxis’ (Smith, 1997). ‘Kaupapa Māori research is both less than and more than a paradigm’ (Tuhiwai Smith, 1999, p.190).

This points to the possibility that critical analysis of discourses relating to past and current Pūtaiao policies and practices offers a significant strategy of inquiry, for research which seeks to inform the achievement of improved future outcomes in Pūtaiao education. In taking this aim, the thesis attempts to incorporate ‘concrete and responsible utopian thinking’ (Honderich, 1995, p.893), claiming allegiance to the wider ‘utopian project’ of Kaupapa Māori theory and praxis (Smith, 2002).

Discourse analysis is an established social science approach to the study of spoken and written records of human experience, associated with the recent poststructural developments in interpretive theory (Denzin and Lincoln, 2000, p.639). Norman Fairclough (1992) offers a model in which the ‘dimensions of discourse and discourse analysis’ are represented by three nested boxes, which correspond to the widening levels of analysis (analysis here being defined as description, interpretation, and/or explanation). The smallest, inside box represents Text, which is surrounded by Discourse Practice (where processes of production and interpretation occur), in turn surrounded by Sociocultural Practice (model cited in Titscher, Wodak et al., 2000, p.152). To relate this model to the thesis topic, documents such as *Pūtaiao* (M.O.E., 1996) could be located in the innermost box,

as central texts in Pūtaiao education. Texts relating to Pūtaiao classroom experiences, teacher education practices, and curriculum and assessment projects would then occupy the intermediate box or level, and more general texts on Māori education (or science education, from a different slant) would fill the outside box, representing the widest level of Pūtaiao discourse.

Based on these thoughts, the term adopted for the primary research strategy in this thesis is **Kaupapa Māori discourse analysis**. In thus labelling the methodology, a question arises, analogous to that of the paradigmatic relationship of Kaupapa Māori theory to critical theory, discussed above: is Kaupapa Māori discourse analysis the **same** as critical discourse analysis? The answer is also similar: while Kaupapa Māori discourse analysis draws on the traditions of critical and postcolonial discourse analysis, it is concerned with specific relevance to Māori interests, rather than looking for universal laws, etc, with an aim to avoid the imposition of replacement ‘grand narratives’. Hence, it could be described as a ‘located’ (McKinley, 2005) or ‘situated’ (Hermes, 1998) version of critical discourse analysis (CDA).

CDA has developed since about 1990 from a ‘strand within linguistics (sometimes labeled ... critical linguistics)’ (Cameron, 1995, p.232) into a major education research methodology with a substantial scholarship in its own right. In a local introductory text on CDA, the comments of author Terry Locke echo the conclusions drawn above (p.15) for Kaupapa Māori research:

CDA (critical discourse analysis) might be better described as a scholarly orientation with the potential to transform the modus operandi of a range of research methodologies. In respect of educational research, it has the potential to reveal the way power is diffused through the prevalence of various discourses throughout an education system, at both the micro-level of individual classrooms and the macro-level of large-scale reform. As in other settings, CDA has to be seen as a political intervention with its own socially transformative agenda. (Locke, 2004, p.2)

The essentially language-oriented nature of CDA, as a derivation from linguistics, is also relevant to the other major distinguishing feature of ‘Kaupapa Māori discourse analysis’, which is the space opened for the inclusion and normalisation of te reo Māori text in the corpus, such that it is treated as equivalent - or, invoking the ‘contra preferendum’ principle of international relations, preferred - to text in English (see next sub-section, p.19).

The thesis perspective on ‘discourse’ shifts in and out: at times looking at wider considerations in science and mathematics education, language change processes in society, or Māori education and development in general; elsewhere focusing closely on the specific details of Pūtaiao, and my own experiences thereof. Accordingly, an element of ‘personal narrative’ is threaded through, in the form of comments on developments in Māori-medium science education from my own perspective of observation and co-construction. A handbook chapter on ‘autoethnography, personal narrative, reflexivity’ (Denzin and Lincoln, 2000, pp.733-68) begins from the importance of making ‘the researcher’s own experience a topic of investigation in its own right’ (p.733). The additional details thus provided help to form a more complete picture of the ‘conditions [and] processes of production and interpretation of discourses’ of Pūtaiao (Locke, 2004, p.42). In this way, the inclusion of ‘personal narrative’ supplements the limited corpus of Pūtaiao discourse available for analysis.

Adoption of Kaupapa Māori methodology in this study, which focuses on specific teaching and learning issues in Pūtaiao, is an attempt to contribute to the emerging pedagogical strand in Māori-medium education research (May, Hill et al., 2004; Rau, 2005). The emphasis in this strand moves beyond the sociopolitical and structural analyses in earlier published Kaupapa Māori studies (Nepe, 1991; Smith, 1990; Sharples, 1994).

In conclusion, Kaupapa Māori as a research paradigm is conceptualised as tūrangawaewae or ‘home ground’ for this study, which highlights once again the issue of **identity**. Hence, my research methodology could also be described as ‘CDA within a Kaupapa Māori habitus’.

The following sub-sections deal with key methodological issues, and introduce policy discourse contexts relevant to Pūtaiao research.

Te Reo Māori in the Thesis

As foreshadowed above, te reo Māori text is treated as normal text in this thesis, since according to Kaupapa Māori principles, te reo ‘is’ normal, and the topic concerns Māori-medium education. From the perspective of a Kura Kaupapa Māori teacher, this practice seems entirely unremarkable, but as a general academic practice it has only recently, and not yet universally, become acceptable

to book publishers (May, 2001, p.xiii). In a document such as this, where Māori words form a significant proportion of the text, it is the most practical formatting decision. It is also in keeping with the status of te reo Māori as an official language of Aotearoa New Zealand, and the reflection of this status in the regulations for this degree, and the University of Waikato as a whole.

One key textual practice is the rigorous use of ‘Aotearoa New Zealand’ to refer to the country of origin, highlighting the bicultural framework of the thesis, since a common disjunction is the inclusion by authors of ‘Aotearoa’ only in sections dealing with ‘Māori issues’ (this entire text, of course, is concerned with ‘Māori issues’). I also wish to avoid the sociolinguistic divide suggested by the either-or appearance of a ‘slash’ in our country’s name: ‘Aotearoa/New Zealand’.

Māori words are translated (in brackets) or explained on first appearance in the text, where literal translations are indicated by ‘lit.’, and/or appear in the Rārangi Kupu (Glossary) on p.210. Translations are mine unless otherwise noted, with Wiremu (Williams, 1971) being treated as the definitive reference for traditional words, and Te Taura Whiri i te Reo Māori (The Māori Language Commission) as the authority for neologisms. Macrons have been added in quotes, particularly to prominent words such as ‘Māori’, or substituted for double vowel orthography.

Overall, the approach to te reo Māori in the thesis is in keeping with that taken towards Māori knowledge and Kaupapa Māori principles, and the notion of ‘attempting to reverse the usual epistemological asymmetry’ by which science/English is taken as the ‘yardstick’ of knowledge/language (Roberts, 1998, p.69). It also follows the ‘central tenet’ adopted by May (2001), ‘that the *normalisation* of minority languages within the public domain is a legitimate and defensible sociological, political and linguistic activity’ (p.xiii, original emphasis).

Feminism, ‘Race’ and Science

There is a well-documented link between feminist and non-white research perspectives (Harding, 1998), with substantial shared interests, including perspectives on science, between feminism and multiculturalism/postcolonialism, to ensure ongoing relevance for each other (McKinley, 2003). Hence, a feminist commentary on multicultural science education (Gough, 1998) is included in the corpus discussed in Wāhanga Tuatoru (see p.72 below). These intersections in

perspective are not without problems, however. Government policies concerning ethnicity (for instance, affirmative action) tend to have divisive effects on feminists, such as when non-white feminists see their interests differently from Euro-American feminists (Murphy and Livingstone, 1993). Such ‘contradictions’ arise when gender is taken to be ‘the most fundamental oppression’ (p.180).

It is only when the struggle against oppression and against the capitalist system is seen as a *tri-partite* struggle – against the oppression of blacks (whitearchy), the oppression of women (patriarchy), and the oppression of the working class – that the black struggle, feminism and socialism stand together, autonomous yet inseparable, equal against the common enemy. Racism and sexism would then become irreducible to the oppression of the working class, which depends on them as it depends on each other and on it. (Murphy and Livingstone, 1993, p.190, original emphasis)

In focusing on the ‘limits’ of feminism, this analysis also points out corresponding limits of an analysis of ‘race’ as the fundamental category of oppression. In the contemporary theoretical concept, ‘race’

operates neither as a signifier of comprehensive identity, nor of fundamental difference, both of which are patently absurd, but rather as a marker of the infinity of variations we humans hold as a common heritage and hope for the future. (Omi and Winant, 1993, p.9)

These words echo the discussion of ethnicity above, and link to the examination of identity in Wāhanga 4.1 below (p.98). In terms of methodology, understanding the overlap between these discourses of oppression is necessary in developing a Kaupapa Māori research position from which to ‘read’ the texts and discourses of Pūtaiao.

Consideration of the past development, current status, and future possibilities for Pūtaiao must be situated within the wider policy discourses of Māori education and science education, with both of these being influenced in turn by the prevailing overall discourse of education policy. Introductions to these three policy contexts follow.

Māori Education Policy Discourse

A generally accepted version of the history of Māori education policy as a series of phases from assimilation through integration, multiculturalism and taha Māori, to tino rangatiratanga, has been developed and rehearsed by many authors (Ewing and Shallcrass, 1970; Barrington and Beaglehole, 1974; Jenkins and Ka’ai, 1994; Walker, 1996; Bishop and Glynn, 1999). In such accounts, presented in terms of a series of phases, it is important to remember that history does not simply

disappear as the next phase is entered, and instructive to recognise the residual influences and ideologies from earlier phases that remain relevant. While policy phases have been described in such ‘acceptable’ terms, many writers have argued that the purposes and results of the education system on Māori have included the encouragement of the loss almost to extinction of the original language and knowledge systems (Williams, 2001).

Contemporary Māori education policy, as reflected in the annual report on Māori education, ‘Ngā Haeata Mātauranga’ (M.O.E., 2005), attempts to balance the following policy considerations, all of which are important (if not always explicated) in the processes that contribute towards the development of Pūtaiao:

- Indigenous legal rights: Te Tiriti o Waitangi as a foundation for the nation-state of Aotearoa New Zealand;
- Social equity: Māori under-achievement in the education system of Aotearoa New Zealand;
- Epistemological and cultural diversity: the preservation of Māori language and knowledge.

Science Education Policy Discourse

A major tension in science curriculum policy is between ‘science for all’ versus ‘science for future scientists’ (Haigh, 1995). This dialectic is related to a perception of the need for high science achievement to maintain international competitiveness, and also the importance of scientific literacy for the citizen of today’s world. These considerations lead to policies that increasingly place Science (along with Mathematics and Technology) at the core of the compulsory curriculum. Schools (and teachers) grapple with the resulting difficulties, caused in part by a traditional science curriculum based on positivist principles, and resistant to reform efforts, that is incompatible with the personal culture of all but a tiny minority of secondary students (Aikenhead, 2000).

Over the last few decades, a substantial international research literature of multicultural science education has developed, in response to these issues. This literature is the focus of Wāhanga Tuatoru. Multicultural science education, in Aotearoa New Zealand as in most of the world, has nevertheless made little or no difference to the disparity of outcomes in science education experienced by Māori students (Smith, 1995). While a great deal of this literature comprises philosophical reflections on the nature of knowledge, little has changed in science

education classroom practices (McKinley, Stewart et al., 2004). Innovative approaches to school science teaching, including constructivism, narrative (Gilbert, 2001) and Science-Technology-Society, or STS approaches (Blades, 1997), which aim to improve success for the majority of students, invariably meet with opposition in powerful academic, political and socio-economic contexts that are served by the gate-keeping role school science plays, both for the privileged classes and also for science's monopoly on truth (Hodson, 1999). Promotion of Māori science education has met with opposition on similar grounds (Dickison, 1994; Matthews, 1995).

Education Policy Discourse

The neo-liberal discourse of marketisation is possibly the most significant contemporary stream in global discourses of education policy. Marketisation is concerned with the construction of school education as a private good to be commodified, for distribution in society by the forces of the free market. This policy direction is informed by both neo-liberal and social conservative ideologies, and regarded by some commentators as an integral part of current developments in capitalism (Apple, 1997; Chubb and Moe, 1997). Market policies in general, and in education in particular, were implemented from 1984 onwards in Aotearoa New Zealand. Since 'parental choice' is part of the politics of introducing such policies, marketisation has been argued to work in favour of Māori-medium schooling. Analysis of the effect of more than 10 years of market policies in education in Aotearoa New Zealand, however, has shown that wealthy families are advantaged, while neither the national interests, in terms of the meritocratic principle - whereby educational success is determined by individual ability and motivation (Jesson, 1990, p.162) - nor the interests of relatively disadvantaged groups in society, such as Māori, are well served (Lauder and Hughes, 1999).

Allied to marketisation is the growing use of 'managerialism' to attempt to improve quality in education, such as an emphasis on appraisal and quality management systems throughout the school sector. Curriculum content has been atomised into achievement objectives, and assessment for qualifications into stand-alone standards. These characteristics in both the administration and content of education have been identified as resulting from the domination of 'instrumental rationality' as a way of thinking in state institutions (Coxon, Jenkins

et al., 1994), a way of thinking which can be viewed as a manifestation of the underlying economic philosophy that defines both instrument and rationality (Fitzsimons, 2001).

The final two sections of this chapter, below, contain two short analyses which are intended to demonstrate application of the 'Kaupapa Māori discourse analysis' research methodology, in two contrasting examples of discourse, both relevant to the topic of Pūtaiao. These sections also help to complete the introduction to the research situation, and its problematics, which this thesis investigates.

1.4 NCEA Pūtaiao and Pāngarau

This section looks at recent results for Māori-medium students sitting NCEA Science/Pūtaiao and Mathematics/Pāngarau examinations. This follows a well-established view of secondary qualifications data as a measure of educational success (McKinley, Stewart et al., 2004; Baker, 1993; Jones and Martin-Jones, 2004; Spolsky and Shohamy, 1999). Since improving Māori representation in the 'big world' of science entails firstly increasing the number of Māori tertiary students of science, the secondary qualifications that lead into this pathway have obvious relevance. The primary role of the data in this section, however, is to add substance to my initial assertion regarding the extra difficulties for students and teachers in Pūtaiao, particularly at secondary curriculum levels.

First, the current systems for senior secondary curriculum delivery, and assessment for qualifications, are reviewed. Then examination results are presented for the first 3 years of NCEA Level 1, in Pūtaiao and Pāngarau. Despite the compelling 'text' offered by the following data, a strong cautionary note must be taken, due to various factors, including the very small size of the Māori-medium cohorts (ranging from 12-71 students sitting each examination paper, in any one year). Because of this, the data are suggestive only, with limited validity to represent the populations concerned, and any conclusions drawn necessarily speculative.

Small cohorts in senior secondary levels remain extremely challenging for Māori-medium curriculum delivery. To address this, in recent years the Ministry of Education (MOE) provided video conferencing (vidcon) equipment and support for distance teaching/learning in kura nationally, in an initiative called KAWM,

acronym for Kaupapa Ara Whakawhiti Mātauranga, which can be translated as ‘Distance (lit. ‘path of transfer’) Education Project’. The name itself raises questions, in that it implies a ‘transmission of information’ concept of education. This is currently (in 2006) an important means by which Pūtaiao and Pāngarau are taught in Wharekura Year 11–13 nationally, with student numbers predominantly in Year 11 or NCEA Level 1 courses. The extra linguistic and cognitive demands on teachers and students in this attenuated pedagogical situation are considerable - as are the limitations. For example, in order for the vidcon gear to function (that is, not to drop the live link), KAWM lessons must be teacher-focused - whiteboard and/or text based, with a lecture, demonstration, or limited discussion style of interaction (J. Murray, personal communication, 2005). More active teaching strategies such as practical or group work are not encouraged by the technology. Nevertheless, the shortage of senior Pūtaiao/Pāngarau teachers, and the high importance placed on these subjects by kura whānau, together constitute a strong imperative for kura to participate in KAWM.

Under the KAWM system, a teacher employed in one kura becomes the national teacher for a course, e.g. Level 1 NCEA Pūtaiao. The teacher’s home classroom lessons are also accessed, via vidcon, by students at up to 10 or more other kura around the country. One Level 1 NCEA Science textbook (by Newhouse Publishers) has been translated and web published, to support this Pūtaiao course. A further support initiative has been to hold wānanga (live-ins) for a few days each year, where teachers and students from around the country can meet and get to know each other, address concerns, etc.

Māori-Medium Examinations

Consultation with Māori during the NCEA development process led to the undertaking by MOE that the new qualification would be fully available to Māori-medium learners. Prior to 2002, for several years, SC Mathematics and Science examinations had been translated into Māori each year, under limited arrangements made between NZQA and individual Wharekura. With the introduction of NCEA at Level 1 in 2002, examination translation was systematized, with schools able to request ‘Te Reo’ examinations during the candidate entry process, for any candidate entering externally assessed Achievement Standards.

Because of this system, the data for students sitting translated papers can be easily obtained from NZQA.⁷ These cohorts can be approximately equated with the student cohorts attending Wharekura or Rūmaki/Immersion schools and units. As requested, NCEA examinations are translated into te reo Māori by NZQA contractors.⁸ The translated papers are currently produced as bilingual examination booklets of twice as many pages as the standard papers, with the Māori and English versions of each page side by side. The translator attempts to include, in footnotes, all Māori terms in known use for the scientific vocabulary in the translated papers. Candidates may write answers in English or te reo (or both). One marker for each Achievement Standard marks translated booklets as part of their allocation, and unless that person is competent to mark in Māori, they are assisted by another person able to read Māori, who translates into English whatever the student has written in te reo, so the marker can mark it.

Thus, this system makes allowance for Māori-medium students by translation of an ‘end-point’ – an already finalised examination paper. This is allowance ‘by language only’ (McKinley, 1995, p.44) - there is no opportunity for Māori input into what is examined. Just as the Pūtaiao curriculum document ‘is not considered to be a Māori curriculum’ (p.55), neither can these translated examinations be considered distinctively Māori science assessments. The assumption is that the content knowledge to be assessed is exactly the same in Wharekura as in mainstream schools: indeed, it is reasonable to suggest this system constitutes added motivation to teach a mainstream science programme, since Wharekura wish to maximise student achievement.

To date, while some senior Wharekura students have gone on beyond Level 1 Science and Mathematics, the numbers entering Level 2 and 3 examinations are currently very small (typically less than 5 per cohort), and the papers are generally answered in English, so this area of Māori-medium science education can fairly be described as ‘embryonic’.

⁷ Acknowledgement and thanks to David Philips, Manager, Research, Monitoring and Analysis Division, NZQA, for prompt and efficient responses to data requests.

⁸ Most substantive assessment work (including examination setting, script marking and moderating) in the NCEA system is carried out by educators (mostly full-time classroom teachers), working for NZQA on short-term individual contracts, so these are all included in the term ‘contractors’, as well as those who complete other smaller roles, such as the translation functions being described in this section.

Examination Data

The eleven Level 1 NCEA Science and Mathematics external achievement standards, included in this discussion,⁹ are listed by ID number, title and credit value in Whika 2 below (p.29). These data omit internally assessed achievement standards, and unit standards, because the Te Reo/Wharekura data for these are not available as separate cohorts from NZQA, since the entries do not involve translated papers. For each achievement standard, for each year (2002, 2003, 2004), examination results were obtained for three cohorts: All candidates, Māori candidates, and Translated paper candidates. The Māori cohorts are approximately ten percent of the size of the All cohorts, and the Translated paper cohorts are of the order of one percent of the Māori cohorts. For each cohort, four raw numbers were obtained, i.e. the number of candidates awarded a grade of Not achieved (N), Achievement (A), Merit (M) and Excellence (E).¹⁰

These numbers were manipulated to generate three non-overlapping student cohorts: Māori candidates were subtracted from All candidates to obtain figures for Non-Māori candidates; and Translated paper candidates were subtracted from Māori candidates to obtain figures for Māori Mainstream candidates. Translated paper candidates were identified as Te Reo candidates.

Year-to-year variability has been a significant national issue raised about the new qualification, NCEA (National Certificate of Educational Achievement), and the data set used here relates to the first 3 years, where ‘teething problems’ were (arguably) able to be blamed for at least some of the variability. Since there seems to be no useful information to be gained by tracking over these 3 years, the figures for 2002, 2003, and 2004 have been aggregated (summed) by cohort, for each achievement standard. This has the advantage of increasing the size of the Te Reo samples, and at the same time simplifying the data for presentation, hopefully without significant distortion. Thus summed, the figures for each cohort were used to calculate the following two achievement measures, tabulated in Whika 2:

⁹ Acknowledgement and thanks to several staff members of NZCER, Wellington, who made very helpful comments on an earlier version of this section.

¹⁰ The original data set obtained from NZQA is listed in the Āpitianga (p.208).

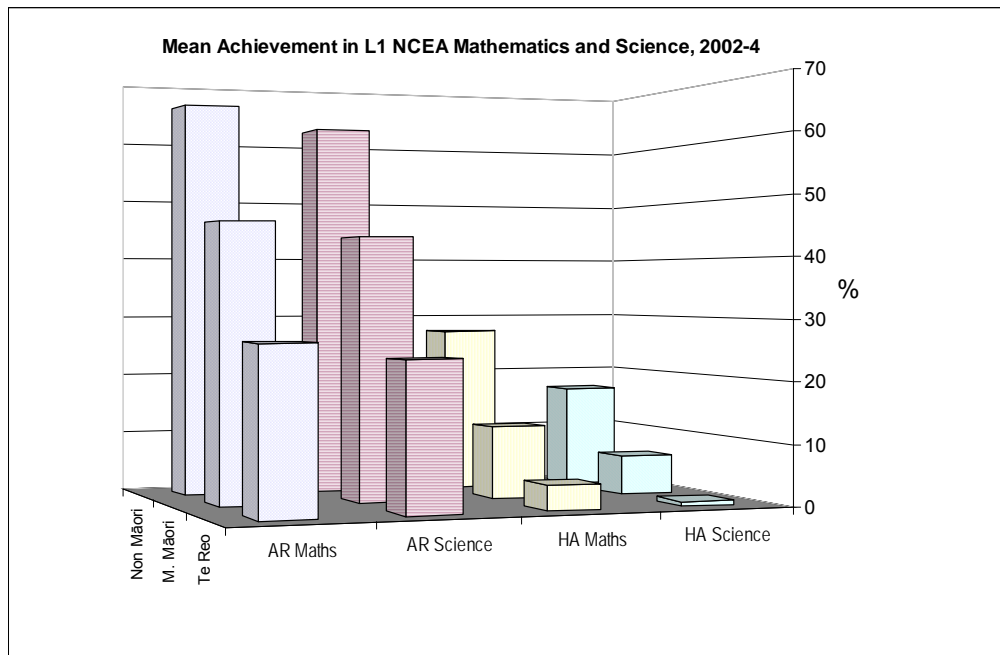
- **Achievement Rate (AR):** Candidates achieving the standard as a percentage of all cohort candidates ($(A+M+E/N+A+M+E \times 100)$).
- **High Achievement (HA):** Candidates gaining a Merit or Excellence grade as a percentage of all cohort candidates ($(M+E/N+A+M+E \times 100)$).

The same data are presented in graph form in Whika 3, p.30, where the data for individual Achievement Standards have been grouped again into 'Science' and 'Mathematics'.

Whika 2: NCEA L1 Science and Mathematics Exam Results

Achievement Standard No. (L1 credits) Title	Cohort	AR (%)	HA (%)
90188 (5) Describe uses and effects of micro-organisms and the transfer of genetic information	Non Māori	55.2	14.3
	Mainstream		
	Māori	35.0	5.3
	Te Reo	20.0	1.3
90189 (5) Describe properties and reactions of groups of related substances	Non Māori	63.8	26.1
	Mainstream		
	Māori	42.1	10.0
90190 (3) Describe rocks and minerals	Te Reo	14.8	0.0
	Non Māori	58.3	18.3
	Mainstream		
90191 (5) Demonstrate an understanding of physical systems	Māori	37.2	4.3
	Te Reo	21.3	2.7
	Non Māori	66.9	17.1
90192 (5) Describe spatial relationships in astronomy and their effects on space exploration	Mainstream		
	Māori	48.2	6.3
	Te Reo	33.3	0.0
90191 (5) Demonstrate an understanding of physical systems	Non Māori	67.8	16.5
	Mainstream		
	Māori	50.0	6.6
90147 (3) Use straightforward algebraic methods and solve equations	Te Reo	24.6	0.0
	Non Māori	61.6	28.1
	Mainstream		
90148 (3) Sketch and interpret linear or quadratic graphs	Māori	40.1	10.9
	Te Reo	20.6	2.5
	Non Māori	56.2	15.9
90151 (3) Solve straightforward number problems in context	Mainstream		
	Māori	34.3	5.2
	Te Reo	12.7	2.0
90152 (2) Solve right-angled triangle problems	Non Māori	76.2	37.3
	Mainstream		
	Māori	58.2	18.7
90153 (2) Use geometric reasoning to solve problems	Te Reo	31.4	4.6
	Non Māori	67.7	29.3
	Mainstream		
90194 (2) Calculate relative frequencies and theoretical probabilities	Māori	47.2	13.6
	Te Reo	42.9	7.9
	Non Māori	75.4	29.0
90194 (2) Calculate relative frequencies and theoretical probabilities	Mainstream		
	Māori	58.4	14.2
	Te Reo	39.1	7.3
90194 (2) Calculate relative frequencies and theoretical probabilities	Non Māori	58.3	24.8
	Mainstream		
	Māori	37.6	9.5
90194 (2) Calculate relative frequencies and theoretical probabilities	Te Reo	13.3	0.6
	Mainstream		

Whika 3: Graph of NCEA Data



Discussion

As noted above, care must be taken not to read too much into these figures. As a population, Māori students clearly achieve in these standards at lower rates than non-Māori (McKinley, Stewart et al., 2004) - a result expected and predicted by all previous analyses of science and mathematics education outcomes (Smith, 1995). However, these results also indicate that Māori-medium candidates generally achieve at lower rates than mainstream Māori candidates - the opposite result to that predicted, or at least hoped for - although, given such small numbers, attempts to quantify these disparities are futile. Indeed, the strongest point concerning the Māori-medium results may be made by looking at the aggregated data across all the standards, which show that for the 1317 Pūtaiao and Pāngarau examination papers completed in the first three years, nearly three-quarters resulted in Not achieved (Whika 4 below). This is a large negative result to ignore or explain as statistically invalid. It indicates little reason for optimism that Māori-medium education has to date resulted in better academic achievement in science and mathematics, and that much work remains to be done, if greater achievement is the goal.

Whika 4: Aggregated Pūtaiao and Pāngarau NCEA Results

	No. papers	N (%)	A (%)	M (%)	E (%)
All Pūtaiao	376	291 (77.4)	82 (21.8)	3 (0.8)	0 (0)
All Pāngarau	941	693 (73.5)	210 (22.3)	38 (4.0)	0 (0)
Katoa (Total)	1317	984 (74.7)	292 (22.2)	41 (3.1)	0 (0)

Another suggestion from these results is that NCEA Pāngarau currently enjoys better success than NCEA Pūtaiao, a conclusion supported by my personal observations teaching in kura. Curriculum developments in Pāngarau have tended to be somewhat ahead of Pūtaiao, more cohesive, and relatively better supported. Pāngarau has the advantage that its content is more unitary, and progression is more transparent. There is also a possible link to the lower level of vocabulary-related issues in Pāngarau, since more conceptual content knowledge is carried in numerals, symbols, and diagrams. Better high achievement (i.e. Merit) results for Pāngarau, compared with Pūtaiao, is also suggestive of this difference.

As I have argued, these translated examinations do not contribute to or promote retention of traditional pre-European mātauranga Māori - part of the ‘knowledge issue’ of Māori science education. Therefore, it has to be conceded that, as a group, these Māori students have further underachieved in mainstream science compared with their peers, while simultaneously being denied an alternative form of secondary science education, such as might be considered particularly relevant in Pūtaiao or Kura Kaupapa Māori education.

Turning to ‘language issues’, it is important to ask if and how Pūtaiao contributes to the future vitality of te reo Māori. In the sense of supporting the kura policy of ‘kōrero Māori anakē’ (speak Māori only), the current Pūtaiao system, including these results, contributes to status planning for te reo Māori (refer p.110), by extending the domain of use of te reo to include the discourse of the senior secondary science classroom. Also, the vocabulary lists compiled in the process of translating these examinations have provided the largest Māori science glossary (of approximately 4500 words) so far produced. (A MOE-funded Pūtaiao dictionary is currently under development in 2005-7). This is ironic, however, since lexicon development (corpus planning) is not the role of national examination systems (see p.109). Questions must still be asked about the **type** of language being promoted by current Pūtaiao teaching/learning discourse

(Halliday, 2004), particularly in view of the poor initial results. While a recent MOE report on Māori-medium student achievement in NCEA (Murray, 2005) noted that 51% of Year 11 immersion students who gained an NCEA qualification at any level achieved 0 credits in Science, the only partial explanation offered was a lack of Science teachers ‘able to teach in an immersion environment’ (p.6).

Very few Excellence grades could be expected in these data, statistically speaking, since in cohorts below about 25 students in size (which applies to six of the 33 Māori-medium cohorts), not even one student would be expected to gain Excellence anyway. Examining the raw data (in the Āpitianga, p.208) shows that the Excellence numbers vary widely anyway, even for the large ‘All’ and ‘Māori’ student cohorts. The total lack of Excellence grades, nonetheless, begs the question of whether it is actually possible for Māori-medium students to gain Excellence in these examinations. This is important in view of the hierarchical nature of the questions, and therefore of the language of the questions, in these science examination papers, reflecting the philosophy of NCEA, as they intentionally change in nature, and increase in difficulty, between Achievement, Merit and Excellence. How this operates in these Science/Pūtaiao standards can be simplistically expressed as switching emphasis from ‘recall/naming-’ to ‘interpretation/evaluation-’ type questions. One possibility, therefore, is that the current system automatically excludes Te Reo candidates from such Excellence questions (perhaps also Merit), by virtue of their limited mastery of science discourse, in either English or te reo Māori. In my experience, when the specific characteristics of science language have been discussed at all in Pūtaiao development processes, it has been only in terms of the need to find/provide kupu hou (vocabulary) relating to science topics, particularly in the secondary curriculum.

The increasingly specialised and technical discourse, which characterises senior secondary science text, results in a predominance of science neologisms in Pūtaiao text, within language structures that are rendered repetitive and inelegant by the nature of the domain, at risk of distortion or ambiguity of meaning. The resulting text is extremely difficult for *anyone* to understand. Part of this difficulty relates to the metaphorical aspects of the English language and of te reo, and how they differ (Heath, 1983). In my own experience, prior knowledge of the science

content is often essential in order to fully comprehend unfamiliar extended Pūtaiao text at senior curriculum levels, particularly if visual aids are lacking. One response is for the kaiako to switch to English in order to make a science teaching point, which bilingual Wharekura students are then able to ‘back-translate’ into te reo. A great deal of emotional investment is apparent in the positions taken in this debate, and strong orthodoxy denies the use of English in kura classrooms, with the result that such practices verge on being ‘undiscussable’ (Young, 1989, p.163) in the current Māori-medium education debates. Clearly, this situation is unhelpful for the interests of Pūtaiao learners and teachers. The characteristics of the language of science, and the implications for the language of Pūtaiao, are investigated further in Wāhanga 4.2 (p.109).

Conclusion

There are various problems associated with neologism, and not using international science terms (Spolsky and Shohamy, 2001): a permanent position of lexicon catch-up; teacher lack of familiarity; and creating a barrier to the wider world of science discourse (Grabe and Kaplan, 1986). There is also the possibility that coining new words exhausts the (admittedly sparse) resources, human and monetary, available for consideration of language issues in Pūtaiao, resources which could be made available for more productive activities (in terms of better teaching and learning of science), if a widespread policy of borrowing, or transliterating, international science terminology were adopted.

The Māori-medium examination data presented above indicate a paradox in Pūtaiao, in that the effect being produced is the opposite of the desired outcome for Māori-medium science education. Policies and practices in support of language status planning goals have, in this case, had the unintended effect of exacerbating underachievement in science education, while simultaneously disallowing reform of the science curriculum according to the underlying principles of Kura Kaupapa Māori, and also failing to support the goal of retaining traditional Māori knowledge.

This situation may be compared with a set of attitudes towards te reo that Ray Harlow describes as ‘covert’, since they contradict overtly-held positive attitudes towards the maintenance of te reo Māori (Harlow, 2005). Harlow gives several examples - the one-name fallacy (‘that there is only one real name for a place, [the

name it] is called when one is speaking English', p.140), an insistence on correct Māori pronunciation when speaking English, tokenism in bilingual publications, and Māori names as logos – all of which he argues indicate an underlying view of the position of Māori 'as a dependent "add-on" to English within New Zealand' (ibid). This is significant, since in Harlow's opinion these attitudes 'tend to militate against the goals ... for the status of Māori' (p.135) and send te reo down a similar path to extinction as Irish – a badge of identity, but not a language of 'normal discourse' (p.144).

Similarly, the overt attitude towards Māori-medium science education is an aim to ensure better academic achievement, while also protecting the future of Māori language and knowledge. The unacknowledged i.e. 'covert' effects of Pūtaiao to the contrary are indicated above. By virtue of the system and policy environment in which it has emerged, Pūtaiao in effect operates as a 'dependent add-on' to Science. Moreover, Harlow's phrase 'opaque and metaphorical' is apt for some of the te reo science vocabulary which has been developed, and the resulting Pūtaiao texts. Such vocabulary and texts perhaps form part of the 'badge of identity' of kura, rather than elements of authentic Māori discourse (Crombie and Houia-Roberts, 2001). This lends weight to a 'suspicion' (following Harlow, 2005) that identity politics and educational imperatives tend to counteract each other, in the language and curriculum debates within current discourses of Pūtaiao. Wāhanga 4.2 returns to focus specifically on language issues in Pūtaiao.

1.5 He Kōrero

This section continues the personal narrative thread, weaving in personal experience to connect the larger story, of the national development of Pūtaiao, with the epistemological journey, inside my own head so to speak, represented by the understandings demonstrated in this thesis. It contains a short discourse analysis which experimentally explores the research methodology developed above, in a context involving 'authentic' Māori language and knowledge.

I learned about some traditional kupu kōrero (sayings) used by Taitokerau speakers at hui mate (tangihanga, funeral) in their whaikōrero (oratories) from my friend Mangu, who in the 1980s accompanied Ngāi Takoto and Te Aupouri kaumātua (male elders/speakers) for several years' 'apprenticeship' on marae

taumata (speaking positions). Addressing the tūpāpaku (deceased), farewelling their departure from the mortal coil and heralding their entry to other realms of existence, was a large part of the content of these oratories. One term of address for the hunga mate (dead people) was ‘koutou kua whetūrangitia’ which Mangu translated as ‘you (plural) who have become stars’. He considered this closely connected to another kōrero describing the process: ‘puta ki te whei ao, ā, puta atu ki te ao mārama’ which they told him means, ‘you’re born in the whei ao, and when you die you go to be born in the ao mārama’. This makes sense as the word ‘puta’ (often with ‘mai’ or ‘atu’) means ‘be born’ when recounting a heke (family tree) – ‘ka moe a mea i a mea, ka puta ko mea’ (X sleeps with Y and produces Z). Mangu told me that ‘whei’ in this phrase means ‘bones’, so his understanding of the full meaning of this kupu kōrero was ‘you’re born in this world made of (flesh and) bones, and when you die, you’re born into another world in which you are made of light – i.e. a star’. This knowledge and understanding of some ancient Taitokerau sayings is very precious to me because it came directly by word of mouth, from the ancestors, to Mangu, to me. It is ‘pure’ Māori knowledge in the sense that, though mediated by English, no non-Māori institutions such as school or book were involved in my learning - and furthermore, these kupu kōrero and their explanations invoke profound ideas.

Though I asked Mangu, he could not tell me why the sequential world names had reversed word order - ‘whei ao’ but ‘ao mārama’ - if these equated with ‘made of bones’ and ‘made of light’ and were thus semantically equivalent. A Māori explanation might be euphony – ‘reka ki te taringa’ (sweet to the ear). Also, the word ‘whei’ is somewhat mysterious, as it is not used in standard modern Māori, for example it does not appear in Ryan (1995), except combined with ‘ao’ as ‘wheiao/whaiao = world of light’(!). The northern word for bones is ‘whēua’, so I assumed it could have been an archaic or arcane variant, or possibly a corruption, though this seemed highly unlikely in such a phrase.

Subsequently I came to see this phrase as widely known in the Māori academy – probably better in the alternate form ‘ki te whai ao, ki te ao mārama’¹¹. The sense

¹¹ One published exception is the book by Ngāpuhi author and activist Dun Mihaka (1989) titled ‘*Ki te Whei-Ao... Ki te Ao Marama...*’ (translated in Webster, 1996, p.47, as ‘into struggle... into enlightenment’).

of progression implied in the reference to two sequential ‘worlds’ is possibly still there, although ‘whai ao’ is often written as ‘whaiao’, and variously interpreted.

Anne Salmond included this latter form as part of a sample of *karakia* involving ‘the conjuring of orientational opposites and markers’ (Salmond, 1978, p.26) in traditional *kōrero*, in her research on worldviews according to traditional Māori thought. Her paper is discussed more thoroughly in *Wāhanga Tuarima*. Salmond, however, translated ‘whai ao’ as ‘daylight’ and ‘ao mārama’ as ‘world of **life**’, thus treating the two phrases as synonymous, rather than a powerful contrastive reference, as the Taitokerau interpretation would provide.

According to Wiremu (Williams, 1971), the primary meaning of ‘whei’, significantly with ‘whai’ given as an equivalent, is an intransitive verb¹² meaning ‘quarrel’. (The standard modern Māori word for ‘fight’ is ‘whawhai’, which Ryan, 1995, also lists as the Māori word for ‘quarrel’. ‘Tohe’ is the word mainly used to translate ‘argue’ today. ‘Whai’ in Ryan means ‘follow, chase, possess’ – the meaning of ‘quarrel’ has been obscured in wider modern usage¹³). The existence of both *iwi* forms of the *kōrero* indicates that ‘quarrel’ may be the original usage and meaning of the word *whei/whai* in this *kupu kōrero*. The reversal of word order – ‘whei ao’, but ‘ao mārama’ - makes more sense if ‘whei’ refers to an action (‘quarrel’ rather than ‘bones’), while ‘mārama’ (‘light’) describes a condition, so goes in the conventional adjectival position following the noun ‘ao’. As a whole the *kōrero* can then be understood to refer to leaving behind the trials and tribulations of this world for the enlightenment of the next.

While this analysis calls into question the ‘made of bones, made of light’ explanation, it still supports the larger sense in which the Taitokerau interpretation differs from that of Salmond: the reference of ‘whei/whai ao’ to this life on earth, and ‘ao mārama’ to a subsequent world or state of existence. In Salmond’s analysis the rhetorical force is weakened to mere repetition, with the two ‘ao’ regarded as one and the same. In standard modern Māori ‘whai ao’ is translatable as ‘sunlit’ (Salmond, 1978) in the sense of ‘whai’ as ‘possessing’ and ‘ao’ as ‘light’, but this does not apply so well to ‘whei ao’. Thus, the dominant

¹² English grammatical terms are interpreted loosely when used for *kupu Māori*.

¹³ This does not preclude the possibility that it is still used in this way by some speakers.

interpretation has lost the reference to birth, death and re-birth in a number of different states of reality (ao), and with it much of the richness of the Taitokerau explanation. Along with the loss of understanding of its literal application to the addressee, there has developed a tendency for this phrase to be abstracted to fit modern situations as a sort of motto or slogan. Christianity is a major distorting influence on discourse to consider in exploring Māori texts such as these, and in the case of the kupu kōrero discussed above, the Church's interest in stamping out traditional beliefs related to 'reincarnation' amongst colonised populations may have come into play.

The analysis also highlights the usefulness of iwi variations in supporting understanding of traditional texts. The notion of 'authentic Māori thought' is an important issue in this thesis. This kōrero rangahau (analytical narrative) is an attempt to use semantics in a way sympathetic to 'configurative linguistics' (Whorf, 1956), and cognisant of discourse analysis processes of archaeology and genealogy, including traditional te reo Māori text, in order to explore 'authentic' Māori philosophy of science, and the possibilities of 'kaupapa Māori discourse analysis'. While my analysis of this kupu kōrero differs from that of Salmond, this in no way lessens the value of her work in my learning journey. Along with my pleasure in the kupu kōrero and its explanation, the disjunctions also remained clear in my mind over the years. I have demonstrated the power of this analytical method to myself, by the resolution and fuller understanding of the kupu kōrero, gained through writing the story. Overall, this thesis results from my attempt to write the story of Pūtaiao.

WĀHANGA TUARUA

He Aha te Pūtaiao?

The question asked by this chapter title can be translated either as ‘What is Science?’ or ‘What is Pūtaiao?’ The first of these questions is investigated in Wāhanga 2.1, where the approach is to examine the boundaries between science and a range of other types of knowledge including philosophy, technology, social science and scientism, as well as indigenous knowledge. Part of this examination is recognition of the need to clarify the nature of the central canons of science, by definition those parts furthest from the boundaries. Such epistemological boundaries have been widely critiqued in postcolonial scholarship for their role in exclusionary thinking and practice (Carter, 2006). Nevertheless, I will argue for the benefits (from a Kaupapa Māori perspective) of clarifying science’s boundaries, in order to keep science ‘in its place’. Some of the many qualifiers used with ‘science’ produce qualified notions of science, notions which can be understood to refer to those parts of science lying between its central canons and its boundaries. These discussions are important in building up and clarifying notions of Pūtaiao.

The alternate question of the chapter title is addressed in Wāhanga 2.2, which provides an account of the development of notions of Pūtaiao, as reflected in the discourses of Māori science curriculum policy during the 1980s and 1990s. The final section, Wāhanga 2.3, draws together the discussion of current discourses of Pūtaiao presented in these first two chapters, with some preliminary conclusions, in order to chart the next stage of the project.

A process of critique and deconstruction of the Enlightenment conception of science as ‘pure’ knowledge has developed during the last 40-50 years (Hanson, 1958). This general process of critique of science has been contemporaneous with new developments in philosophy, namely postmodernism and poststructuralism. The two discourses (in science and philosophy) are closely linked but non-identical, treating two somewhat separable objects of analysis, i.e. ‘science knowledge’ and ‘philosophy of science’, respectively. This view is reflected in Richard Duschl’s (1985) phrase ‘mutually exclusive development’ to describe the previous 25 years in science education and philosophy of science. Relatedly,

Reuben Hersh (1994) notes that ‘philosophers of mathematics ignore mathematics and mathematicians’.

Two important lines of critique in these debates (in science and philosophy) have come from feminism and anti-racism (e.g. Wertheim, 1997; Harding, 1993; Haraway, 2004), which can both be described as claims by subaltern groups in society (Gramsci, 1992). Subaltern groups in society may hold different viewpoints and knowledges from those that are sanctioned or considered mainstream (e.g. ‘old wives’ tales’ in relation to medicine). One important type of different or ‘subjugated’ knowledge (Foucault, cited in Webster, 1996), which has been prominent in these science and philosophy debates, is indigenous knowledge (IK), of which mātauranga Māori is considered a specific example. Partly due to its role in the philosophical debates (Loving, 1997), there has been contested recognition of the claim of IK to be considered as a valid alternative form of science (Peters, 1993) - an argument, in other words, for a culturally pluralist view of science (Hodson, 1999). A pluralist conception of ‘sciences’ as ‘systems of knowledge’ (Roberts, 1998) makes space for consideration of the claims of IK (Youngblood Henderson, 2000; Battiste, 2000) and other contenders for science status, but does not necessarily imply that all sciences are similar or equivalent – this remains a question to be addressed (Irzik, 2001).

Although the word ‘science’ can simply mean ‘systematic knowledge,’ it usually refers to what is more precisely termed ‘natural science’: i.e. physics, chemistry, biology, and their sub-disciplines. Mathematics, also considered a natural science, is usually delineated separately in the school curriculum due to its perceived importance (Tymoczko, 1994; Hersh, 1994). This, then, is the assumed meaning of the word ‘science’, which is important in considering its leading position in hierarchies of knowledge. In literature concerned specifically with its relationship to other cultural forms of knowledge such as mātauranga Māori (MoRST, 1995; Williams, 2001; Simon, 2003), this meaning of ‘science’ is often explicated by such usages as WMS (Western modern science) (McKinley, 2005) WS (Roberts, 1998) or W-science (Kawasaki, 2002). I use the term W-science when necessary below to avoid ambiguity. The appearance of many meanings, and many qualifiers for ‘science’ (Aikenhead, 2000) indicates its contested nature, i.e. the debate over ‘what counts as science’ (Stanley and Brickhouse, 1994). ‘School

science', for example, refers to the simple/simplistic version of science as presented in the traditional school curriculum, which most likely plays a part in establishing and maintaining the 'unmarked' meaning, and its distinction from mathematics. 'School science' is also a useful approximation of what is meant by the term 'W-science' (and equivalent terms, see above) in the multicultural science literature.

A pluralist view of science, which reverts to the wide definition of 'systematic knowledge', opens the floodgates to the inclusion of an increasing range of knowledge bases, as human culture becomes increasingly sophisticated and systematized (with the help of W-science and W-technology). It becomes more difficult to identify areas of knowledge that remain firmly outside the gates of pluralist science (Irzik, 2001). One result of the pluralist view of science, therefore, is to *necessitate* the use of a qualified term such as W-science or natural science, when one wishes to use the more limited meaning of 'science', although, as noted above, outside critical scholarship, 'physics, chemistry and biology' remains its generally assumed meaning (Gregory, 2001).

2.1 The Nature of Science

In one of the most famous studies of the nature of science, Thomas Kuhn (1970) discussed his usage of the word 'paradigm' to mean the 'disciplinary matrix' of symbolic generalisations, beliefs and values, as well as that set of exemplars, or applications of the disciplinary matrix knowledge, which all members of a particular scientific community subscribe to, learn, teach and use in the practice of their discipline. Kuhn used his concept of paradigm in examining how progress in science is achieved. He suggested that 'normal science' is the steady accumulation of knowledge in a specialised discipline, until new information, or an advance in technology, catalyses a change in some aspect of the 'disciplinary matrix', or paradigm, of that discipline (and its community of scientists, students etc), which is what he termed a 'scientific revolution'. This was the original formulation of what is now commonly referred to as a 'paradigm shift'. Kuhn was interested in understanding the features of a scientific community and its practices, which allow science to steadily accumulate knowledge. This was also an early critique of the accepted dogma of the impartial, objective nature of the scientists' work, and of the unquestioned importance placed on methodology (as in the scientific method) to account for scientific progress.

Kuhn clarified (in the postscript to the second edition of his study, published in 1970, seven years after its first appearance) that ‘theory, or set of theories’ was the more correct term for most of what he had coined ‘paradigm’ in the original text. Kuhn also recognised the importance of ‘exemplars’ in localizing and concretising the cognitive content of science: ‘In the absence of such exemplars, the laws and theories [s]he has previously learned would have little empirical content’ (p.188). Having gained facility in the exemplars of a particular scientific discipline, Kuhn argued that scientists work and communicate (with other scientists in the same discipline) with a great deal of ‘tacit knowledge’, which together with the ‘learned knowledge’ comprise the scientists’ paradigm. These are very similar to Michael Polanyi’s description of a scientist’s ‘subsidiary’ and ‘focal’ awareness (Kim, 2005), as Kuhn acknowledges in the postscript (Kuhn, 1970, p.191).

Kuhn’s work is widely considered to be a watershed in the development of the notion of the research paradigm in the social sciences. Indeed his work, and the debate over the nature of science in general, appears to be more important to social scientists (Hoyningen-Huene and Sankey, 2001) than to scientists trained in physics, chemistry or biology, from the ranks of which almost all science teachers are recruited. This is because these latter domains of W-science are still based largely on empiricist models of the discipline, of scientific method, and, ultimately, of the universe, which means scientists in these fields seldom examine the nature of reality or knowledge, i.e. issues of ontology and epistemology. Clearly, there is a need for science teacher training to address this philosophical neglect.

Yet Kuhn does not include the social sciences in his discussion of paradigms - ‘it remains an open question what parts of social science have yet acquired such paradigms at all’ (Kuhn, 1970, p.15). In the 1970 postscript, reflecting on the reception of his work on the notion of ‘paradigm shift’ as scientific revolution, he muses:

Historians of literature, of music, of the arts, of political development, and of many other human activities have long described their subjects in the same way [as a succession of tradition-bound periods punctuated by non-cumulative breaks]. If I have been original with respect to concepts like these, it has mainly been by applying them to the sciences, fields which had been widely thought to develop in a different way (p.208).

Kuhn indicates here that he uses the word 'science' in its unmarked sense (i.e. W-science or school science – see discussion above). Thus, in the sense in which Kuhn used the terms 'paradigm' and 'science', his work does not directly apply to social science disciplines such as education. Cathleen Loving (1997) discussed such uses of Kuhn's study under the heading 'dubious extrapolations'. New and expanded meanings of these terms have since evolved, however, as seen by their use in contemporary social science discourses.

Most of what Kuhn included in a science discipline's 'paradigm' is referred to as 'methodology' in contemporary social science, with considerable overlap between the two. Kuhn was not talking about paradigm as the scientist's underlying concept of reality, although, of course, that concept inheres in everything of which we are conscious (Middleton, 1996). In current social science, however, the paradigm is defined as the 'net of epistemological and ontological premises', or 'set of basic beliefs that guide action' (Denzin and Lincoln, 2000, p.19). This change in perspective on the paradigm notion is a key point, since it has allowed (or at least accompanied) the expansion of the notion of 'what science is' to bring about the pluralist view on science.

So questions of ontology and epistemology are less important in some areas of science, including school science and W-science, and more important in others such as social science. These philosophical aspects become paramount in discussing the claim of IK to science status. According to Elizabeth McKinley (1995, p.69), 'it is at the philosophical level that the greatest discrepancies between positivist science (as well as some other views of science) and indigenous knowledge are to be found'.

In science, ethical considerations are treated independently of other aspects of knowing such as logic and rationality. Furthermore, science makes no distinctions based on the origins or history of knowledge. Regardless of whence it comes, any information considered valid according to scientific criteria is absorbed into, and becomes part of science. This is one aspect of what is described above by Kuhn as the 'steady accumulation of knowledge' that characterises 'normal science'. In encounters with other forms of knowledge, 'any such specifiable content would be

incorporated in the hegemony' (Webster, 1996, p.234) of W-science. Before exploring issues of ethics and local knowledge (below), first the philosophical thread is followed from science towards **technology**.

A conventional view is that 'science is a step beyond technology, requiring at least the *attempt* to explain and understand'. (Gregory, 2001, p.7, original emphasis). Since technology, according to this account, is a form of knowledge developed in all cultures (unlike science), it is useful to consider the philosophy of W-technology, and how this differs from that of IK.

Philosophy of W-Science and W-Technology

Martin Heidegger (1977) traces the thinking behind W-technology to an essence he calls 'the rule of Enframing, which demands that nature be orderable as standing-reserve' (p.23). This analysis describes the thinking now commonly termed 'commodification', for example in critiques of market policies in education (Chubb and Moe, 1997; Lauder and Hughes, 1999; Lauder, Hughes et al., 1999). Heidegger makes it clear that this philosophy of commodification carries through into W-science, commenting on the diachronic relationship between the development of both:

Chronologically speaking, modern physical science begins in the seventeenth century. In contrast, machine-power technology develops only in the second half of the eighteenth century. But modern technology, which for chronological reckoning is the later, is, from the point of view of the essence holding sway within it, the historically earlier. (Heidegger, 1977 p.22)

Heidegger is saying that the 'essence' of modern technology pre-dated, and helped to give rise to, W-science, which then catalysed the rise of 'machine-power'. To describe the 'ambiguous essence of technology' (p.33) as containing both 'the extreme danger' (p.31) and 'the saving power' (p.34) seems applicable to modern science and technology. Heidegger's discussion (or its English translation, to be exact) is conducted in abstract philosophical terms, but even where it is not, is sometimes obscure. For example, it is necessary to clarify what is meant by the word 'essence' in this passage. Synonyms could be 'philosophy', 'underlying attitude' or 'central value', an interpretation supported by Hugh Lacey (1999, Ch.6), in arguing that 'control of nature' has been granted 'virtually unsubordinated value' in modern value complexes (which ultimately direct

science and technology). Such an ‘essence’ could even be equated with that which Young (1989) termed the ‘meta-decision’ (p.9 above).

The Key Differend: Whakapapa Versus Standing-Reserve

This description of the essence of W-science and W-technology stands in stark contrast with the general understanding of IK, including mātauranga Māori (see Wāhanga Tuarima, p.176), with its emphasis on human kinship with the natural world, or *whakapapa*, rather than ‘commodification’ of the natural world through the process of enframing it as *standing-reserve* (Patterson, 1994). These ‘two approaches representing fundamentally different and mutually irreducible ways of looking at the world’ (Beattie, 1970, p.264) constitute the central ‘differend’ (Lyotard, 1988) of Pūtaiao, and the key theme of this thesis.

That this contrast between ‘whakapapa’ and ‘standing-reserve’ is a fundamental philosophical difference between the two systems of knowledge, i.e. W-science and IK/mātauranga, finds support in the following statement by Georges Canguilhem¹⁴, in a discussion of ‘the moral underpinnings of [Descartes’] theory of the animal-machine’ (Delaporte, 1994, p.227):

The theoretical mechanization of life is inseparable from the technological utilization of the animal. Man can claim possession of and mastery over nature only by denying that nature has any purpose in itself, and then only by *regarding all of nature other than himself* - even that which appears to be animate - *as a means to an end*. (ibid, my emphasis)

W-science and IK are thus shown to have profoundly different philosophical bases. At the same time, compatible aspects or items of IK will always be ‘colonised’ (Ninnes and Burnett, 2001, p.29), i.e. taken out of context and subsumed into W-science. These considerations lead toward the conclusion that IK is different from, and therefore not W-science, and raise the key question of whether or not W-science changes in the process of assimilating knowledge from other cultures - or is this a means by which W-science evolves, becomes more and more W-science-like?

Economics as Science

Economics is another form of knowledge which is often claimed to be a science. The above discussion on pluralist science (or plural sciences) invites us to ask if the claim that ‘economics is science’ is a pluralist claim, or does economics claim

¹⁴ The French philosopher of science Georges Canguilhem (1904-1995) worked and wrote in a tradition leading from Gaston Bachelard (1984) to himself, to Michel Foucault (1998).

to be part of W-science (or school science)? The obvious answers are yes (based on the above discussion) and no (based on the school curriculum), respectively. Economics is a social science, and cannot be subsumed under biology, chemistry, physics, and/or mathematics. The development of the discipline of economics has had an entirely different and separate trajectory from that of W-science (Amin, 2005, p.19). For economics, the conflation that leads to the fallacy that economics is W-science is in a sense the inverse of that which is the case for IK, since economics is based on the same underlying philosophy of commodification as Heidegger claims for W-science and W-technology (Devine, 2004). Therefore economics cannot be considered an alternative form of natural science based on a different philosophy, as can IK.

While many areas in both IK and economics overlap with W-science, there are also central areas in economics (as in IK) that are incompatible with the science status claim. The point is shown by the contrast between the following two quotations, the first on an aspect of mātauranga, the second on economic theory:

On the east coast the old Māori year began with the appearance of the first new moon after the heliacal rising of Matariki (the Pleiades). (Best, 1986, p.11)

The psychological element [within economic theory] suggests that given a certain circumstance or change or whatever, it is unsurprising that people should generally – or at least in significant numbers – come to behave in a certain way. The institutional element then goes on to show that given this shift in overall behaviour, there are bound to be certain consequences – in all likelihood, unintended consequences – that make for an aggregate change. *If the consequences are thought of as beneficial*, then the pattern identified in the explanation is traditionally described, in a phrase of Adam Smith's as an invisible hand; *if they are thought of as harmful*, it is sometimes described as an invisible backhand or an invisible foot. *Invisible hand and invisible backhand are the very stuff of economic theorizing* in the received, neoclassical mould. (Honderich, 1995, p.211, my emphases)

The emphasised phrases in the second quote pinpoint where politics undoes the claim to scientific status of economics. Unasked questions include 'thought of by whom?' and 'beneficial/harmful to whom?' Therefore economics is neither W-science, nor an alternative form of natural science. It is a social science, but 'contrasting it with other social disciplines of thought' (ibid) does not make it into W-science.¹⁵ Perhaps economics is the most W-social science, most bound by

¹⁵ 'Complexity theory' (Kauffman, 1993) investigates order and pattern in the natural world, as a complement to the random effects in evolution. To find the 'invisible hand' to be a case of complexity theory (Kauffman, 1995) would possibly supply a rational explanation (and a route to

Heidegger's 'rule of Enframing', as suggested in the following sub-section. 'An economic transaction is a solved political problem. Economics has gained the title of queen of the social sciences by choosing *solved* political problems as its domain' (Bowles and Gintis, 1993, cited in Harris, 1996, p.201, original emphasis).

Science and Colonisation of Māori

Imperialism, economics and science (and technology, and the entire academy) have been closely, synergistically interrelated in worldwide developments during the last few centuries. At a fundamental level, imperialism can be thought of as the operation of the philosophy of commodification discussed above with respect to less powerful societies and cultures, which is one way of expressing its connection to both economics and science. Key literature themes exemplifying this connection include: voyages of discovery (Harding, 1998; Salmond, 1991), naming (worlding) the world (Spivak, 2003); and colonial trade in the development of global capitalism (Stewart-Harawira, 2005). While traditional structures of imperialism have been dismantled (some would say disguised e.g. (Ladson-Billings, 1998, p.8), this historical nexus has ongoing impact and influence today.

Three major roles of science in the colonisation and marginalisation of Māori can be delineated as follows: firstly, making it possible, by providing British colonists with a technological power advantage; secondly, the (ab)use of science to justify both the end and the means of colonisation; thirdly, by objectifying Māori for study by science.

Each story of imperialism is unique, according to the specific context, but there is also enough general similarity to support recent development of an international scholarship of postcolonialism (Said, 1978) in which the issues of identity, positioning and subjectivity are central. These issues link closely to the epistemology debates in science over objectivity and universalism versus relativism, and both are relevant to the debates in multicultural science education and Pūtaiao. For example, McKinley (2003) studied how these conflict-ridden issues in the work and lives of Māori female scientists affected their self-identities

demystify) the foundations of economic theory, but would not transform economics into either mathematics or biology.

in terms of ‘fractured subjectivities’. Backgrounding this study, McKinley reviewed the role of science in the case of imperialism of the British colonisation of Aotearoa New Zealand. Possibly the most pertinent factor was timing: this colonisation process coincided with the heights of faddish Victorian Darwinism, which provided a new vocabulary for a potent form of scientific racism (Gould, 1997), in which such notions as the ‘family tree of man’ (McKinley, 2003, p.54) gave scientific validity to the belief in the superiority of all things European over all things Māori, as inherent justification, both for the entire imperialist project, and for specific anti-Māori acts that it entailed (Moorehead, 1968; Numbers and Stenhouse, 1999).

The concept of the ‘survival of the fittest’, used to explain the evolution of species in the natural world, was applied enthusiastically to the human world. It became a very powerful belief that indigenous peoples were inherently weak and therefore, at some point, would die out.¹⁶ (Tuhiwai Smith, 1999, p.62)

John Stenhouse (1999) attributes Darwinism’s ready acceptance in Aotearoa New Zealand and Australia, by comparison with Europe and North America, to religious tolerance and the lack of a pre-Darwinian scientific establishment, as well as ‘racist purposes’ (p.81). Stenhouse cautions against exaggerating the political significance of evolutionary racism or social Darwinism, however, noting ‘some [Māori] leaders, like Pākehā humanitarians before them, argued that Pākehā sinfulness, not science, lay behind the [dying Māori] theory’ (p.85-6).

Supporting the overall colonial enterprise, but mitigating the extent to which murder/genocide (Tuhiwai Smith, 1999, p.62) could be justified as means to an end, were several factors, including the important missionary influence, which sought to save (living) souls, the lateness in the overall era of British empire building, which meant it was more planned and thought out, and the nature of Māori society at the time of contact (Webster, 1998). Iwi Māori proved able to respond quickly and positively to European influences, adopting and adapting technologies of war, literacy and money in particular, in ways which nuanced the cultural interface and bilateral balance of power from the start, by comparison, for example, with indigenous Australian ethnies, who shared much colonial history in common (Moorehead, 1968). It was widely held by 19th century colonials that

¹⁶ This belief is, of course, based on lack of understanding of the biological concept of ‘species’. In other words, it arises not from science but from scientism or science ideology (see following subsections).

Māori were ‘superior natives’ (Salmond, 1985). Developing out of the philosophical level of scientific racism, as part of the elaboration of the modern academy (Becher, 1989), a third important colonial role for science was to construct Māori as an object of study,¹⁷ in which the disciplines of Linguistics, Anthropology, and Education, among others, were heavily involved (Tuhiwai Smith, 1999). Thus, the subaltern position of Māori as a marginalised population has been an inevitable and deliberate result of the premises on which the nation-state of Aotearoa New Zealand has emerged (Lankshear, 1990), in which science and economics, as integral parts of the imperialist complex, have had significant parts to play.

The contradictory colonising message to Māori – simultaneously saying ‘you must become like us’ (the ‘command’ to ‘turn toward the West’; Spivak, 1990, p.8) and ‘you will never be like us’ is revealed in analysis of early Māori-language newspapers:

While [British colonists] believed that any human group had the potential to be redeemed from barbarism, European notions of levels of civilisation were inseparable from ideas on racial hierarchies.

Try as Māori might to abandon their māori practices ... they remained unchangeably ‘native’ and *kiri mangu* [black skin] in the colonial milieu. (Curnow, Hopa et al., 2002, p.92).

Despite the ending of war between Māori and Pākehā, and the dismantling of overt racist structures such as legalised discrimination, such psychologically debilitating effects of colonisation have gone largely unrecognised as part of the ‘epistemic violence’ of the discourses of the Other (Spivak, 1987) that continues to impact strongly on Māori today (Wetherell and Potter, 1992).

Truth and Ethics: Positivist Philosophies and the Standard Account of Science

That the power it provides has been used to help people hurt others, however, does not make W-science bad (Sorell, 1991, p.77ff), nor do the fallacies once promoted as scientific truth make it incorrect (hence the use of ‘tentative’ in the Loving quote below). So, what is science? One excellent two-word definition of science is ‘organised scepticism’, attributed to Robert K. Merton (1910-2003) by Phillips (1987, p.63) and Matthews (1995, p.143).

¹⁷ ‘Bishop Museum of Honolulu, Hawai’i, was the first scientific institution to study the problem of measuring living Polynesians’ (Buck, 1938, p.15).

W-science is ‘a loose configuration of critical processes and conceptual frameworks, including various methods, aims and theories all designed to shed light on nature ... done in the context of a human endeavour that is both interpretive and tentative’ (Loving, 1997, p.437). William Cobern and Cathleen Loving offer the following definition of the Standard Account of science:

- 1.0 *Science is a naturalistic, material explanatory system used to account for natural phenomena that ideally must be objectively and empirically testable.*
- 1.1 *Science is about natural phenomena.*
- 1.2 The explanations that science offers are *naturalistic* and *material*.
- 1.3 Science explanations are *empirically testable* (at least in principle) against natural phenomena (the test for empirical consistency) or against other scientific explanations of natural phenomena (the test for theoretical consistency).
- 1.4 Science is an explanatory *system* – it is more than a descriptive *ad hoc* accounting of natural phenomena.
- 2.0 *The Standard Account of science is grounded in metaphysical commitments about the way the world ‘really is’.*
- 2.1 Science presupposes the possibility of knowledge about nature.
- 2.2 Science presupposes that there is *order* in nature.
- 2.3 Science presupposes *causation* in nature.
- 3.0 Nevertheless, what ultimately qualifies as science is determined by consensus within the scientific community. (Cobern and Loving, 2001, p.58-60, original emphases)

As a science graduate, to me this definition of science seems perfectly reasonable (although the word ‘ideally’ in point 1.0 possibly raises unaddressed questions). I take it as specifying criteria by which claims to science status may be evaluated, while simultaneously indicating the limits of science - its legitimate scope or boundary. Nevertheless, the dominant empiricist epistemology, underwritten by philosophical commitments collectively referred to as ‘positivist’, has kept ethics out of science. The following comments clarify why the term ‘ethical science’ is problematical, if not contradictory, in terms of the Standard Account as defined above. This quote also indicates the links between science, philosophy, economics and democracy:

In its early stages positivism was characterised by a belief in the value freedom of its activities. Under criticism because of the obvious falsehood of this view, the defence was to distinguish between the scientific contexts of ‘discovery’ and ‘verification’. This defence may have failed in fact ... but it succeeded subjectively because it provided a continuing basis for the separation of science from ‘politics’, which was necessary if the resolute refusal of positive science to deal rationally with values was to be maintained. This refusal took the form of an ethical ‘decisionism’. Scientists could only make a personal decision about values [which] might be informed by reason but was seen as essentially non-rational in its basis. Science, per se, could deal with values only as the psychological states of individuals ... As such, the realm of ethics and political commitment was seen as accessible *to science* only as a realm available for empirical generalisation, law-like explanation, and manipulation. In this way, whatever

the impact of personal statements by scientists to the contrary, positive science lent itself to the further development of an alienated culture of manipulation.

The appropriation of the findings of such a science by the advertising industry, by those who manage political campaigns and by an increasingly research-guided entertainment industry, was the bridge whereby this dwarfed vision of ethical and political reason entered the popular culture, providing social support for manipulative personal relations, thus completing the circle of limitation which has robbed advanced capitalism of its progressive possibilities. (Young, 1989, p.20, original emphasis)

Philosophical work by Hans Reichenbach (1891-1953), and others, was foundational in establishing this view of science and ethics as incompatible (Sorell, 1991, p.4-7, also fn.19). Reichenbach was closely associated with the Logical Positivist movement that began in 1907, in which the Vienna Circle was central, although his preferred term for his own ideas was ‘logical empiricist’ (Honderich, 1995). Hilary Putnam (2004) explains how rejection of Kantian a priori ethics led logical positivists to adopt ‘a vastly inflated version of Hume’s idea that ethical judgements are not statements of fact but either expressions of sentiment or disguised imperatives’ (p.17), for which view Putnam cites a 1951 Reichenbach work as the locus classicus (fn.20).

Scientism

Cobern and Loving argue that the problem facing IK and postcolonial interests is not the ‘universality of science’ according to the Standard Account, but rather **scientism**, giving examples of the ‘vastly overstated and singularly one-sided’ claims made on behalf of science.

Good health, economic well-being, and national security all depend on many things, only one of which is science ... though the NAS [National Academy of Science] and the ICSU [International Council of Scientific Unions] appear eager to accept credit for good technological innovations, there is no parallel acceptance of technological disasters. ... Something is wrong with this portrayal of science (we might even say *betrayal* of science). (Cobern and Loving, 2001, p.63, original emphasis)

Scientism is described as ‘a term of abuse’ (Honderich, 1995, p.814), in the sense that, as Massimo Pigliucci (2002, p.115) notes, ‘nobody thinks of himself [sic] as espousing scientism.’ Pigliucci claims that ‘in philosophy, it has become a widespread sport to accuse your opponent of scientism’. Two concise definitions of scientism are: ‘science as it pretends to be’ (Stenmark, 2001, p.viii); and ‘the thesis that every expression which can genuinely be correctly applied - which can be used in saying something true - is reducible to some expression of a natural science’ (Morris, 1992, p.41).

Mikael Stenmark (2001) distinguishes between ‘academic-internal and academic-external Scientism’, further characterising each of these according to the philosophical commitments entailed. As Stenmark notes, ‘this [categorisation] is important because one can hold on to some scientific claims but, nevertheless, reject some others’. His typology is synopsised in Whika 5:

Whika 5: Types of Scientism

TYPOLOGY OF SCIENTISM (Stenmark, 2001)		
<i>Form</i>	<i>Philosophical commitment</i>	<i>Examples and relationships</i>
ACADEMIC-INTERNAL SCIENTISM (science reductionism):		
1	all/some non-scientific disciplines can be reduced to or translated into natural science	social sciences and humanities are branches of biology
Methodological	mandates the use of only the methods of natural science in other academic disciplines	common interpretation of academic-internal scientism 1
2	all sciences can be reduced to or translated into one particular natural science	biology is reduced to chemistry, and chemistry is reduced to physics
ACADEMIC-EXTERNAL SCIENTISM (science expansionism):		
Epistemological 1: Epistemic	the only kind of knowledge we can have is scientific knowledge*	but we are rationally entitled to believe things not known to science (COMMON)
Epistemological 2: Rationalistic	we are rationally entitled to believe only what can be scientifically knowable	stronger form than epistemic, but both accept that science has some limits
Ontological	the only things that exist are the ones science can discover*	more ambitious than, and entails, epistemic form
Axiological 1	science is the only truly valuable part of human learning or culture	implies, and is implied by, epistemic form
Axiological 2	science alone can answer our moral questions and explain as well as replace traditional ethics*	does not necessarily entail epistemological or ontological forms
Existential (or redemptive)	science alone can answer our existential questions and explain as well as replace traditional religion*	replaces religion with ‘scientific materialism (naturalism/humanism)’
Comprehensive	science alone can and will solve all or almost all genuine human problems	inclusive form - science has no limits or boundaries

* The four scientific theses critiqued by Stenmark.

Stenmark critically evaluates the four ‘most interesting and challenging’ versions of scientism, marked by asterisks in the above table, by focusing on the work of scientists, especially evolutionary biologists, who espouse these scientific views. As guilty of scientism to varying degree, he cites Francis Crick, Richard Dawkins, Stephen Hawking, Carl Sagan and Edward O. Wilson (Stenmark, 2001, p.vii). Analysing the work of these eminent science writers and others, he makes the key

conclusion for all four scientific theses that they are not science, but ideological corruptions thereof.

For example, the programme of ‘sociobiology’, which is defined by Wilson as ‘the systematic study of the biological basis of all social behaviour’ (p.34), encompasses politics, morality and religion, as well as science itself, within its scope, claiming that all of these phenomena can be explained by evolutionary theory. Stenmark examines claims made by adherents of sociobiology, some of which have become widely known as the ‘selfish gene’ theory, which basically holds that natural selection works by selfishness, and extends that to the belief that the behaviour of all living things is biologically determined by selfishness. This leads to such problematic assertions as ‘universal love and the welfare of the species as a whole are concepts that simply do not make evolutionary sense’ (Dawkins cited in Stenmark, 2001, p.59).

Stenmark demolishes this argument by examining the easily distinguishable difference between ‘biological selfishness’ and ‘moral selfishness’, pointing out that it is perfectly possible and reasonable for human behaviour to be biologically selfish but morally unselfish, or the reverse. Stenmark concludes:

These are possibilities Dawkins completely overlooks simply because he conflates these different senses of selfishness and altruism and related notions such as universal love and generosity. The result is sheer confusion and a serious misconception of the relevance of evolutionary theory for society and ethics. (p.61)

There is an important contradiction here worth underlining. On one hand, the empiricist account, especially that of the logical positivists (Putnam, 2004), which remains the predominant philosophy of science as defined by the Standard Account, insists that science has nothing to say about ethics, whereas the evolutionary¹⁸ account, on the other hand, holds that science is the *only* determinant of ethics. According to the scientism typology above (p.51), the empiricist view, arguing to keep ethics out of science, is a manifestation of epistemological and ontological scientism, while the evolutionist view, which argues for science to control ethics, can be regarded as axiological₂ scientism, usually held in conjunction with, and strengthened by, the existential form as well. Putnam (2004) sums up ‘the philosophers of science’s evasion of values’:

¹⁸ Strictly, ‘evolutionist’ - but the distinction from ‘evolutionary’ is unclear, due to meaning ‘malignancy’ (Boyd, 2001), see p.188 below.

Apparently any fantasy - the fantasy of doing science using only deductive logic (Popper), the fantasy of vindicating induction deductively (Reichenbach), the fantasy of reducing science to a simple sampling algorithm (Carnap), the fantasy of selecting theories given a mysteriously available set of 'true observation conditionals,' or, alternatively, 'settling for psychology' (both Quine) - is regarded as preferable to rethinking the whole dogma (the last dogma of empiricism?) that facts are objective and values are subjective and 'never the twain shall meet.' That rethinking is what pragmatists¹⁹ have been calling for for over a century. When will we stop evading the issue and give the pragmatist challenge the serious attention it deserves? (p.145)

Nevertheless, as Mason Durie (2005) notes, 'rejection of science in favour of indigenous knowledge' is a significant form of the knowledge debate for Māori and other indigenous people. Such pro-mātauranga stances are aligned (in mainstream academic thinking) with those of religious fundamentalists and creationists (Matthews, 1995, p.146). Collectively, these stances comprise what Tom Sorell (1991) refers to as 'anti-science or pseudoscience'. Sorell makes a distinction between 'scientism in philosophy', which is the object of his critique, and 'scientistic ways of thinking [found] elsewhere, for example in politics or science itself' (p.xi), describing himself as 'less keen to criticise scientism outside philosophy' because, in that case, scientism can be useful in 'bolstering up an appreciation of, and respect for, science in the face of anti-scientific and pseudo-scientific ideas' (p.2). This suggests he considers such ideas more dangerous or incorrect ideologies than scientism. 'While it may not be necessary ... to master an existing discipline, complete with ideological distortions, before criticising it, it might, indeed, be worse entirely to dismiss it before mastering it' (Young, 1989, p.133). For this argumentative polarity in knowledge/science, 'the two extremes of scientism and anti-science are equally flawed and sterile positions' (Pigliucci, 2002, p.118).

Paulo Freire (1998), who was a 'key writer' drawn on in the development of Kaupapa Māori theory (Smith, 2002, p.34), identified scientism as inimical to the work of emancipation (Freire, 1998, p.29, p.88). Discussing the 'indispensable qualities of progressive teachers', including tolerance, Freire noted that

those who embrace scientism are equally intolerant [as the authoritarian or the bigot], because they take science for the *ultimate truth*, outside of which nothing counts, believing that only science can provide certainty. Those immersed in scientism cannot be tolerant, though that fact should not discredit science. (ibid, p.42, original emphasis)

¹⁹ The pragmatist tradition in American philosophy includes Charles S. Peirce (1839-1914), William James (1842-1910) and John Dewey (1859-1952).

This reflects Stenmark's conclusion:

The truly scientific mind must instead be conscious of the limitation of the scientific enterprise, and also allow forms of truth and knowledge which lie beyond the scope of the sciences. (Stenmark, 2001, p.142)

It is necessary to clarify the distinction between 'scientism' and 'science ideology'. Some authors use these terms interchangeably. A distinction, however, is found in the work of Canguilhem, who recognised a valid role for science ideology as outdated or historical science, giving as examples the doctrines of atomism, ovism and animalculism. His remarks are also enlightening about the relationship of science to religion and superstition:

A scientific ideology comes to an end when the place that it occupied in the encyclopedia of knowledge is taken over by a discipline that operationally demonstrates the validity of its own claim to scientific status. ... The existence of scientific ideologies implies the parallel and prior existence of scientific discourses. Hence, it also presupposes that a distinction has been made between science and religion. ... Hence, scientific ideology is by no means the same thing as superstition, for ideology has its place, possibly usurped, in the realm of knowledge, not in the realm of religious belief. Nor is it superstition in the strict etymological sense. A superstition is a belief from an old religion that persists despite its prohibition by a new religion. Scientific ideology does indeed stand over [*superstare*] a site that will eventually be occupied by science. But science is not merely overlain; it is pushed aside [*deportare*] by ideology. Therefore, when science eventually supplants ideology, it is not in the site expected. (Delaporte, 1994, p.35-36)

This distinction serves to refine the definition of scientism, by adding a diachronic restriction: to those science ideologies which contradict the *contemporary* canons of science (Boyd, 2001). This section has focused on the relationships and boundaries between science (Carter, 2006) and the following other types (or systems) of knowledge:

- IK including mātauranga;
- social science including economics;
- philosophy including ethics;
- scientism and science ideology.

2.2 A History of Pūtaiao Curriculum Policy

This section presents a more detailed account of the development of Pūtaiao curriculum to date, reviewing past and current policy and practice. In doing so it responds to an alternative interpretation of the chapter title, reviewing the development to date of Pūtaiao curriculum policy as an 'historical fact'. It is based on a reading of two unpublished Master of Education theses, concerning earlier

policy phases, namely, '*Science Aotearoa*' by Jocelyn Jesson (1990) and '*A Power/Knowledge Nexus: Writing a Science Curriculum in Māori*' by Elizabeth McKinley (1995).

Science Aotearoa

Māori first appeared in national science curriculum policy during the Form 1-5 Curriculum Review in Science (CRIS), which was gazetted in April 1985, and which Beverley Bell was appointed to direct in June that year (Jesson, 1990). As part of CRIS, in Term 1, 1986, eight discussion papers were sent to all schools inviting comment on the key issues in science education that Bell had identified during her previous work in Britain, including one called Multicultural Science, which suggested reasons for including 'things Māori' in science. The eight reasons given in the paper can be grouped into three: improving Māori achievement, avoiding racism, and benefiting all students with multiculturalism. Jesson notes these reasons 'reflect the intermingling of learning theory, sociology and politics, but overall the discussion paper represented the emerging discourse of modern educational thinking in New Zealand' (p.57). Following the discussion papers, in April 1987 eight curriculum development groups were set up, including one called Science Aotearoa. In Bell's explanation of the rationale for the development groups, reported by Jesson, the only reference to Māori was in 'social concerns of equity, particularly for girls and Māori students' (p.67). Based on this, it appears the planning of the Science Aotearoa project was influenced by some of the recent developments in Māori education policy discourse, including social equity, taha Māori and multiculturalism, but no acknowledged role for Māori language and Māori knowledge had yet developed in the science educational discourses at that time.

Part of the brief of the development groups was to produce a professional guide for teachers, and Science Aotearoa was also the name of the document that this group produced during three years of on-going work. Jesson's thesis documents the process of Science Aotearoa, including the changes in the discourse of the group as work proceeded, and critiques the final draft document. This is an interesting story in policy sociology, for only seven guides were ever published by the Ministry of Education at the end of CRIS. The draft Science Aotearoa document, although sent to Wellington, never went to print. It is likely this outcome is related to the philosophical conflicts that Jesson identified within the

Science Aotearoa group as the ‘interaction of different agendas’, which she defines as ‘the developmental psychology approach and the more explicitly political sociological approach’ (p.166). Part of her critique of the draft Science Aotearoa text is the range of contradictory perspectives it contained, with ‘a number of different discourses jostled together’ (p.141).

Jesson records the Bilingual and Bicultural Maths and Science Hui (Meeting) held 30 May – 3 June 1988 as a specific marker of when the discourse guiding the work of the Science Aotearoa group abruptly changed direction. During the 1980s, a shift had occurred in the understanding of the legal rights of Māori, guaranteed by the Treaty of Waitangi. These now included the protection of te reo me ōna tikanga (the language and its customs), and as a result, new Māori voices were being heard for the first time in education policy discourses. Concomitant with the developments in indigenous politics around the world, policy studies of international law were reaching conclusions such as that Māori people had a right to be educated in te reo Māori (Hastings, 1988). The Kaupapa Māori education discourse had been constructed as a theoretical framework to guide future developments (Smith, 1990). The following sentence, from a statement made by Monte Ohia at the above hui, captures the mood concerning the knowledge conflict:

Science and maths has to fit into Kaupapa Māori and any move to fit Kaupapa Māori topics and programmes to maths and science must cease. (Jesson, 1990, p.126)

Jesson analysed the changes in the discourse: ‘The purpose of the Science Aotearoa group moved from producing resources about taha Māori for use in science education, through a position advocating some form of recognition of Māori epistemology as science, to a final position advocating bilingual science – science education in the Māori language’ (p.166). This description indicates how the argument for retention and revitalisation of te reo Māori, justified by reference to the Treaty of Waitangi, was added to the original discourse about social equity, updating the earlier emphasis on taha Māori and multiculturalism. This, then, could be considered the point at which the discourse in Māori education policy entered the new phase of tino rangatiratanga.

During the Science Aotearoa process the discourse of Māori science was at an early stage. While the final draft document made reference to the existence of a

different epistemological system, the emphasis on teaching science in te reo Māori overtook and obscured any debate about the possibility of teaching different science. Jesson notes that, in the final draft document, ‘the particular way of knowing through science is, in fact, not addressed as problematic’ (p.153). Hence, while Māori language assumed prominence in the discourse of Māori science education during the CRIS development, Māori knowledge did not. Overall however, the Science Aotearoa project was an important early contributor towards the Māori science discourse.

Since the entire CRIS project (of which Science Aotearoa was a small part) was overtaken by the restructuring of the education system in the late 1980s and the development of the New Zealand Curriculum in the early 1990s, and since the document was never actually published, Science Aotearoa could be seen as having little lasting relevance in the development of Māori science education. It could though be regarded as significant in setting the scene for later developments, and providing important professional development for individuals involved in Māori science education. The story of its development process, moreover, is an instructive example of changing and conflicting discourses in curriculum policy, related to issues of legitimation and authority of different voices in policy discourse.

When Science Aotearoa began, Pākehā people dominated the group and implicit viewpoints of ‘Māori as other’ drove the group’s thinking. By the end of the Science Aotearoa process the new discourse of Māori education had emerged, in the form of Kaupapa Māori, which necessitated that Māori people and pro-Māori thinking control Māori education developments. While the failure to publish the Science Aotearoa document might be interpreted as a move to suppress Māori content in science curriculum policy (i.e. as an example of institutional racism/Eurocentrism), perhaps such a policy text was no longer acceptable to Māori voices in the curriculum policy discourse either. In terms of the central dialectic, it appears by the end of the Science Aotearoa project, Māori voices were effectively arguing for ‘science in Māori’, and that the earlier ‘Māori science’ position had been dropped. The clash of agendas in the Science Aotearoa group, ranging from social constructivism (the ‘developmental psychology’ approach) to Kaupapa Māori (the ‘political sociological’ approach), provides a good example

of contesting policy discourses. It also indicates why the Science Aotearoa process was unable to satisfactorily resolve the epistemological and pedagogical issues involved in Māori science education into an outcome in the form of a document that met the objectives of all the parties involved. There remains the possibility that the Science Aotearoa experience was a contributing factor in the strategic decision to develop a complete Māori-medium curriculum.

Pūtaiao i roto i Te Marautanga o Aotearoa

Te reo Māori finally made it into national science curriculum policy in 1996 with the publication of *'Pūtaiao i roto i te Marautanga o Aotearoa'* (M.O.E., 1996), and in her thesis, McKinley traces the process that began in 1992 when she and Pauline McPherson Waiti, as co-contractors to the Ministry of Education, took responsibility for developing the document (McKinley and Waiti, 1995).

McKinley indicates that the Māori science discourse did not find a prominent voice in the development of 'Pūtaiao': 'The only recognition of Māori is by language only. How and what the language carries is just as important as the language itself in the recovery of Māori' (McKinley, 1995, p.44). Hence she makes the key conclusion that in the sense of knowledge content, 'Pūtaiao' 'is not considered to be a Māori curriculum' (p.55).

This result occurred because the content and structure of 'Pūtaiao' were largely pre-determined by the English science curriculum document, 'Science in the New Zealand Curriculum' (M.O.E., 1993), which had been completed (to publication in draft form) before the contract for 'Pūtaiao' was advertised. McKinley records that the advertisement 'took many Māori educationalists a little by surprise' (McKinley, 1995, p.2). The question then arises, was the decision by the Ministry to develop curriculum policy texts in te reo Māori a late move in the development of the National Curriculum, subsequent to the production of the English documents, or had the decision been made earlier, but kept from public knowledge? This question is significant in terms of McKinley's thesis that Māori had actually very little input into the resulting curriculum policy.

Indeed, McKinley argues that 'Pūtaiao' cannot actually be considered to be a curriculum development project. If the Māori curriculum developments were a late decision, it indicates a poorly planned approach to Māori-medium education

policy, especially in view of the fact that Kura Kaupapa Māori had been established in legislation back in 1990. This is, however, a more innocent conclusion than the second possibility, whereby secrecy could have been used deliberately to limit Māori input into the curriculum development. In either scenario, the hallmarks of institutional Eurocentrism are unmistakable (Harding, 1998).

The process of developing the Pūtaiao document gave the writing group, of which I was a member, an opportunity to discuss Māori science, which was of benefit to those of us involved, and important for Māori science discourse. Most of the people involved in the writing group had expertise either in traditional science knowledge or in traditional Māori knowledge, but not both.²⁰ While the document presents a framework for the curricular knowledge base that includes some features derived from traditional Māori knowledge, the directive in the contract that all of the achievement objectives contained in ‘Science’ had to be included, effectively ensured that ‘Pūtaiao’ would be dominated by mainstream science content and curriculum thinking.

According to evidence such as the directive mentioned above, it seems fair to assume that the Ministry of Education intended that ‘Pūtaiao’ would in fact be a straightforward Māori translation of ‘Science’, and McKinley states that it was intended for use in all Māori medium programmes including Kura Kaupapa Māori, according to the terms of the contract as negotiated. It is therefore important to examine the position of ‘Pūtaiao’ (and the other Māori language curriculum documents) in the on-going discussions between Kura Kaupapa Māori and the Ministry. Given the strong identity of Kura Kaupapa Māori in Māori medium schooling, it would be difficult to imagine that Māori medium curriculum policy would be developed specifically for non-Kura Kaupapa Māori programmes. Yet in a sense this is what resulted. One of the conditions being negotiated in the late 1980s in order for Kura Kaupapa Māori to be established as state-funded schools was that the Kura Kaupapa Māori curriculum would incorporate the ‘national curriculum’, although this had not yet been defined at the time. (This discussion was documented in the Tomorrow’s Schools Kura Kaupapa

²⁰ As I recall, a significant amount of the meeting time allocated for developing the document was spent discussing ideas about Māori science, until time constraints, rather than resolution of the underlying questions, prevailed.

Māori Working Group Report, produced in October 1989.) Since Māori knowledge is at the core of the rationale for Kura Kaupapa Māori (Nepe, 1991), however, this clearly results in an inherent conflict for Kura Kaupapa Māori curriculum, which is greater in science than the rest of the curriculum (Irwin, 1999), as previously discussed.

McKinley's thesis indicates that the 'Pūtaiao' project was not intended to be a development of curriculum policy for uniquely Māori science, although the addition of non-essential 'bits' of traditional Māori text was approved. Therefore she describes the document as a 'contradiction', resulting from a conflation of discourses in curriculum and Māori education. On the one hand, it is a radical curriculum innovation; on the other hand, it perpetuates the marginalisation of Māori knowledge. While it is irrelevant to the vast majority of science teachers, neither is it fully suitable for the purposes of Kura Kaupapa Māori. Such inherent contradictions might be expected to limit progress in Pūtaiao, contributing to its under-implementation in classrooms and hence, indirectly, impeding the science learning of students in Māori-medium programmes.

'Pūtaiao' is undoubtedly significant for Māori. It establishes a precedent for the production of science curriculum policy in te reo Māori. It is difficult to envisage even the possibility that in the future, Aotearoa New Zealand might return to a situation in which science curriculum policy existed only in English. In this sense, regardless of its flaws, it is an extremely important 'first' for Māori science education; a platform which can be improved and built upon. 'Pūtaiao' has also been received as a very significant development by the science education community, and in the community at large (Barker, 1999). By virtue of the fact that it is a complete school science curriculum written wholly in Māori, it challenges and changes ideas about the capacities of the language, and possibly also about science. It is also part and parcel of a growing normalisation of te reo Māori, such that as a nation we have become used to, perhaps even expect, its use in everyday life, such as in signage or newspapers, on television and the radio.

In these ways, the existence of 'Pūtaiao' as a document is of tremendous political importance, which in a sense is totally unrelated to its contents – and therein lies a measure of jeopardy. This can be expressed by saying that the less one knows

about *te reo me ōna tikanga*, or science, the more impressive the document appears to be. This reflects the truism that in order to critique any text requires fluency in the language of the text, as well as expertise in its subject matter. Thus, what I am labeling jeopardy here is the lack of individuals able to provide detailed informed critique of the contents of ‘Pūtaiao’, particularly in comparison with what would be considered appropriate as a level of discourse for a national curriculum document. The bigger picture is that ‘Pūtaiao’ as curriculum policy has been produced within a vacuum of corresponding practice of Māori-medium science education - i.e. the lack of a community of practitioners, a history of teaching and learning, acknowledged subject experts, accepted pedagogy, pre-existing curriculum texts, programmes, resources, etc. Politically and educationally, therefore, ‘Pūtaiao’ cannot be regarded as equivalent to ‘Science’. It is not simply another science curriculum document. Its existence, its structure and its content can only be understood in relation to, and contingent upon, those of ‘Science’.

This analysis suggests that, despite the production of ‘Pūtaiao’, issues of *tino rangatiratanga* with respect to curriculum knowledge content are still on the agenda for negotiation between Kura Kaupapa Māori and the state. Through its legitimisation as an official national curriculum text, in the meantime, ‘Pūtaiao’ was the baseline to dictate the direction and shape of state-funded developments in Māori-medium science education occurring since its publication in 1996. The *marautanga Māori* (Māori curriculum documents) have been included in most national curriculum developments since the publication of the New Zealand Curriculum (NZC) in the early 1990s, even though the roll-out of the Māori documents was slow, with the final one (Hauora) still in draft form when the Māori-medium section of the Marautanga Curriculum Project to update the NZC began in 2005. In Pūtaiao, examples of such ‘parallel’ processes include the teachers guidebook, *‘Te Whakamahi i te Pūtaiao’* (M.O.E., 1997), and the Pūtaiao exemplars, *‘Ngā Tauaromahi Pūtaiao’*, published in 2004.²¹ There are exceptions to this; for example, Māori versions were not produced for the senior Biology, Chemistry and Physics curricula published following the production of ‘Science’.

²¹ Website www.tki.org.nz/r/assessment/exemplars.

2.3 Current Policy and the Dialectics of Science Education

The discussions presented in these first two chapters indicate that current developments in Pūtaiao emphasise the dialectical position identified in Wāhanga Tuatahi as ‘science in Māori’, at the expense of ‘Māori science’. Some resulting problems and disadvantages accompanying this imbalance have been explored. The current approach, which provides Pūtaiao by end-point translation of mainstream science materials, arises out of the universalising, technicist²² reason which controls increasing proportions of state activity in education. It is universalising in assuming only one approach to science education exists, effectively constructing difference as sameness (McKinley, 2005, p.227), and, simultaneously, justifying increasingly technicist, and technical, solutions to the problems of Pūtaiao education.

Underlying this central dialectic, which is the discursive foreground of this thesis, it is important to consider the wider curriculum dialectics in science education. Curriculum research debates between ‘science for scientists’ and ‘science for all’, as noted above (p.22), influence science curriculum, as does the tension between the perspectives of science educators and those of other ‘stakeholders’ such as business and the economy (Bell, Jones et al., 1995). The influence of constructivist science teaching pedagogy has also created polarities in science education in Aotearoa New Zealand during recent decades (Matthews, 1995; Bell, 1995), although acceptance of a weak version of constructivism appears to prevail (McMillan, 1995; Carson, 1997, p.111).

Over a decade ago, Graham Hingangaroa Smith (1995) commented on the inability of constructivist (as well as traditional/liberal) science education to overcome Māori underachievement, in one of few published Kaupapa Māori analyses of school science education. Smith issued a challenge to ‘New Zealand science education academics’, to the effect that their international reputations ‘ought’ to rest on their ‘ab[ility] to deal with domestic issues’, particularly ‘the Māori crisis’ (p.119), as he referred to the longstanding disparity in science

²² The adjective ‘technicist’ applies to practices such as the use of vidcon technology to amplify the size of the NCEA-level teaching resource, despite the pedagogical limitations; or the deployment of extra contractors to solve the issue of Māori-medium secondary qualification provision - first to translate the examinations, then to re-translate the scripts.

education outcomes noted above (p.30). Smith critiqued not only the constructivist position on science education, but also the prominent critic of constructivism, Dr Michael Matthews, noting

a contradiction in Matthews' position [with respect to the politics of Māori knowledge], on the one hand arguing against 'social constructedness' and yet on the other demonstrating quite clearly the social constructedness of science in the privileging of selected definitions of science. (p.105)

Smith argued that Kaupapa Māori is able to 'rescue' constructivism, by extending reform to 'structural considerations' such as 'power-relations':

Māori social, political, economic and cultural subordination to the dominant group is manifested in many ways including the control over knowledge and the curriculum. What counts as science in the school represents a selection of knowledge which sometimes leads to the exclusion of Māori interests. (p.116)

Another 'structural' consideration cited by Smith is that of

Ideology: there is a need to respond to Māori aspirations in relation to the validity of Māori language culture and knowledge revitalisation, particularly at the ideological level. There is a need to assert the validity of Māori knowledge and frameworks (ibid).

Here 'ideology' is used in the sense of 'philosophy', and these comments clearly link back to the analysis by Heidegger of the 'essence' of technology and science (see p.43). This paper opens some important questions for Pūtaiao, which I should like to pursue further. For example, Smith clarifies at the start that his 'paper does not purport to engage deeply with epistemological or ontological issues of constructivism deriving from the question of "what ought to count as science?"' (Smith, 1995, p.105). He follows 'a sociological perspective' on knowledge:

The critical insight here is that the school curriculum represents a selection of knowledge made by dominant non-Māori interest groups. In this sense, school science which is reified as neutral, acultural, and value free is clearly open to challenge. (p.108)

Yet from these quotes, it seems the question of 'what counts as science?' is central to Smith's ideas about how science education needs to change. Therefore, while raising the question of 'the Māori crisis', the advice for science educators in this paper is limited to a call for 'reorganisation at the pedagogical level in order to deliver more effectively for Māori' (p.119). Smith sums up his perspective as follows:

I see tremendous potential in the constructivist approach, but at the same time, Matthews also makes some important criticisms. I would hold to the position that both schools of thought can be accommodated within an eclectic approach to science education and do not necessarily need to be

constructed as an absolute oppositional discourse. My overriding concern is to seek the best approach for delivering success in science for Māori students. (Smith, 1995, p.109)

Noting the resonance of ‘oppositional discourse’ with the proliferating dualisms in this topic, the key word here is ‘eclectic’, which in Pūtaiao aligns with ‘pragmatic’ and ‘compromise’ (against purism and orthodoxy) as approaches to curriculum development for which I will advocate in this thesis. The overall conclusion of Smith’s paper was that development of science education in Kura Kaupapa Māori would be required to overcome the longstanding disparity in outcomes. This article (Smith, 1995) pre-dated the publication of the Pūtaiao document; it appeared at a time when only a handful of KKM programmes included any Year 11-13 students. Discussions were then taking place between individual kura and NZQA, concerning translation of School Certificate examination papers into Māori for Wharekura students. It is timely, perhaps particularly in view of the NCEA results presented in Wāhanga 1.4 above, to revisit the hopes and concerns Smith expressed in this paper.

The ‘nature of science’ debate has been closely involved in many science education reform movements (Benson, 1989), including multiculturalism (see Wāhanga Tuatoru), constructivism, history and philosophy of science (Matthews, 1994), Science-Technology-Society (STS), and narrative approaches to science education (Gilbert, 2001). Dualisms are clearly rife in this territory: Richard Duschl (1990) argues ‘science has two faces, or two profiles’; ‘products of science’ (the knowledge base) and ‘processes of science’ (manipulative and cognitive – methods). ‘This two-faced nature of science has dominated science education practice during the twentieth century’, leading respectively to the ‘concept approach’ and the ‘inquiry and process approach’ (p.9-11). Duschl analyses the dialectical imbalances, and how these have negatively impacted on science education since about 1960.

The tragedy of teaching science as absolute truth or with curriculum objectives that seek to empower students with the contemporary final form of science is that the potential to achieve something very special with students is lost. (ibid)

Based on this critique, Duschl argues that there is a need to change the focus of science education, so as to include knowledge about science, not only scientific knowledge:

The distinction between scientific knowledge as a curriculum objective and knowledge about science as a curriculum objective is based primarily on the exclusion and inclusion, respectively, of history of science and of the important role of theory development in science. The key to understanding science is to understand the important and diverse roles theories play in science. (p.42)

An understanding of the wider discourses of science education, including critiques such as those of Duschl and Smith, is important in suggesting possibilities for further Pūtaiao curriculum development. These two chapters have argued that current discourses of Pūtaiao fail to move beyond the class of teaching strategies labelled as 'Bilingual science' in Jesson's typology (cited in Smith, 1995, p.114), which is defined as 'the teaching of the standard science curriculum in Māori language'. In other words, the Kura Kaupapa Māori approach to science education, predicted by Smith in his 1995 paper, has not yet (in 2006) fully emerged in practice, at least not at a discernible national level. This thesis aims to further investigate such a Kura Kaupapa Māori approach to science education, and to identify conditions that would be conducive towards its development.

To return to the discussion of definitions from the start of the chapter, there are many qualifiers used with the word 'science', of which two ('Māori' and 'Western') form the central dialectic in this topic. What types do the qualifiers of 'science' fall into? Firstly, there are disciplinary markers or specifiers. 'Biological', 'mathematical', 'physico-chemical', and 'social' are a few common examples. Not all of these, however, are uncontested. 'In fact, because the complexity of human beings cannot be captured quantitatively, the concept of "social science" is at its root an oxymoron' (Pinar, Reynolds et al., 1995, p.64). D. C. Phillips (1987; 1992) in contrast, makes a cogent defence of 'naturalistic social science'.

One study 'says that probably in its central application the term [science] is honorific' (W. Gallie, cited in Sorell, 1991, p.178, fn.1). This is the sense used by proponents of 'creation science', because they seek to replace 'evolution science' with another 'science', an aim described as 'scientistic or verging on it' (Sorell, 1991, p.2). Honorific is also, according to Matthews, the usage of science in 'Māori science' (Matthews, 1995, p.146), although I dispute this in Wāhanga Tuarima below (p.186). A pro-Māori version of this position (more equivalent to that of the proponents of Creation Science) was given by botanist Murray Parsons:

The term Māori Science has been used to emphasise Māori people too used the scientific method and that it is not the prerogative of western countries only. (M. Parsons, 1995, cited in Williams, 2001, p.19)

This argument supports the view that the term ‘Western science’ is itself problematic (the political stance is emphasised here, as in other quotes, by de-capitalising ‘western’) - a reason to use ‘W-science’ instead, and then only when necessary. At the same time, Parsons can be read here as suggesting the term ‘Māori science’ from a political rather than strictly scientific perspective and need (hence enabling the usage to be described as ‘honorific’ or ‘verging on scientific’ - see above). The role of such ‘pro-Māori science’ positions in discourses of mātauranga is also discussed in Wāhanga Tuarima.

Two further classes of qualifier (other than disciplinary and honorific) used with ‘science’ could be labelled ‘epistemological’ and ‘perspectival’. These are classes called for by the widespread usage of terms such as ‘postmodern science’ (an epistemological qualifier?) and ‘feminist science’ (a perspectival qualifier?). It must be noted, however, that these qualified notions of science usually occur in discourses of philosophy, rather than those of ‘science itself’. Questions which could be posed concerning these types of qualifiers include:

- What (if any) is the essential difference between ‘epistemological’ and ‘perspectival’ qualifiers for ‘science’?
- Which class of qualifier for science best fits the terms ‘Māori/indigenous science’, and ‘critical science’?
- Why is the term ‘postmodern science’ widespread in the literature, but not ‘poststructural science’, and what would be the difference between the two?

Another type of qualifier for ‘science’ is also mostly encountered outside science domains. These qualifiers often occur in binary pairs, such as ‘good science’ and ‘bad science’, or ‘authentic science’ and ‘inauthentic science’. Such qualifiers are heard in discussions of quality in science education, but also in domains such as resource management, where priorities (‘values’) of different societal sectors commonly come into conflict. This discussion of qualifiers of ‘science’ concludes at the end of Wāhanga Tuarima, following further discussion of the major relevant discourses in language, knowledge and culture (p.194).

Returning to the twin questions posed by its title (‘What is Science?’ and ‘What is Pūtaiao?’), this chapter can be considered an extended examination of the meaning of the ‘word’ (in its widest possible sense, as advocated by Mikhail

Bakhtin; Danow, 1991), 'pūtaiao'. Coined to mean 'science', the discussion has shown that 'pūtaiao' contains ample discursive space for further interrogation: which meaning(s) of 'science' does 'pūtaiao' correspond to, and when; and are there meanings for 'pūtaiao' that 'science' does not convey? These questions are explored in the following chapters.

WĀHANGA TUATORU

Multicultural Science Education Research

In seeking to unravel and address the difficult questions that have been raised about Pūtaiao, or Māori science curriculum, the multicultural science education research literature²³ is a natural place to turn. This specific field has a history of around 30 years, and continues to expand in scope and volume, recently being described as a ‘large and rather amorphous body of literature’ (McKinley, Stewart, et. al., 2004).

This chapter presents a review of the curriculum debates found in the multicultural science education research literature in the last few decades. As expected, one of the major themes in this literature is the nature of science, and its relationship to culture. A few strong positions on paradigm/philosophy were formed around the binary polarities related to this question, positions which have been variously labelled - as ‘universalist-multiculturalist’ (Siegel, 1997), or ‘positivist-postmodern’ (Loving, 1997), among others. The aim in the following discussion is to highlight key arguments, to show strengths and weaknesses on either side of these paradigmatic divides. The intransigence of these oppositional positions contributes to the ongoing volume of publication in the field, while another source of expansion is the increasing number and range of specific cultural contexts around the globe in which multicultural science education research is being undertaken.

Clearly, this debate is framed by several others: the privileging of science in the curriculum, brought about by the imperatives first of the space race and later economic competitiveness (Pinar, Reynolds et al., 1995); the wider philosophical debate over the nature of science and the development of postmodern and poststructuralist traditions; and the post-World War II international political context, in which culture became a central issue in processes of nation-building, decolonisation, and sovereignty.

In other words, multicultural science education research can be viewed as a response to the dominant scientific discourses in science and science education,

²³ Extensive on-line bibliographies are available at: http://www.stemworks.org/digest_main.html

and as such, must be applauded for its very existence. On the other hand, despite the large amount of work published, central questions in the debate appear to remain unresolved (Ninnes, 2003). According to Masakata Ogawa,

we have not yet reached a consensus on its true colors of what [we] have been calling 'indigenous knowledge', 'traditional ecological knowledge', or 'indigenous science' in the contexts of science education. The consensus will be one of the top priorities to promote research in culture studies in science education. (Ogawa, 2004, p.2)

This comment encapsulates the challenge and the goal taken up in the following discussion, not to mention the remainder of this thesis. *Does* the notion of multicultural science make sense, or is science universal, and if so, is it meta-cultural? At which level(s) should science education be reformed - curriculum, pedagogy, language - in order to increase participation and achievement for indigenous students, and Māori students in particular? These questions will be briefly resurrected at the end of the chapter.

To formulate an account of the debates in multicultural science curriculum, I selected a corpus of approximately 25 interesting papers, spanning the publication years 1981-2003, and covering the major positions for and against multicultural science, from a range of viewpoints, including multiple papers by authors who were particularly active in the debate over extended periods of time. For convenience, the corpus is discussed in four chronological groups, as follows:

- I: 1981
- II: 1990s
- III: 2001
- IV: 2002-3.

I: 1981

The earliest stage comprises only one paper, by an Australian educator, M. N. Maddock (1981), a paper later cited in support of indigenous/Māori science (McKinley, McPherson Waiti et al., 1993). Maddock (1981) addressed most or all of the arguments that have since been comprehensively contested, foreshadowing the polarities and pitfalls which have eventuated in the quarter-century since its publication.

The viewpoint proposed is that science and science education are cultural enterprises which form a part of the wider cultural matrix of society and that educational considerations concerning science must be made in the light of this wider perspective. (Maddock, 1981, p.1)

After commenting on the roles of science and science education in the post-Sputnik West, the many US and UK science curriculum development projects of the 1960s, and their export through aid programmes to the Third World, he discussed ‘the problems involved in transplanting science curricula from one culture to another’ (p.4), including different worldviews, termed ‘intellectual models’ ‘embedded in culture’ (p.12), language issues (science vocabulary and English as a second language), and ‘the arrogance of ethnocentricity’ (p.13). He challenged ‘the American scene, where ... very little cognizance was taken of the fact that there are numerous subcultural groups within the country which may hold very different, culturally ingrained views’ (p.6).

Maddock asserted ‘that *a degree of* dualism or biculturalism has to be accepted’ (my emphasis) in order for science education to make progress. He suggested the collation of existing and new ‘cultural material [by] suitable sensitive researchers and its organization into a condensed form of information on cultural scientific knowledge and models relevant as a foundation for science teaching, is one area of research well worthy of support by international funding agencies’ (p.18).

II: 1990s

By the mid-1990s the debate over the nature of science had permeated throughout the US academy, and after having been previously ignored, eventually began to be reflected in the mainstream science education literature (Loving, 1997, p.422). A traditionalist backlash emerged, exemplified by the much-cited ‘*Higher Superstition: The Academic Left and Its Quarrels with Science*’ (Gross and Levitt, 1994). These authors made cogent critiques of certain lacunae in the ‘anti-science’ literature, in which they included multiculturalism, but focused on some of the more extreme examples of ignorance of science, which did little to support their argument. Their exaggerated description of science as ‘under siege’ raises the question of ‘moral panic’ (Cameron, 1995), which is defined as sensationalism for underlying political purpose, where legitimate but unfounded concerns are inflated and propagated to camouflage ‘inadmissible claims’ such as those based on racism or sexism. To label ethnocentric science education as ‘balkanisation of the academy’ (Gross and Levitt, 1994, p.204) may be bending to their own end (either cynically or unwittingly) a phenomenon related to postcolonialism in the academy, described by Gayatri Spivak:

within a permissible cultural politics which allows enchanted spaces to be created, sometimes alternate institutions which might define themselves as 'beyond the institution' are allowed to flourish so that the work of cultural explanations within the institution can go on undisturbed. (Spivak, 1990, p.5)

In related local discourse, Mike Dickison's (1994) paper, deriding the notion of Māori science, was widely read by Māori and Pākehā science educators. Similar sceptical comments about Māori science education by Matthews (1995) were part of his generally patronising tone towards non-West cultures, as well as towards other scholars, according to his critics (Bell, 1995).

At times, authors arguing for the universalist position in science education have drawn for support on such questionable critiques as that of Gross and Levitt (e.g. Good, 1995; Loving, 1997). But the reverse criticism also applies, such as the assertion that some multiculturalist claims are based on dubious sources ('bad science', Loving, 1997, p.147).

The universalists viewed the very term 'multicultural science' as oxymoronic, and the debate gained traction and volume during the 1990s. Stanley and Brickhouse (1994) set out the multiculturalist case for including 'a few well-chosen examples of sciences from other cultures' (p.396), thus echoing the earlier call by Maddock, but in updated language (e.g. 'sciences'). In response, Ron Good (1995) challenged multiculturalists 'to be specific' with their 'critiques of modern science' which he defined as 'the science begun in Europe a few centuries ago' (p.335):

What is inaccurate about the scientific knowledge produced by biologists, chemists, physicists, and so on about nature? What "non-Western science" have we neglected to include in legitimate science? Or is the issue something else? Is it that science knowledge is used by some persons and cultures to the disadvantage of others? At the very least, let's clarify the nature of the argument. (Good, 1995, p.336)

Here, the first two questions demonstrate important universalist misunderstandings of the basis and nature of the debate, while this definition of 'science', implying its ownership by Europe and her colonisers, is subject to claims of ethnocentrism. Nevertheless, Good has a point about a need for clarity. Brickhouse and Stanley (1995) replied: 'What is used as an example is not nearly as important as the issue of how the nature of science will be portrayed in the science curriculum' and pointed out: 'There is an emerging body of

postcolonialist literature that may serve as a resource for those who are concerned with helping students understand the relationship between science and culture' (p.338).

Harvey Siegel (1997) made an attempt to bridge the divide by arguing that, 'given the failure of the critique of epistemological universalism', the 'tension between multiculturalism and universalism' is mostly only apparent, since the (in his view, only defensible) 'case for multiculturalism' is a universal 'moral obligation' 'to treat cultures other than our own, and the members of those cultures, justly and with respect' (p.97-8), which includes 'exposing non-Western students to ideas which are not part of their culture, and – sensitively and respectfully – indicating to them that some of their cultural beliefs (e.g., animism) are not respectable scientific beliefs', since 'teaching them these things is part of their science education' (p.104). While this argument may be sound from the perspective of mainstream (colonialist) aims of science education, it is framed within an ethnocentric 'us and them' paradigm which is off-putting, if not offensive (and therefore pedagogically self-limiting) from the perspective of 'members of those cultures'. (Siegel's more recent views on the epistemological debate are included in Wāhanga 5.3.)

In contrast, Glen Aikenhead (2000) argued this moral obligation towards other cultures demands a pluralistic multiscience approach in which teachers become culture brokers, explicitly teaching border-crossing to enable students to learn 'various sciences' including 'common-sense understanding' and 'Aboriginal science' as well as 'western science'. Besides respecting other cultural forms of knowledge, Aikenhead introduces a critical perspective by arguing that 'renegotiating school science is fundamentally a political event' necessary to overcome the 'gatekeeping role' played by traditional school science (p.257).

Extending Aikenhead's critical perspective, Annette Gough (1998) structured her argument for moving beyond Eurocentrism toward a more democratic science within a feminist poststructuralist framework, including a synopsis of the feminist and postcolonial critiques of science. Claiming the need to overcome the 'unconsciousness' of scientists concerning their own 'bias or political agenda' which leads them to believe they are 'neutral and objective' (p.185), she also

suggests ‘the search for national and international standards in science education and the renewed emphasis on traditional content in science curriculum frameworks’ (p.200) constitute further obstacles in the path beyond Eurocentrism.

An example of a complementary indigenous pluralist viewpoint is provided by Prakash’s (1999) essay in a collection on IK (Semali and Kinchloe, 1999), which includes the postmodern challenge to science in support of his argument for the benefits of ‘people’s science’, using *dahin* (yoghurt/curds) from indigenous Indian culture as an example of sustainability and ecological literacy.

Although there was some critical rhetoric during the 1990s, very few examples of multicultural science education materials (Ninnes, 2003), or clear guidelines for teaching science multiculturally, had appeared. While multiculturalist rhetoric was concerned with arcane philosophical debates, the link between these and improving the outcomes of science education for indigenous students remained tenuous, and inequity of outcomes continued, or worsened. Teaching multisciences (Hodson, 1993) is likely to prove impracticable, since content overload is already a constant issue for science teachers. The intriguing suggestions contained in these papers, namely: to become conscious (i.e. informed about the debates, and about one’s own perspectives); to explicitly teach cultural border-crossing in the science classroom; and to investigate indigenous practices as alternatives to mainstream environmental science education, still required full development, to be implemented and evaluated in classroom programmes. Their traction for improving equity was as yet undetermined.

III: 2001

The third set of papers is taken from the first 2001 issue of the prestigious journal ‘Science Education’, which brought together work by several leading multiculturalist and universalist authors, including responses to each other, thus providing a useful snapshot of the (then) current state of the debate. The papers in this collection continue to be widely cited (e.g. Carter, 2006; Hipkins, Bolstad et al., 2002), indicating their ongoing importance.

Stanley and Brickhouse (2001) restated their earlier ‘conten[tion] that science education *should* be multicultural’ (p.35, my emphasis):

We do not believe a universalist view of science is either compatible with a multicultural approach or fully coherent as a foundation for the science curriculum ... Many educators have focused their efforts on the question of what kind of science (Western modern science and/or local 'ethnic' science) to teach indigenous people whose worldviews are distinctly different from mainstream Western ones. (ibid)

Here, the first sentence encapsulates the two major multiculturalist arguments, namely that W-science (and by extension W-science education) is inherently both ethnocentric, and lacking in truth. The second sentence presents as unproblematic three (arguably unfounded) assertions: that there are non-Western sciences; that these are (or can become) available as curricular choices/alternatives for educators; and that these form the bases of indigenous students' worldviews. The bulk of the paper reviews the theoretical philosophical debates behind these positions, rebutting Siegel's claim (above) 'not only ... to know what is universally right or wrong, but of the very possibility of attaining such knowledge'. This amounts to a position of strong moral and epistemological relativism (Moody-Adams, 1997), which threatens to invalidate the entire discussion, if not the very notion of scholarship, which depends on some notion of 'standards' of knowledge. A related lacuna is their 'worry' that an approach to multicultural science education, advocated in the same issue by Snively and Corsiglia (2001), over-emphasises 'the politics of science' at the expense of 'teaching about other aspects of the nature of science' (Stanley and Brickhouse, 2001, p.46). This amounts to denying or problematizing their own stated axioms (above). In advocating 'an examination of the debates within WMS [as] a way of teaching students about the relative merits of different sciences' (p.47), these authors effectively construct the academic debate in which they are engaged as 'multicultural science education', a position which is a significant move away from their earlier call to incorporate science knowledge from non-Western cultures. While the inherent problems of this previous recommendation remained unaddressed, nor does this later move away from science content altogether appear to be an improvement. While claiming multiculturalism, the paper reveals embedded ethnocentrism:

the problems [Matthews and Siegel] believe all sciences should be interested in solving [how radios work, why the moon stays in orbit, why hundreds of thousands of Africans are dying of AIDS] are really local problems that would be of most concern to Westerners. If the question were to explain the anaesthetic effect of acupuncture or how to live with limited resources, WMS might not fare as well. (Stanley and Brickhouse, 2001, p.46)

One cause of these lacunae appears to be the lack of distinction made between philosophy and empirical knowledge, so that Western scientific ideas are frequently compared with non-Western values in a way that leads to the trap of denying the validity of Western science, in order to assert the validity of non-Western values.

The paper referred to above, by Gloria Snively and John Corsiglia (2001), is one of the few in this collection which includes an identifiably indigenous perspective, with John Corsiglia noted as a ‘Consultant on First Nation’s [sic] history and culture, British Columbia’ (p.6). This paper starts by arguing ‘that since Aboriginal cultures have made significant contributions to science ... the definition of “science” should be broadened, thereby including TEK [Traditional Ecological Knowledge] as science’; but then goes on to

distinguish between “Western modern science”, which is the most dominant science in the world, and “indigenous science” which interprets how the world works from a particular cultural perspective ... [T]raditional ecological knowledge ... is both the science of long-resident oral peoples and a biological sciences label for the growing literature which records and explores that knowledge. (p.8)

In this way, the meaning assigned to ‘science’ varies between ‘W-science’ and ‘pluralist science’, which results in lack of clarity. This paper attempts to respond to the universalist challenge to document indigenous science, although some claims, such as the discovery of rubber, vulcanizing and platinum metallurgy by Native Americans, were refuted by other scholars (Ortiz de Montellano, 2001). The related issue of documentation and accessibility of indigenous science is also problematic, with large claims made at various points:

[E]ducators can now use a burgeoning science-based TEK literature that documents numerous examples of time-proven, ecologically relevant, and cost effective indigenous science. (Snively and Corsiglia, 2001, p.6)

TEK is being used by scientists to solve important biological and ecological problems. (p.8)

Growing worldwide acceptance among scientists and international aid agencies of indigenous knowledge is reflected in a network of 33 national and regional TEK and IK Resource Centers, so far embracing six continents, as well as the Philippines, Japan, Micronesia and New Zealand, and a dozen more centers are in the process of becoming established. (p.20)

Examples of indigenous and TEK science may be accessed through living elders and specialists of various kinds or found in the literature of TEK, anthropology, ethnology, ethnobiology, ethnogeography, ethnohistory, and mythology, as well as in the archived records of traders, missionaries and government functionaries. (p.11)

Some of the difficult, unacknowledged issues related to IK are revealed in the final statement above: first, its holistic nature, dispersed across a wide range of Western disciplines; second, the reliance on European archives; and third, the assumption that IK is still retained substantively today by members of indigenous communities.

Snively and Corsiglia offer ‘a five-step process for producing a TEK unit in cross-cultural science teaching’ in which the steps are:

- Step 1. Choose a Science Topic or Topic of Interest (e.g. medicine, cultivating plants, animal migrations, geology, sustainability)
- Step 2. Identify Personal Knowledge
- Step 3. Research the Various Perspectives
- Step 4. Reflect
- Step 5. Evaluate the Process. (p.27)

It is unclear whether this process is intended to replace or supplement the current science curriculum, although learning Western science still seems to be the ultimate aim, according to statements such as ‘it is possible to teach Western scientific concepts to native students with a preferred traditional spiritual view of the world, without changing in the sense of replacing, the students’ preferred orientation’ (Snively and Corsiglia, 2001, p.26).

The paper ends with the assertion that ‘respect for nature’ (p.30) is the ‘genius of indigenous science’ (p.29) which will be required to manage the problems of the future. This is an important point, but does not follow from the argument of the paper, which contains two main contradictions: first, in claiming IK as both science and traditional wisdom, and second, in the primary purpose of cross-cultural science education as learning Western science or IK. This paper also conflates philosophy and empirical knowledge: in focusing on the ‘facts’ of TEK there is the implicit assumption that this will change and improve the ‘values’ of W-science.

The final full-length paper in this selection, by William Cobern and Cathleen Loving (2001), rehearses the arguments in defence of the universalist view or Standard Account of science (see p.48), and includes a warning about ‘radical revisionist’ materials on non-Western contributions to science, claiming these contain a ‘triumphalist’ rather than factual version of events (p.52). They argue that including TEK in science implies a wide definition of science such as

‘descriptive knowledge of nature’ (p.55). Describing a multicultural science lesson on ecology, which incorporated traditional Native American views on nature, including ‘nature is viewed as sacred’, they make the crucial point that this ‘is one such legitimate way [of thinking about nature], but it is not the way of science’ (p.56). Therefore,

although we hate to use the word hegemony, Western science would co-opt and dominate indigenous knowledge if it were incorporated as science. Therefore, indigenous knowledge is better off as a different kind of knowledge that can be valued for its own merits, play a vital role in science education, and maintain a position of independence from which it can critique the practices of science and the Standard Account. (p.51)

Valuing IK for its own merits and for its ability to critique Western science, as Cobern and Loving recommend here, is consistent with a Kaupapa Māori view. Corsiglia and Snively (2001) responded, however, ‘that indigenous science offers important science knowledge that WMS has not yet learned to produce’ (p.82) and that TEK ‘is able to compete because it is already doing so ... and because there are areas where WMS is weak’ (p.84). These statements, however, sit oddly with their comment that ‘most indigenous parents want their children to be exposed to the best knowledge that Western modern science can offer’ (p.85), although in using such general terms as ‘areas’, ‘important knowledge’, and ‘the best knowledge’, this is difficult to evaluate. For instance, there is the possibility that the ‘areas’ where IK is stronger than WMS are outside the school science curriculum.

Several commentaries from other scholars on the three full-length articles also appeared in the same issue, which added a further level to the debate. In their issue introduction, Lewis and Aikenhead (2001) focused on the need to shift Eurocentric paradigms, and listed three points accepted in common by Cobern and Loving (2001), Stanley and Brickhouse (2001), and Snively and Corsiglia (2001):

- all systems of knowledge are embedded in the context of a cultural group;
- all systems are, therefore, culture-laden;
- science (Western science) is the system of knowledge about nature that is predominant in Western culture. (Lewis and Aikenhead, 2001, p.3)

According to Lewis and Aikenhead (2001), the issues under debate in this volume are two-fold:

- how to position Western science so that it can inform and be informed by the nature-knowledge systems of other cultures;
- the role that non-Western nature-knowledge systems should play in the science curriculum. (ibid)

The three lead articles, discussed above, were also reviewed in the same issue by Gurol Irzik (2001), whose main argument against the multiculturalist position is that it relies on the ‘disunity of science’ thesis, which then leaves no choice but to broaden the notion of science to make room for TEK and IK (p.71-72). Irzik refutes Stanley and Brickhouse’s (2001) assertion that science is ‘disunified and multiple’ in favour of Cobern and Loving’s (2001) claim that ‘science can be defined with sufficient clarity so as to maintain a coherent boundary for ... school science curriculum development’. Irzik then highlights the difficulty of taking a multiculturalist position, as he sees it:

Will we invite our students to judge which is a more true account of nature? Or are we going to simply tell them that different cultures have different conceptions and worldviews that are equally valid? ... Which of these two attitudes is ethically more correct? (Irzik, 2001, p.73)

Pitting science and IK in competition against each other like this, as is typical of universalist arguments, reveals underlying scientism (p.50 above). There is the implicit assumption that the criteria used to decide the ‘winner’ and ‘loser’ will be those of science. Nevertheless, Irzik agrees ‘wholeheartedly’ that there are things of value to learn from IK. These commentaries acknowledge the ‘dilemmas and tensions’ (Lewis and Aikenhead, 2001, p.5) of the debate. Its problematic state was summed up as follows by Bernard Ortiz de Montellano (2001):

Teaching multicultural science is a meritorious enterprise, but the devil is in the details. What should be taught? Examples must be both anthropologically and scientifically accurate. Unfortunately, much of the material developed is triumphalist rather than pedagogically sound for an elementary level audience or is inaccurate and little documented. (ibid p.79)

IV: 2002-2003

The last stage represents more recent contributions. Dawn Sutherland and Reg Dennick (2002) reported their questionnaire and interview study, exploring the views of Grade 7 Euro-Canadian and Cree students, which included some Cree speakers, thus incorporating language issues. While preliminary, with results considered to be inconclusive, this study does at least attempt research ‘inside the classroom’ - somewhat rare in the multicultural science education literature. An indicated future area of study is the possibility that ‘the syntactic order as a function of language structure may influence science explanations’, a research direction that tends towards linguistic relativism (Whorf, 1956; see Wāhanga Tuawhā), and the interference of non-standard English in mathematics and

science conceptual learning (Wilson Orr, 1987). This paper suggests ‘the standard process of presenting the nature of science to students, which assumes the ideas are equally accessible to all students, may not be a valid assumption’ and, though guilty of essentialism in references to ‘the epistemological differences between Cree and Euro-Canadian students’, ‘suggests a greater emphasis on understanding the epistemological differences between traditional and Western scientific knowledge systems should be explored in the middle years (Grades 5-9) science programme, especially in schools with high Aboriginal populations’ (Sutherland and Dennis, 2001, p.21). Stating that multicultural science education ‘may assist in the initiation process to science’ (p.22), however, indicates adherence to the purposes of mainstream science education.

The final set of papers comprises five out of ten chapters in a recent major collection, *Multicultural Science Education* (Hines, 2003). In the first of these, Roberta Ahlquist and Julie Kailin (2003) rehearse the arguments for a critical multicultural (as opposed to a cultural pluralist) perspective: the impact of science and technology on everyday life and the environment; inherent sociopolitical injustice in science-based industries; myths of objectivity; and a critique of global capitalism, including the increasing influence of big business on science education, through the funding of classroom materials. It seems ironic, however, to characterise as ‘critical’ the claim that, since Western science contains many historical contributions from non-Western cultures, it cannot therefore be superior knowledge:

This is why it is important to demystify and dismantle the myth of superiority that Western capitalist science promotes. It is a dangerous myth because it disrespects and disregards the vast contribution of other peoples and civilizations on this earth. (p.38)

For the same reasons, it could also be argued that, since ‘Western science’ includes many contributions from non-Western cultures, it clearly **must** be the most superior form of knowledge. As a corollary, this argument suggests that the term ‘Western science’ is a misnomer.

Appeal by Ahlquist and Kailin to ‘dubious sources’²⁴ in support of their claim adds to the problem, and indicates the ongoing currency of these sources in the multicultural debate. One of these sources is cited in a review of ‘bad’ culturally relevant materials in this same volume (Loving and Ortiz de Montellano, 2003). Brief suggestions for developing ‘good’ culturally relevant materials include the requirement for ‘fewer topics in more depth’ and that ‘teachers learn a little anthropology and history associated with a particular scientific phenomena (*sic*)’ (p.161), in working towards ‘democratic, culturally relevant classrooms – where ethnic, racial or cultural differences are not ignored or hidden but are openly discussed as worthy and interesting’ (p.160).

Peter Ninnes (2003) reports in his chapter on ‘representations of indigenous identities and knowledges’ in science education texts, which link to discourses in identity, and hence ethnicity and postcolonialism (see also discussion on p.98). Nevertheless, Ninnes concludes that ‘a number of problems remain unresolved’ (p.182).

Paul Rowland and Carol Adkins (2003) present a rationale and overview of Native American science education (NASE) as a ‘special lens’ or ‘vantage point’ on multicultural science education (MSE), concluding that while NASE can be ‘easily justified through ethical arguments that appeal to cultural preservation as well as to students’ academic success’, MSE, whether for ‘voluntary minorities’, ‘minority ethnic students’, or ‘majority students’, is far more difficult to justify (p.117). This perspective gains support from (and is mutually reinforcing of) the contemporary North American scholarship on identity (Battiste, 2000). It is the inverse of the earlier multiculturalist argument (Brickhouse and Stanley, 1995), which called on postcolonialism to support multicultural science education, since in this case the postcolonial view privileges its own claim to multicultural science education to the exclusion of mainstream (and possibly other subaltern) groups.

In the final chapter of the volume, Samina Hadi-Tabassum (2003) set out to define ‘a theoretical framework for multicultural science’ (p.187), indicating no irony in

²⁴ Two cited examples are: Bernal, M. (1987). *Black Athena: The Afro-Asiatic roots of classical civilization*. New Brunswick, NJ: Rutgers University Press – see Loving and Ortiz de Montellano (2003, p.154); and Weatherford, J. (1988). *The Indian givers: How the Indians of the Americas transformed the world*. New York: Fawcett Columbine. See Ortiz de Montellano (2001, p.78).

this objective, despite basing the argument on Foucault's notion of genealogy and claiming 'postmodernism no longer accepts the "master narratives" of Western science' (p.190). In 'meditating on multiple sciences' the author claims Western science has dominated 'mostly because it imposed linguistic and social conventions in the struggle for agentive control' (ibid). In contrast, 'the concept of multicultural science is informed by postmodern views of classrooms that do mediate a sense of multiplicity, fragmentation, instability of meaning, dissent and dissolution of grand narratives, and emancipatory practice' (p.191). Brief comments on three examples of multicultural science education - in Navajo, Hawaiian, and limited-English-proficient contexts - lead into discussion of the author's team-teaching experience, in a culturally diverse classroom, teaching thematic science on the topic of solar energy, which 'used a two-way immersion bilingual framework for our class, so that students were "doing science" in both English and Spanish' (p.196). The only bilingual example given, however, is "The sun has energia solar" (p.198). The unit sounds impressive, having the following characteristics: activity-based; starting with cultural narratives about the sun; incorporating physics, astronomy, technology and making things, including a solar-powered model car to race in a competition. The case for calling this 'postmodern science' is unclear, however, since it could equally well be described as a good example of up-to-date mainstream or W-science teaching. Postmodern terminology, such as 'transgress the borders' and 'crosspollination', is used to describe 'successful postmodern science education':

The students worked well with each other across racial, ethnic and linguistic lines. Their ability to transgress these borders was evident during the solar energy car race, when camaraderie was at its strongest as students cheered each other. Thus, there was a crosspollination of languages, knowledge, and experiences within our multicultural science classroom. (p.198)

It is certainly to be hoped that many students of all backgrounds are able to have such experiences in their science education. But the use of 'postmodern' by this author is not essentially in relation to the **science** content or curriculum. This results in an elision of the two notions - 'science for non-Western students' and 'non-Western science' - as meanings for 'multicultural science', and illustrates the tendency towards confusion around definitions in this field.

The research literature has included little specific curricular material for multicultural science education. To complete this review, two examples follow.

The first is from a University of Auckland cross-faculty (Arts and Science) Stage I paper, titled '*Indigenous knowledge and Western science: perspectives from the Pacific*' (Roberts, 1998, p. 75):

- Module 1: Foundations of Indigenous Knowledge (9 lectures + 2 tutorials)
- Module 2: Foundations of Western Science (9 lectures + 2 tutorials)
- Module 3: Navigation and Voyaging (6 lectures + 2 tutorials)
- Module 4: Environment (6 lectures + 2 tutorials)
- Module 5: Health and Disease (6 lectures + 2 tutorials).

While indicative only, these titles indicate a 'two worlds' (Salmond, 1991) approach to the comparison between science and mātauranga/IK, with the inherent weaknesses (Munz, 1994) - and strengths - of such an approach. The three themes selected as focus areas are ones in which Māori knowledge may be construed as 'equivalent' or 'equal', or even 'superior', to W-science knowledge.

An example of multicultural science curriculum for schools is found in a book by Tewa Indian Gregory Cajete (1999) titled '*Igniting the Sparkle: An Indigenous Science Education Model.*' Like the Roberts paper above, this is a universalised treatment, 'meant to function as a template' for application to 'other indigenous populations around the world', in 'third-world nations as well as among Native Americans' (p.10). Thus, while most of the book rehearses the arguments in support of 'indigenous science education', brief curriculum details are appended under the following headings:

- Syllabus #1 The Creative Process in Art, Science and Native American Cultures
- Syllabus #2 Philosophy: A Native American Perspective
- Syllabus #3 Social Ecology: A Native American Perspective
- Syllabus #4 Herbs, Health and Wholeness: A Native American Perspective
- Syllabus #5 Animals in Native American Myth and Reality
- Syllabus #6 The Primal Elements: A Native American Perspective
- Syllabus #7 Astronomy: A Native American Perspective. (ibid pp.193-218)

It is unclear whether this syllabus is intended to replace or supplement a science programme, and no information is provided of 'actual' classroom implementation. Since the topics are not typical of 'school science', the proposal is vulnerable to allegations of 'soft options' (Phillips, 1987), which are discussed again below (p.98), in relation to the 'canon'.

Conclusion

The above review indicates that much literature on multicultural science education comprises rhetorical critique of the relevant issues, from many different angles, in diverse cultural contexts, and to varying levels of complexity. The diachronic

aspect of the review shows how the same arguments have been recycled for many years. To address the concerns of many scholars working in this area, an online discussion forum for CSSE (Culture Studies in Science Education) has recently been established, with Masagata Ogawa (2004) as the first convenor, and Elizabeth McKinley (2005) the second and current convenor (in December 2006), to facilitate the ongoing international conversation.

Most of the difficulties discussed in the multicultural science education literature arise from two closely related sets of intellectual bias, one related to culture, represented by the term 'ethnocentrism', the other more specific to science, i.e. 'scientism' (see p.50). Ethnocentrism has been shown to be embedded both in modern science and in the academy in general, including the discipline of education (Ladson-Billings, 1998), and both universalist and multiculturalist arguments have been shown to contain ethnocentric thinking. Recent perspectives have included emerging new forms of ethnocentrism, sometimes as a positive strategy for overcoming historical oppression, for example Afrocentrism (Rivers and Lomotey, 1998).

Scientism is related to ethnocentrism, as identified above, and to sexism, which has limited and failed to acknowledge the contribution of women. More specifically, scientism arises from unacknowledged biases ('unconsciousnesses', Gough, 1998) within science. The most prominent of these are the myth of objectivity, in which the aspiration to be free of human bias is taken for its achievement (see also p.188), and the myth of omniscience, which misrepresents science's aim to mandate the best available explanation for natural phenomena.

While these caveats over the (mis)representation of science and its achievements in the curriculum are cogent, it does not follow that science is therefore no more powerful than other cultural forms of knowledge, against the tide of the overwhelming dominance of science knowledge, and its impact on the life of every citizen in the contemporary world (Matthews, 1995, p.146). Indeed, the history of modern science demonstrates that it is by nature a 'colonising' form of knowledge, in the sense that any knowledge about nature is enframed as 'standing-reserve' (Heidegger, 1977). Science subsumes relevant information from all cultures, and therefore can be claimed as belonging to all. Perhaps the

problem is not so much that modern science is Western in nature, but that modern science has been ‘captured’ by privileged groups in the West (Mihaka, 1989).

A related concern results from this recognition that all indigenous knowledges contain empirical information that can be translated into modern science knowledge (although to do so invariably risks separation from the original cultural context). Multiculturalists have used this recognition to argue that IK actually **is** modern science (or postmodern science, Peters, 1993), which reinforces the above lacuna. Generally speaking, IK is holistic, not compartmentalised in the same way as Western knowledge. Therefore, a major problem with including IK in the science curriculum is that it implies either teaching an entire culture (hence also implying Western science equates with Western culture), or including decontextualised extracts, which in turn become caricatural. An example of this is the overplayed context of harakeke (flax) to stand for Māori representation in the curriculum (McKinley, Stewart et al., 2004).

Discussion of the nature of science and IK in terms of ‘ideas’ often fails to distinguish between empirical and philosophical aspects of knowledge, in suggesting that inclusion of IK can improve science education. While the underlying philosophy on which IK is based may be better than that underpinning modern science (see Wāhanga Tuarima), this must be changed at a broader level than the school science curriculum. It is difficult to envisage how including IK ‘facts’ or ‘values’ in school science curricula might change the philosophy within which science knowledge is framed.

Another common lacuna in the multicultural science education literature relates to ideas linking the psychology of indigenous people/children to IK. Indigenous students are often either assumed to ‘have’ IK, which interferes with their learning of science, or are argued to ‘need’ IK, usually as an intermediate step towards science. ‘No one has a pure worldview that is 100 percent Indigenous or Eurocentric’ (Little Bear, 2000, p.85). A more politically robust position holds that indigenous students have a right to learn IK, but this is often either at the expense of science, or again justified as a transition to learning science. Many such arguments essentialise the identity of indigenous students (e.g. Sutherland and Dennick, 2002), in simplistic analyses of modern ethnicity (see p.10).

The following table lists four major lacunae and problematic assertions, found in the multicultural science education literature, with an attempt to re-frame each one in more robust terms:

Whika 6: Lacunae in the Multicultural Science Education Research Literature

Lacuna	Re-framing
Science is flawed; therefore IK is as powerful as science.	<i>Science is flawed, but is often presented in the curriculum idealistically.</i>
IK is science.	<i>IK and science are different forms of cultural knowledge based on different philosophies. Science advances by incorporating knowledge from all cultures, so 'belongs' to all cultures.</i>
Science can be taught based on IK philosophy.	<i>Better teaching of philosophy of science, including critical perspectives, is required. IK philosophy may offer an alternative to that of science, and therefore be of immense significance. Further research is needed on IK philosophy and its role in education.</i>
Indigenous students have/need IK instead/in aid of learning science.	<i>Indigenous students have a range of modern subjectivities of relative cultural balance, but very few if any indigenous students today have a solely indigenous worldview unaffected by Euro-American culture.</i>

This list indicates the wide range of issues which the multicultural science education literature attempts to address. Yet the first one, the need for realistic presentations of the history, philosophy, culture and workings of science in the curriculum (Gough, 1998), might more properly be regarded as a general science education issue. IK philosophy, furthermore, due to the fundamental nature of its differences from philosophy of science, cannot be simply 'infused' (Corsiglia and Snively, 2001) into the science curriculum, despite its obvious importance.

Science education in Samoa (Tavana, Hite et al., 1997) or outback Australia (Sansom, 1982; Attwood and Magowan, 2001) differs greatly from the development of Pūtaiao in Aotearoa New Zealand, yet all three scenarios are describable as 'multicultural science education in the Pacific'. In the US, the arguments for multicultural science education (as the above review shows) vary somewhat for African American, Native American, Latin American or Asian American students. These are examples of the range of scenarios within which multicultural science education is considered, yet these differences are often

minimised in their treatment in research literature. This may possibly be connected to the nature of the academy itself, which encourages theorising and generalisation. This may also explain why most suggestions about how to implement multicultural science education can be classified as one, or a combination, of the four approaches listed below in Whika 7. The first two of these perhaps reflect generally ethical classroom practices, rather than specifically ‘multicultural’ science education. Examples from the corpus above to illustrate each approach are given, as well as cross-references to the science education literature review by Rosemary Hipkins, Rachel Bolstad et al. (2002). This state-commissioned literature review contained a section on ‘teaching science in multicultural classrooms’ (p.205) which outlined three variations or perspectives on ‘border crossing pedagogy’ (p.208). These three perspectives fit within approach 3 and 4 in my typology below, supporting the suggestion that the first two approaches may not, strictly speaking, qualify to be labelled as ‘multicultural’.

Whika 7: Approaches Towards Multicultural Science Education

Approach	Examples (from the corpus)	‘Border-crossing Perspective’ (Hipkins, Bolstad et al., 2002, p.208-10)
1. Teaching science with sensitivity and respect for the cultural background of students	Hadi-Tabassum, 2003; Siegel, 1997	
2. Teaching science with the inclusion of examples from non-Western cultures	Stanley and Brickhouse, 1994; Sutherland and Dennick, 2002; Prakash, 1999	
3. Teaching non-Western cultural knowledge as well as, or instead of, science	Aikenhead, 2001; Rowland and Adkins, 2003; Snively and Corsiglia, 2001	The cross-cultural perspective
4. Teaching how the nature of science compares with the nature of IK	<i>i. Teaching the debates as science:</i> Stanley and Brickhouse, 2001	The multicultural perspective
	<i>ii. Teaching science with awareness of the debates:</i> Cobern and Loving, 2001; Gough, 1998	The pluralist perspective

However the approaches might be classified, labelled, supported or not, the important question to ask is what guidance the multicultural science education

debate provides for Pūtaiao, as a form of science education based on Kaupapa Māori aspirations for Māori students?

Firstly, there are important differences between the classroom contexts covered by the literature reviewed above, and those relevant to the Pūtaiao curriculum, the most obvious of these being the medium of instruction. Very little of the literature concerns science classrooms and schools where the lingua franca is not English but an indigenous language. The lack of a language component keeps the focus on changing the content or discourse of science education, an objective which becomes obscured, in Pūtaiao curriculum development, behind the enormous language task. So these differences, while limiting the relevance to Pūtaiao of the international literature, also offer advantages to the investigation of the 'knowledge issues' arising in Pūtaiao education (see Wāhanga 1.2).

Secondly, politics and philosophy are clearly very important in determining what and how knowledge is presented in the science curriculum. This importance, in my own experience, is not apparent in current mainstream **or** Māori-medium science education praxis, such as teacher training, professional development, and curriculum projects.

In terms of philosophy, Loving (1997) described the appeal by the multiculturalists to postmodernism as going to the opposite extreme from the excesses of positivism, such as teaching 'final form science' (Duschl, 1990), and looked for a balanced view:

To reduce all that has come to be known as good scientific explanation to the same category with myth, mysticism, belief, personal agendas, or commonsense notions of the world is not supported by the history of science. While there may not be one inductive (or deductive) scientific method – the all-too-familiar lockstep list on chalkboards across America – there are unique aspects to what successful and good science must do to justify its explanations that involve reasoning and public discourse, testing and retesting, trying to confirm or find fallible with rigor, making results public using rational arguments, or using mathematics and statistics when appropriate to strengthen or weaken. These ways did not come easily to humans. (Loving, 1997, p.439)

The word doing most discursive work in this quote is perhaps the last ('humans'), since it simultaneously includes and silences the key question of *which* humans (Noddings, 1994) benefit from, and control the future of, science.

Edward Said (1993) discussed the politics of knowledge, noting ‘on the national and intellectual level the problems are very similar’ (p.310), giving a postcolonial version of Loving’s comments on the value of science:

The whole effort to deconsecrate Eurocentrism cannot be interpreted, least of all by those who participate in the process, as an effort to supplant Eurocentrism with, for instance, Afrocentric or Islamocentric approaches ... these clamorous dismissals and swooping assertions are in fact caricatural reductions of what the great revisionary gestures of ... anti-imperialist resistance originally intended. For such gestures it ... was always a matter of opening and participating in a central strand of intellectual and cultural effort and of showing what had always been ... part of it, ... but which had been either denied or derogated. (Said, 1993, p.311)

So, in this topic, it has become a common complaint: science education (and the mainstream in general; Jocks, 1998) caricaturises indigenous knowledge; scientists (Pigliucci, 2002) and science educators (Hadi-Tabassum, 2003) caricature postmodernism; postmodernists caricature science (Loving, 1997); new ethnocentrism caricature anti-imperialism (Rowland and Adkins, 2003); and reification and essentialism caricature indigenous ethnicity (May, 2001).

The process of Pūtaiao curriculum development must take heed of the multicultural science education debate, and avoid becoming trapped by the extremes of either positivist or postmodernist philosophies. This conclusion echoes the recommendation from the previous chapter (p.63) for an ‘eclectic’ or ‘pragmatic’ approach. To return to the questions posed at the start of the chapter, a preliminary conclusion is that science is **both** universal **and** cultural (see also Wāhanga Tuarima). The notion of ‘multicultural science’ is problematic, given the lack of resolution over how it is to be defined, but the above review has also problematised the term ‘Western science’. In order to reform the idealism of current representations of science in the curriculum, change is needed at the level of curriculum, with the resulting changes this would entail for pedagogy. This addresses the question of ‘knowledge content’ in Pūtaiao, signalled in Whika 1 (see p.5; the language questions of Whika 1 are addressed at the end of Wāhanga Tuawhā).

So far, several dialectical polarities in science and science education have been identified:

- scientism versus anti-science
- universalism versus multiculturalism

- positivism versus postmodernism.

Such binary oppositions are prevalent in this topic, with yet more still to be introduced. It is time to leave the specific field of multicultural science education research, and move into wider ‘theoretical landscapes’ (Salmond, 1982), to further explore the basic notions and questions which have been raised in relation to Pūtaiao curriculum. The next chapter examines more general debates in curriculum, identity, culture, and language, highlighting several further discursive antinomies, relevant to Pūtaiao, in these areas.

WĀHANGA TUAWHĀ

Language, Identity and Representation in Science, Education and Pūtaiao

While multicultural science education grapples with the problematics - political, factual, ethical, epistemological, or a combination thereof – mainstream (or ‘elitist’; Harding, 1993) science education sails on, retaining, along with mathematics, its flagship role in the curriculum. Thus, as William Pinar, William Reynolds et al. (1995) explain, ‘in mathematics and science education, traditional curriculum development still occurs, as these privileged areas still receive significant amounts of government and private grant monies’, in contrast to curriculum in general, where the focus has moved from development to ‘preoccup[ation] with understanding’ since ‘many complexities have entered our conceptions of what it means to do curriculum work ... we are no longer technicians, that is, people who accept unquestioningly others’ priorities’ (p.6).

The implication here that science and mathematics curriculum development is relatively outdated is made more overt in Richard Duschl’s review of the historical ‘failure’ of science curricula, in which he argues ‘one of the factors associated with the problem is, “the fact that developers [scientists] often come from fields outside of education and may be unaware or resistant to the available curriculum research” [citing Connelly, 1972]’ (Duschl, 1985, p.551). Elite levels of funding driven by external demands associated with the knowledge economy, linked with outdated concepts of curriculum and curriculum development, combine in helping to explain why the science curriculum is so resistant to change:

The twentieth century began with nature divided into physics, chemistry, biology and geology by an emerging community of scholars calling themselves scientists, but the century ended with nature viewed as a trans-disciplinary collage by communities of engineers, technologists, scientists and funding agencies. The twentieth century began with the high-school science curriculum divided into the content of physics, chemistry, biology and geology, taught to an occupational elite. The century ended with a curriculum that adhered largely to its nineteenth-century roots, in spite of many innovative attempts to change it. In short, school science resisted co-evolving with western science during the twentieth century. This successful resistance suggests that school science must somehow be serving the interests of dominant stakeholders who enjoy social, economic and political power in society. (Aikenhead, 2000, p.257)

While learning science is clearly important in its own right, the subject matter, as traditionally presented in the school curriculum, lends itself to ‘correct or incorrect’ methods of teaching and evaluation, (Doll, 1998), and avoids the ‘messy’ social/ethical dimensions of ‘real science’ (Gough, 1998). It is possibly also for this reason that science (along with mathematics) has proved suitable to play a gate-keeping role in an increasingly technicist (see fn.22, p.62) notion of education.

Duschl’s review of the then ‘contemporary crisis in science education’ is now over 20 years old (Duschl, 1985). At that time, he viewed the problem as stemming from around 1960, at the beginning of the space race era. Similarly, echoing the discussion of scientism in Wāhanga Tuarua, William Doll (1993) notes this was when modern science ‘expanded from a discipline or a procedure into a dogma’:

Such *adoration* of science, its deification, probably reached its height of influence in the early 1960s, shortly after Sputnik and just at the beginning of the curriculum reform movement. (Doll, 1993, p.2, original emphasis)

At that time, scientists were put in charge of science curriculum development, but ‘ignored developments in the history and philosophy of science which have been shown to have significant implications for science education’ (Duschl, 1985, p.551) in favour of teaching ‘science as inquiry’ in ways that reinforce ‘scientific ideology’, and have proved difficult to dislodge in subsequent developments, such as multicultural science education (see Wāhanga Tuatoru). Here, Duschl uses the term ‘science ideology’ to mean a misrepresentation of the contemporary canons of philosophy of science, which differs from the usage by Canguilhem as ‘outdated science’ (discussed on p.54). Duschl’s usage of ‘science ideology’ is synonymous with ‘scientism’ as defined above (p.50).

Duschl traced the vast increase in funding for science curriculum that occurred during the period of these science community-driven ‘reforms’. This is significant, because the trends discussed in the mid-1980s by Duschl continue today. The current ‘troubling decline’ in tertiary science enrolments, which leads to a shortfall in projected numbers of scientists (feared to threaten US/UK dominance on the world stage - see the Young, 1989, quote below), is currently reported in terms of ‘crisis’ in both the US (Science and Engineering Indicators

2004, National Science Board; Jackson, 2004) and UK (Curtis, 2003) – for which, unsurprisingly, the remedy called for is more funding for science education.

Postmodernism and Multiculturalism: Oppositional Politics of Knowledge

When postmodernist ideas address the ethical and political questions over the use of science, education, or other dominant discourses as power, they are relevant to Māori interests (Webster, 1993a; 1993b). Doll (1993), for example, while acknowledging the lack of consensus on what postmodernism is, or what it implies for education and curriculum, suggests that ‘a *critical* reappraisal of modern modes of thought’ (p.5, my emphasis) is a key element of postmodernism. In contrast, surveying the meanings that ‘gather round’ the term, Dick Hebdige (1996) lists the following types of postmodernism: neo-conservative, anti-modernist, critical, and ludic. Of these, only ‘critical postmodernism’ (defined by Hebdige as ‘all those strategies which set out to dismantle the power of the white male author as a privileged source of meaning and value,’ p.178) is clearly aligned with Kaupapa Māori, since the other three versions do not necessarily question power and privilege.

McLaren (1995) suggests using the adjective postmodern ‘only in its most general sense’ to refer to ‘the cultural logic or sensibility currently organising aspects of everyday life’ (p.13). Here the term postmodern is used primarily as a signal of recognition that ‘the modern world is now a thing of the past’ (Toulmin, 1982, p.254). As Robert Young (1990) puts it:

Postmodernism can best be defined as European culture’s awareness that it is no longer the unquestioned and dominant centre of the world. (p.19)

Robert E. Young (1989) makes a more pointedly political observation:

the spectre of a shift in the geo-political centre of gravity to a point somewhere between China, Japan, and India shrieks its way through neoconservative demonology. (p.50)

In these observations, while resonating with the theme of ‘de-centring Eurocentrism’, postmodernism appears to refer primarily to an era in **time**, meaning something like ‘after modernism’ (Peters, 1996). Posited from a Euro-American perspective, it calls into question the relevance of postmodernism to a researcher operating in a non-European cultural paradigm such as Kaupapa Māori research. It supports a conclusion that a better qualifier for ‘science’ in Pūtaiao may well be ‘critical’ (or perhaps ‘poststructural’, see p.66), rather than

‘postmodern’. Critical viewpoints (as discussed in Wāhanga 1.3, p.7), are primarily concerned with the politics of knowledge/power, concerns which are central to a Kaupapa Māori perspective.

In the multicultural science education literature (Wāhanga Tuatoru), postmodernism is either enlisted or demonised, as suits the author’s purpose, often without adequate definition as to what notion of postmodernism is being invoked. For example, David Blades (1997) uses postmodernism to explore lack of change in science curriculum reform projects in Canada, while Hadi-Tabassum (2003) examines postmodernist perspectives in the Latin US science classroom. More commonly, postmodernism has been cited in support of the inclusion of IK in the science curriculum (Prakash, 1999), although the relevance of this argument to Pūtaiao was queried above.

Michel Foucault, despite his frequent citation by other scholars (such as educators, including the first two cited in the previous paragraph) in association with ‘postmodernist’ influences in social science, professed himself unable to understand the meaning of the term ‘postmodernity’, or what kind of problem is common to postmodernist or poststructuralist thinkers (Peters, 1996). Michael Peters describes ‘postmodernism’ and ‘postmodernity’ as ‘catch-all concepts’ (p.34), holding in common an **attitude** (following Lyotard) of ‘an incredulity towards meta-narratives’ (p.54). This is a more useful understanding of postmodernism (than that of era, above), since it allows for the ongoing continuance of the conditions of modernity, and the tension between postmodernism and modernist doctrines at various levels, including Marxism, liberalism, structuralism and positivism.

The link between multiculturalism and postmodernism consists of common central notions in both traditions, prominently the pair of notions of ‘(the decentring of) Eurocentrism’ and ‘incommensurability’. Some regard it as a ‘troubled alliance’ (Webster, 1996), in suggesting that postmodernism is not necessarily in the interests of ‘other’ cultures. For example, noting that ‘ethnic movements avail themselves of the image of their culture appearing in postmodernist theory’, Webster (1993, p.2) concludes that ‘Māori culture appears to have become postmodernised,’ because ‘appearances of contemporary Māori

culture are ideologically separated from the everyday realities of Māori society.’ Webster’s analysis of the Māori Renaissance is discussed more fully below (p.104).

There are at least two ways the notion of incommensurability is relevant to Pūtaiao curriculum. Firstly, the ‘incommensurability thesis’ is debated in epistemology of science, a thesis and debate independent of (while perhaps foundational to) the question of postmodernity (Hoyningen-Huene and Sankey, 2001). Secondly, there is the postmodernist notion of the ‘differend’ (Lyotard, 1988), which signifies the presence of discontinuous or incommensurable discourses, i.e. discourses that are unable to be judged according to the same criteria, a description clearly applicable to the dissonance between Māori and Pākehā culture. ‘One side’s legitimacy does not imply the other’s lack of legitimacy’ (ibid p.xi). As worldwide transport and communication networks have developed, the number of contacts/conflicts between such incommensurable discourses has skyrocketed, as a state of globalization has become increasingly realized (King, 1991; Jesson, 1999; Fitzsimons, 2001). Thus, arguments around incommensurability and identity, or difference versus sameness, arise at various levels in considering Pūtaiao, namely: curriculum content and pedagogy, language and thought, science and philosophy, ethnicity and culture.

This means, as noted above, **binary oppositions**²⁵ are rife throughout this topic. In one interesting example, linguist Sydney Lamb describes a basic dualism in ‘cognitive style’ (and hence philosophical approach) as follows:

To put it simply, we may say that “lumpers” and “splitters” operate in different cognitive styles. As cognitive style manifests itself broadly in thinking patterns, we can expect to find correlations between views in one area and those in another. Consider the three contrasts ... to illustrate “core philosophical differences”: “absolutism vs. relativism; monogenism vs. polygenism; “lumpers” vs. “splitters.” We may conjecture that absolutism goes with “splittism” and that relativism correlates with “lumpism.” (Lamb, 2004, p.496)

Lamb relates these observations to the growing understanding of the purposes and functions of the left and right hemispheres of the brain, and how these co-operate in the tasks required by language: the left brain ‘is the home of that part of linguistic structure - most of that traditionally studied by linguists - that operates by making sharp contrasts’ (p.500).

²⁵ A favourite theme of John Dewey (1938; also see Peters, 1977).

Thus it is very important for linguistic communication that /p/ be distinct from /b/, and even segments which are intermediate phonetically between these two are perceived as one or the other - binary perception of continuously varying phenomena. (ibid)

The right brain takes care of ‘aspects of phonology’ ‘includ[ing] intonation, stress, duration of vowels - phenomena where sharpness of contrast plays a more peripheral role’. Other right brain functions ‘include not only prosodic features but also pragmatics and much of semantics’ (ibid), ‘holistic thinking as well as intuition’ (p.501). Lamb concludes by speculating that ‘lumper-thinking is right-brain driven, while splitter-thinking, like most thinking that goes on in academic circles, relies heavily on left-brain activity’ (p.502), and calling for greater acceptance of each thinking type by those of the other.

Pūtaiao as ‘Bricolage’

Lamb’s ideas, while speculative, provide an encompassing, unitary view on many of the questions underlying Pūtaiao, although their main purpose here is to illustrate the widespread occurrence, and the futility, of binary oppositions, or dialectical polarities. In the sense that such arguments imply an acceptance of one view or the other as ‘truth’, this betrays a commitment to grand narratives, hence returning to the discursive concerns of postmodernity, raised above. To investigate the question of postmodernity, Peters (1996) reviewed the debate between the Frankfurt School critical theorists, especially Habermas, and the French poststructuralists, ‘principally Jacques Derrida, Foucault and Jean-François Lyotard’ (p.33). This debate is relevant to the argument for favouring ‘critical’ over ‘postmodern’ as the more useful perspective on (or qualifier for) science, for the purposes of Pūtaiao curriculum development. A postmodernist attitude, nonetheless, points to the wisdom of incorporating aspects of both sides of a duality - a ‘both-and’ approach, in contrast with ‘either-or’ thinking (lumper-rather than splitter-thinking? - Lamb, 2004). It echoes the recommendation by Smith (1995) for an ‘eclectic’ approach to science education for Māori students (see p.63 above), and refines the understanding of ethnicity (discussed in Wāhanga Tuatahi above) as a ‘tension or balance’ between the poles of primordialist and situational understandings. In the postmodern view, compromise between opposing positions is envisaged as a ‘bricolage’, where elements from both sides of a dualism intermingle (with hybrid strength), rather than as a theoretical ‘balancing act’ (with the limitation of movement, and danger, that implies). To apply postmodernism to my topic in this way, while simplistic, is

useful in providing a richer perspective on how to regard and negotiate the various important dialectical polarities arising in the discourses related to Pūtaiao.

4.1 Cultural Politics and Pūtaiao

A Kaupapa Māori approach to science education requires an informed view of the sociopolitical relationship between Māori and Pākehā, and how this impacts on the Pūtaiao curriculum via the debates in knowledge and language. A sociopolitical lens focuses specifically on notions such as ethnicity (Hall, 1991), nationalism (Eriksen, 2002) and globalisation (King, 1991). These notions impact significantly on the multicultural science education debates examined in the previous chapter, yet there are often treated superficially, such as in the essentialising treatment of indigenous students in science education research (p.79 above).

Multiculturalism and the Canon

The oppositional discourse, in its attack on the canon, in its construction of countercanons, in its flows and molecular structures, runs the risk of becoming what it opposes, dissolving all texts, secular and canonical, into an endless stream of interpretation within which a secure foothold, however tentative, is unlikely. ... How do we avoid the fixity of form and the dissolution of formlessness? (Taubman, 1993)

Pūtaiao has received little previous attention in sociopolitical debates, so analogies are important in reading the literature on culture. The first of these involves the similarities between Māori cultural politics and those of other indigenous ethnies, which underpin the international indigenous academic identity (Stewart-Harawira, 2005), founded on early work such as that of Frantz Fanon (1965). Thus, for example, Stuart Hall's comments on culture, below, are considered relevant to the contemporary Aotearoa New Zealand situation.

Also, the literary canon plays an analogous role in the language debates to that played by the Standard Account in science (p.48 above). The link is the Eurocentric notion of 'the best that has been thought and known' (West, 1993). Canons of literature have featured prominently in the postcolonial scholarship on notions of **authenticity** and **representation** (Spivak, 1987; Hall, 1991; Said, 1995).

To what extent do the cultural politics of literature apply to science? In terms of Bourdieu's (1991) notion of forms of symbolic power, all languages are theoretically equal, separate constructions arising from the characteristics of the species (Sapir, 1933 p.7; Ricento, 2000, p.12). Hence English is argued to be the 'accidental' language of science (Kaplan, 2001). By contrast, W-science is a pan-human construction, to which all cultures, not just the British (or Western), have contributed (irrespective of the prevalent ideological narratives of its representation). IK is elided with modern science when this cross-cultural distinction between the debates in knowledge and language is not recognised. To answer the above question, while access to canons of both literature and science is controlled by interpersonal power in many ways, science knowledge is fundamentally constrained by our ability to measure the space-time continuum in ways that literature or art is not (Spivak, 1990). Perhaps the space-time dimensional scales within which science operates can be considered its essential, foundational 'text' - the equivalent of the 'No!' ('primal father') which Taubman (1993, p.37) suggested forms the 'canonical unconscious' and, in so doing, structures the literary canon. For this reason, in Wāhanga Tuarima, 'space and time' are considered as fundamental, cross-cultural science concepts.

This analogy is useful in discussing the wider multicultural curriculum debate, much of which has arisen within the discipline of English (and its sub-disciplines such as Film Studies), with literary criticism playing an important role in the (post-)disciplinary history of Cultural Studies (Hall in Morley and Chen, 1996, p.401). The analogy allows a more productive reading of the language ideological debates concerning questions of authenticity and translation of knowledge content, since the published studies on these questions have generally focused on literature rather than science (Blommaert, 1999). Besides suggesting how the two debates (in knowledge and language) come to occupy a similar position in relation to cultural politics, the analogy also highlights an important difference between the two. The 'Law of the Canon' (Taubman, 1993, p.45) is dynamic, changing as society changes (in detailed outline, if not in efficacy), but the laws of thermodynamics, while permanently open to challenge and refinement, are not (as the prospect of global warming seems ready to remind us).

The literary canon is a representation of our culture, thus of our identity (Pinar, 1993, p.69), our collective self. The scientific canon is a representation of the world/environment, the not-us (the known in relation to the knower). This metaphor suggests how the literature on culture in the curriculum can be viewed from the perspective of Pūtaiao. Multiculturalism in the science curriculum is rightly concerned with the ‘unconsciousnesses’ of science that produce sexist, racist and scientistic thinking and practice; but this does not necessarily call into question the central canons of science knowledge. The canon of literature, however, is comparatively more determined by politics or interpersonal power. This is why the methods that involve changing the canon, by which multicultural reform has operated at the level of the classroom to achieve positive results in other curriculum areas, such as English (e.g. Macbeth in Māori costume) or Art programmes drawing on multicultural traditions, are unavailable to science education. Canon considerations also help explain the difficulty with basing Pūtaiao curriculum on the science found in Māori contexts, such as the chemistry of rongoā (traditional plant remedies). Although making rongoā in the science classroom would be useful in early chemistry learning (e.g. to illustrate solubility behaviour), to go further into the chemistry of rongoā requires much more advanced knowledge, while not teaching central concepts of chemistry (i.e. the canon), as is generally considered important in school science. This is why attempts to base science education on, for example, Māori contexts, often result in ‘soft options’, in which the social and ethical dimensions are covered at the expense of the canonical science knowledge (Cajete, 1999; Phillips, 1987).

Identity and the Politics of Representation

Ideas of culture and ethnicity depend on the foundational notion of identity. Australian authors Peter Ninnes and Greg Burnett (2001) situate their ‘research on science textbooks [in] a larger project concerning the representation of diverse knowledges and identities’ (p.26), in this paper focusing on Aotearoa New Zealand science texts. Our local science education is thus a useful context for their representational research. Five ‘aspects of postcolonial theory considered particularly relevant to an analysis of representations’ (Ninnes and Burnett, 2001, p.26) are listed below, the first three being described as ‘paradigm notions’, and the last two as methods, which are useful in a ‘postcolonialist stocktake’:

1. ‘Colonial practices continue ... in Aotearoa New Zealand’ including control of Māori through representation in curricula;

2. Representation of Māori (and other minority groups) is typically essentialist (reifying);
3. Construction of cultural binaries ‘exaggerate difference between groups and mask diversity within (i.e. homogenise) groups’;
4. Exoticizing ‘process[es] of constructing the “other” (Said, 1978)’ (p.27) can be explored;
5. The use of textual devices (such as past tense) can be analysed and exposed. (p.26-7)

These points are relevant in the cultural politics of Pūtaiao, and in the research methodology, i.e. Kaupapa Māori discourse analysis, adopted in this thesis (see analysis of Firth, 1972, in Wāhanga Tuarima). Their following comments reflect the problems faced by multicultural science education, explored above in Wāhanga Tuatoru:

While the curriculum and the textbooks display evidence of substantial efforts to represent diverse knowledges, our analysis suggests this is primarily a means of appropriating these diverse perspectives for the cause of promoting and teaching western science, which in turn acts to control and subjugate these knowledges ... the spatial positioning of particular ‘other’ knowledges appears to act to relegate them to a lower status than ‘western science’ ... Finally, the textbooks and the curriculum tend to adopt unitary or constructivist views of science (or both), and rarely address issues of power, colonialism, imperialism, race and so on ... there clearly needs to be a greater effort to examine the historical and political relationships between science and Māori. (Ninnes and Burnett, 2001, p.35)

Various delineations of the underlying notion of ‘identity’ have been proposed. Peter Taubman (1993) provided a succinct, useful model, comprising ‘three separate but interactive registers’ (p.288) which he uses to comment on approaches to multicultural and antibias curriculum. His model is summarised below:

Whika 8: Taubman’s Model of Identity

IDENTITY <i>3 intersecting registers:</i>	Characteristics of each register:	Drawbacks, consequences of losing dialectical tension:
Fictional	Identity as a construct of language; appeals to poststructuralism (Lacan, Foucault, Derrida)	Alien, alienating and oppressive; ‘bloodless’, ‘quicksand’ meaningless, irrelevant
Communal	Ground for action ‘identity in motion’ sense of community cultural literacy	Becomes fixed, immobile; monumentalisation; essentialism; new forms of oppression
Autobiographical	Personally meaningful - responsibility, non-determinism; the existential subject (Habermas, Stern)	Naïve, limited, incomplete; leads to self-interested individualism and empty transcendence

Although the registers cannot be collapsed onto one another, they can be held in a dialectical tension with each other. They are *only* useful if they are in tension with each other. If multicultural or antibias education is introduced from within only one register, the result is a distortion in thought and action. (Taubman, 1993, p.303, original emphasis)

Taubman contends that most approaches to multicultural and antibias education, while grounded in the communal register of identity, have fallen into the ‘trap’ by ‘relinquish[ing] the tension’ thus becoming ‘the frozen identity emerging in the first register’ (p.299). He also employs the model to analyse the criticism of multicultural and antibias approaches by certain ‘conservative educators’ as using the autobiographical register from which to decry the ‘particularism’ and ‘ethnic chauvinism’ of multicultural education, which they claim ‘denies the individual and the transcendental humanity of the subject’ while unconsciously fixing the other two registers in the dominant (white male) culture, termed ‘the common culture’ (p.302). ‘It is a majoritarian particularism masquerading as universalism’ (May, 2001, p.309). Therefore,

current approaches to multicultural and antibias education are simplistic and flawed. Not only have they failed to address how identity is formed, what it might mean, and how it functions, but they have left unexplored the way the approaches themselves consciously or unconsciously are used to create identities. (Taubman, 1993, p.287-8)

Wlad Godzich assigns terms to various notions of agency in identity, according to era (cited in McLaren, 1995, p.237-8):

- pre-modern - persons
- modern - individuals
- postmodern - subjects.

For example, in traditional, pre-modern Māori society, the connections in the social fabric (whakapapa) were known for most people, and considered vital in relationships - in other words, they were unique ‘persons’. This contrasts with the modern view, which envisages individuals as interchangeable ‘atoms’ in the ‘machine’ of society. This view holds that on a ‘level playing field’, individuals who are well socialised and have marketable skills can succeed. The modern identity still prevails, but is morphing increasingly and unevenly towards forms of postmodern identity. The postmodern identity is composed of subjectivities of ‘production and consumption’ – ‘exploited not for collective ends but for private rituals of self-fashioning’ (McLaren, 1995, p.238). These ideas are particularly relevant to teachers because of the important role played by schools in maintaining and reproducing students’ ideas about identity, society and culture.

McLaren argues for the importance of teacher awareness of these issues, as part of ‘critical pedagogy’. His challenge to schools is that they should not become ‘ultimately reproductive mechanisms for new forms of subjectivity based on a merging of identity and the fetishized consumer object’ (p.238-9).

Part of the colonising message about identity to Māori was ‘You will never be like us’ (see p.48). Echoing this, Hall (1996) identifies the ‘mark of difference’ as the essential meaning of ‘black’ in ‘black popular culture’, which by analogy can also be considered the ‘essential meaning of Māori’ in notions of ‘modern Māori identity’. To Hall, ‘black’ (or ‘Māori’) signifies the ‘historical experience’, the ‘distinctive cultural repertoires’, and the ‘counter-narratives’. Hall argues that cultural politics needs to move beyond the dialectical ‘zero-sum game’ within which the term ‘popular culture’ acquires meaning in the

mapping of culture between the high and the low [in] four symbolic domains ... in psychic forms, in the human body, in space, and in the social order. ... It is therefore necessary to deconstruct the popular once and for all. There is no going back to an innocent view of what it means. (Hall, 1996, p.468-9)

Hall uses ‘innocent’ to describe a view which fails to acknowledge that popular culture is that which is excluded from the canon (connecting it to the discussion of canons above). Hall goes on

to insist that in black popular culture, strictly speaking, ethnographically speaking, there are no pure forms at all. Always these forms are the product of partial synchronization, of engagement across cultural boundaries... Always these forms are impure, to some degree hybridized from a vernacular base... They are not the recovery of something pure that we can, at last, live by ... they are what the modern is. (Hall, 1996, p.473)

Hall’s comments concern aesthetics – literature, cuisine, film, music, etc – not science. Nevertheless, the canon analogy developed above suggests ‘modern science’ and ‘IK’ have come to occupy equivalent positions in the debates, as high (sanctioned/scientific) and low (popular/customary) knowledge, respectively.

Deconstructing the Dialectics of Authenticity

Some authors attempt to argue that Māori culture and ethnicity is constructed (Hanson, 1989; Rata, 2003), therefore not ‘real’ (authentic), so it can/should be disregarded/dismissed. An opposing, more widely supported view holds that ALL human culture is constructed, and all ethnicities (Hastrup, 1982); therefore all culture is authentic (Levi-Strauss, 1977). This latter position is more pro-Māori than the former, yet nevertheless it fails to provide grounds for evaluating cultural

projects and developments, such as Pūtaiao. The problem remains of defining the required criteria. Both views tend towards the extremes of either instrumentalism or relativism, which are both unhelpful, as explained below, to the interests of indigenous ethnies, such as Māori.

Instrumental-only thinking with regard to culture tends to value its economic worth exclusively, with the resultant losses of smaller cultures, concomitant with globalising trends throughout the last three to four centuries. Cultural relativism, while seemingly opposite to instrumentalism, leads to the same result, though less forthrightly, since if all cultures are thought of as being of equal 'value', then what 'counts' in the world is something other than culture (Borg, Mayo et al., 1998). This is analogous to the 'pluralist sciences' position which holds that all cultural knowledge systems are of equal value, yet fails to disturb the hegemony of, or even to critique, the dominant form (Loving, 1995).

This polarity is expressed in general terms as **cultural relativism** versus **cultural imperialism** (out of which instrumentalism arises). Like the science dipole of scientism and anti-science discussed above, both extreme positions are hostile to Māori or indigenous interests. Putnam acknowledges this when he notes relativism's 'respectable appeal [to] those who fear that the alternative to cultural relativism is cultural imperialism' (Putnam, 2004, p.45). But his main point is that the dipole is reinforced (if not formed) by the 'fact/value dichotomy' characteristic of W-science, and influential throughout most domains of a 'scientific' culture:

recognizing that our judgments claim objective validity and recognizing that they are shaped by a particular culture and by a particular problematic situation are not incompatible. And this is true of scientific questions as well as ethical ones. The solution is neither to give up on the very possibility of rational discussion nor to seek an Archimedean point, an 'absolute conception' outside of all contexts and problematic situations, but - as Dewey taught his whole life long - to investigate and discuss and try things out cooperatively, democratically, and above all *fallibilistically* (ibid, original emphasis).

In other words, for both science and culture, Putnam argues that viewing the situation in terms of oppositional either-or polarities is unhelpful and unrealistic. In education, this cultural dipole is listed as one of seven characteristics of 'traditional pedagogy' (Young, 1989 p.96), which is defined here as 'teaching a pre-decided curriculum':

Whether this curriculum is the curriculum of the establishment or a subversive curriculum, its pedagogical structure is the same. It displays teaching methods [which ... either] conceive of the world from the standpoint of a dominant culture or dogmatically reject the possibility of evaluative comparison of cultures altogether, that is, they embrace either cultural imperialism or relativism (Young, 1989, p.96-7)

Said suggested ‘the real issue is whether indeed there can be a true representation of anything, or whether any and all representations, because they are representations, are embedded first in the language and then in the culture, institutions, and political ambience of the representer’ (Said, 1978, p.272). Authentic representation remains a focus of concern in indigenous language education literature (Henze and Davis, 1999). It is problematic in relation to both the language and knowledge content of Pūtaiao programmes. Underlying both of these, however, as the above discussion highlights, is the question of authenticity of modern Māori identity, on which the existence of KKM depends, and which KKM in turn supports. While the ‘identity’ of KKM depends on a specific point of view, the ‘identity’ of the science knowledge content of Pūtaiao programmes assumes a universal truth in speaking for all. The philosophical disjunctions between these various levels of debate concerning identity, authenticity and representation have yet to be widely debated or addressed by practitioners, policymakers and developers of Pūtaiao.

Traditional Māori knowledge, social structures, and language have been increasingly lost since colonisation began, yet Māori cultural roots remain to some degree intact. Despite widespread use, such as in ‘Kaupapa Māori research’, the term ‘Māori’ is understood to be a ‘construct’ in the sense of a recent identity concept, contingent on colonisation (Papesch, 2006). We recall that in traditional reo it takes a small ‘m’ (see quote on p.48) and means ‘ordinary’ or ‘normal’, as in wai māori (fresh water) as opposed to wai tai (seawater). Wiremu notes its usage for Māori people, and as an adjective meaning ‘belonging to Aotearoa New Zealand’, started in around 1850 (Williams, 1971, p.179).

Along these lines, a more ‘authentic’ way for me to describe myself is through my identity of iwi (Ngāpuhi), hapū (Ngāti Kura), and marae (Te Tāpui, ki Matauri i te Taitokerau). My ‘race’ or ‘ethnicity’ as Māori may be an ideological construct, along with the notion of ‘race’ itself, but my iwi identity is socially constructed and maintained through ‘processes of discourse’ known as whakapapa (T. Smith,

2000), based on genetic history (see also John Rangihau, cited in Roberts, Norman et al., 1996, p.8). In this sense, Kaupapa Māori concepts of ethnicity retain some adherence to the primordialist view (see discussion p.11), without, of course, regarding primordialism as an adequate concept of ethnic identity. In terms of Taubman's model of identity (Whika 8, p.99), modern Māori identity draws *more easily* than modern mainstream identity on the communal register; while in Godzich's terms (p.100), modern Māori identity retains a *relatively greater* degree of pre-modern agency or 'personhood', in comparison with the contemporary Aotearoa New Zealand mainstream identity. These are important comparisons in notions of 'authentic' identity.

Thus the notion of authenticity, applied to aspects of human culture such as language or ethnicity, makes sense only as a relative, rather than absolute, concept; so while some particular examples of te reo me ōna tikanga might usefully be regarded as more or less authentic than others, it is impossible to make 'objective' binary judgements (as 'authentic' or 'inauthentic'). This argument for authenticity does not apply, however, to the canon of basic laws of science, which apply equally to all inhabitants of this planet. This invalidates the science-IK high-low bipolarity described above (p.101). It also highlights the importance of the boundaries of science, and particularly of its canon, in terms of its legitimate concerns, and its effects in society.

Marketing the Māori Renaissance

It is commonplace to refer to the 'Māori Renaissance since the early 1970s' (Webster, 1998, p.14) in accounts of the improvement in official attitudes towards the Treaty of Waitangi, including its widespread acknowledgement as basis for the legal rights of te reo me ōna tikanga (Nepe, 1991, Harlow, 2003). On the other hand, some commentators suggest the Māori Renaissance exists primarily at an 'ideological' level, supported (if not engineered) by colonialist interests, in order to draw attention away from the lack of 'real' change for Māori (Webster, 1993a; Webster, 1993b). As a population, Māori, while growing faster during these recent decades, compared with Pākehā, continue to be over-represented in the negative social indices (Mulholland, 2006). Paradoxically, 'some of these indices have actually worsened during the Renaissance' (Webster, 1998, p.25). Webster gives as example the rates of readmission for serious psychotic illnesses, which

for Māori increased by 40% over the decade 1981-1990, while Pākehā rates fell by almost one quarter (ibid).

It is also suggested that renewed Māori protest from approximately 1975, particularly the Springbok rugby tour protest in 1981, effectively stimulated the social conscience of mainstream Aotearoa New Zealand (Walker, 1996; Webster, 1998). This may have been part of a growing international concern for ethics during the 20th century, particularly following World War II (Spoonley, Macpherson et al., 2004). Research suggests, however, that racial prejudice in Aotearoa New Zealand has not actually disappeared, but has become more concealed (the 'geological' metaphor of subterranean forces; Wetherell and Potter, 1992, p.208). Relatedly, discussing 'the cultural politics of guilt,' Avril Bell (2004) illustrates how dominant positions of both refusal and acceptance of guilt by Pākehā allow 'the avoidance of engagement and responsibility' (p.90), both hence proving futile for Māori interests.

Thus, the 'Māori Renaissance' has prominently featured Māori-medium education and media, but shows little sign of translating into improvement of the negative statistical indices of the Māori population overall. Evan Poata-Smith (2004) details how 'the vast majority of Māori families have borne the brunt of the economic restructuring' (p.60) of the last two decades. Departure of manufacturing industries to third world countries, and increasing mechanization in agriculture and other primary industries, are recent capitalist trends which have significantly increased unemployment amongst Māori and Pasifika people. New social scourges, such as 'P' and neighbourhood gaming, have further debilitated these sectors of the population.

Steven Webster traces the development of a 'contradictory and sometimes ideological' relationship between perceptions and realities of Māori culture back to the notion of 'Māoritanga' (as a domesticated 'race pride') developed by 'anthropologists and administrators' in the 1920s (Webster, 1998, p.74).

If a better understanding of contemporary Māori society is to be achieved, Māori culture must not be understood abstractly in the Romantic tradition as 'a whole way of life' somehow unique, integral, harmonious, and Other than that supposedly led by European societies. This preconception sometimes obscures and is even a mystification of the other side of Māori culture as it is lived, more or less consciously by most Māori in their daily lives. ... Few

Māori benefiting from the Māori Renaissance are not painfully aware of this other side of Māori culture, and aware that regardless of their more privileged status and opportunities, it is their culture too. (p.48-9)

Webster's analysis problematises the 'Māori Renaissance', but does not clearly explain why state education policy reversed over 60 years, from paying teachers to ensure children did not speak Māori, to paying teachers to ensure that these same people's mokopuna (grandchildren) speak only in Māori. Thus, a kaumātua, speaking at the opening of a new kura (school) in Auckland in 1993, recalled his own childhood experience in the 1930s of being punished for speaking his home language (labelled 'swearing' by teachers), and contrasted this with the rule of 'kōrero Māori anake' (speak Māori only), which today operates in Kura Kaupapa Māori.

Foucault's perspective on power in society provides a cogent understanding of this remarkable change (Foucault, 2001). Foucault explains power as discourse, likened to a conversation that power holds with itself (not, as I might previously have thought, between 'more powerful' and 'less powerful' in society, a model of discourse essentially as a hui or debate). So what change in the **self-image** of the Aotearoa New Zealand government would account for the changes in its support of te reo me ōna tikanga over the last one or two generations, yet still explain the marginalised position today of most Māori in society? To answer this, I will recapitulate the history of the Māori Renaissance, following Webster's (1998) analysis, and borrowing McLaren's (2005) ruthless political cynicism, from the perspective of Pūtaiao.

The Treaty of Waitangi was signed in 1840, shortly before the major period of armed struggle between Britain and iwi. In the 1860s, the bulk of military power available to Britain was brought to bear on Māori until they surrendered, and in the process had much of their property confiscated (as punishment for 'rebellion') and turned to needs of the colonisers (Stenhouse, 1999, p.82-3). This historical conjuncture makes it difficult to interpret the Treaty as evidence of sincere British intent to 'share' power with Māori in the new nation of Aotearoa New Zealand. As James Belich (1986) and others have noted, it actually supports a view of the Treaty as device, a way to forestall the interests of other European colonial powers (especially France and Catholicism) and also to prolong, for logistical as

well as humane reasons, the onset of full British military engagement in her distant new colony.

The history of statutory oppression of Māori (in which the Treaty was only one event) demonstrates that Māori were perceived over an extensive length of time as an actual threat to European power. Science played an important role across the entire gamut - institutional, personal, military, philosophical (Harding, 1998) - of oppression of Māori, because social Darwinism was used as rational reinforcement of Eurocentrist policies and practices (Walker, 1996), a role continued by its re-invented 'modern science' (actually, scientific, see p.50) guise of catallactics (Devine, 2004).

During the course of the 20th century, as globalisation was increasingly realised, humanity became more aware of ethical issues, concomitant with development for the first time of the technological capability to destroy itself (and the planet) completely (Hannerz, 1991), and with modern genocide on an unprecedented scale (Gaita, 2002). Today, every government is under the spotlight of the TV camera, and governments' images are of utmost importance. In 1900 it was 'politically correct' to mourn the imminent extinction of the Māori race, talk of 'smoothing down its dying pillow' (W. Buller, 1884, cited in Stenhouse, 1999, p.85). Finally, in 1907, the Tohunga Suppression Act, the most blatant anti-mātauranga legislation of all (Durie, 1996), was introduced – indicating not only that the government finally judged such a law 'safe' (no longer carrying a significant risk of strengthening banned practices), but also that it was still felt necessary (though on largely political/military grounds, not those of 'knowledge/rationality'), to counter the growing threat to the government posed by Rua Kenana (Williams, 2001). Ironically, James Carroll, an MP of both Māori and European heritage, introduced the Bill, and despite reservations expressed by Hone Heke and Apirana Ngata (and possibly others), 'all the Māori MPs supported passage of this legislation' (p.195).

During World War II our new-found national unity was cemented by the successes of the Māori Battalion in defence of nation and Empire. Schools were no longer required to disrupt intergenerational cultural transmission – urban drift and technology had all but completed the process. Webster (1998), discussing this

history, concludes Māori have been ‘sold’ a modern renaissance which is more symbolic than real. Webster’s Marxian analysis indicts educated (and/or naïve) middle-class Māori for conspiring, intentionally or not, to assist the dominant forces of economic exploitation in the hegemonic hoodwinking of the iwi into believing themselves, and the Treaty, re-positioned in the distribution of power in society.

The commitment of the state to these ideological directions in the Maori Renaissance [i.e. its separation from, and contradiction of, Māori social reality] since the early 1980s parallels their reactionary restructuring policies in other social and economic areas. Thus the lie is given to their support of the Renaissance. It was realised that the appearances of the Renaissance served these political interests while obscuring the reality of increasing integration of Maori in capitalist society, either as part of the new elite or, more likely, the increasingly disenfranchised and impoverished. (Webster, 1998, p.156)

But, as the new millennium approached, a different danger to the nation-state arose, one unimaginable at the beginning of the century. Surveys revealed rapid decline in the number of speakers of te reo Māori (Benton, 1997). As international recognition of severe global language and cultural losses grew, by about 1985 a major policy consideration for the Aotearoa New Zealand government became to prevent the extinction of an indigenous language and culture (May, 2005) which had received much international attention for many years (Tuhiwai Smith, 1999). This sensitivity regarding its international image and position forms a coherent reason, according to Foucault’s notion of power, for the ongoing commitment by the Aotearoa New Zealand government to fund te reo initiatives such as Māori-medium education and Māori television. Indeed, the most compelling interpretation under economistic thinking for the 180-degree turn, noted anecdotally above, in policy on Māori-medium education, is the value of the ‘Māori brand’ in the global market. For the brand to continue to be useful might well depend on Māori identity (hence language) remaining extant. Is it merely coincidence that the start of Kura Kaupapa Māori funding coincided with the restructuring of our national economy to better suit the needs of global capital?

The knowledge economy is a challenge to us all. The Māori community, including Māori researchers, businesses, educators and iwi groups need to be up with the play, and be leaders in using knowledge to generate and develop new ideas. The recognition and development of traditional knowledge, including respective rights to this, is also a key issue. (Ministry of Commerce, 1999, cited in Devine, 2001, p.15)

Webster notes how cultural relativity has contributed to the emergence of movements such as Kaupapa Māori:

The convergence of postmodernist interests and ethnic politics has promoted the anthropological principle of *cultural relativity* to market brokering: the more esoteric or rarified the definition of a culture, the more expertise or influence is required to affirm or deny the authenticity of a version. Like high art, Other cultures are a long-term investment. (Webster, 1993, p.237, my emphasis)

In the context of Pūtaiao, the above analysis of its sociopolitical environment calls into question the extent to which government policies for funding Māori-medium science education could ever reflect the same set of interests as those which (individually and collectively) motivate Māori educationalists. Currently, the government provides funding by means of which to contract out to individual Māori educators the bulk of the responsibility for Māori-medium education, a system which, it appears, has in the last few years created a greater disparity for Māori students in mathematics and science education outcomes. ‘With these patrons of Māori culture, who needs enemies?’ (Webster, 1998, p.21). While the government measures its commitment to social equity by the balance sheet of Māori-medium education funding, the ability for those involved (such as myself) to improve this system, in terms of outcomes for students, easily becomes lost in the ‘bigger picture’ - diffused almost to invisibility across institutions and agents concerned with an array of complex and wide-ranging issues. Thus, for example, I find myself writing this thesis, exploring the disadvantages for students and teachers of current purist language policies, whilst serving on the advisory panel for production of a MOE-funded Pūtaiao dictionary, assisting with facilitating the next edition of the Pūtaiao curriculum, and, each December, providing script translation services for markers of NCEA Science/Pūtaiao and Mathematics/Pāngarau examinations.

Quite unlike Māori land, only the shadow of Māori culture can ever go to the Governor.²⁶ ... On the other hand, although culture is in this sense inalienable, by the same token one cannot eat it any more than the Māori can eat the shadow of their land. (Webster, 1993, p.238)

4.2 Science Language

Having attempted to delineate the most cynical pro-Māori view possible on the political context in which Pūtaiao curriculum develops (to face, as it were, the ‘worst-case scenario’ for Māori interests), this section returns to more symbolic

²⁶ Alluding to a kōrero attributed to Nopera Panakareao, a Ngāpuhi rangatira and signatory of the Treaty of Waitangi in 1840, reassuring his people that only the shadow of the land was to go to the Governor, while the iwi would retain its substance - an assessment he soon ruefully reversed (Webster, 1998, p.252).

realms of discourse. As noted in Wāhanga Tuatahi, this topic necessitates a interdisciplinary approach, which includes aspects of linguistics, as well as philosophy, in addition to the more usual sociological educational considerations. This section deals with linguistic issues in **language shift and planning** as they relate to Pūtaiao, starting with an introduction to these terms below, before considering them in the specific language context of the Māori-medium science classroom.

Language planning has been described as an ‘outgrowth of sociolinguistics’ (Luke, McHoul et al., 1993). The literature on LPP (language planning and policy) reflects a form of applied linguistics arising since World War II, which is ‘closely tied’ to postcolonial nationhood (Kaplan, 1990). The field is primarily concerned with the effects of unequal power on languages, which tend to reflect the fortunes of the cultures of their speakers (Wa Thiong'o, 1986), with a few becoming predominant, and many others subaltern, corrupt or extinct. These processes are collectively referred to as ‘language shift’. Māori is one such currently endangered language (Harlow, 2005), for which language planning is necessary in the attempt to halt or reverse the massive shift to English, resulting from colonial processes, including state education.

Language planning is divided into two parts: status planning, or language determination, and corpus planning, or language development (Harlow, 2003). This section focuses on language development: status planning for te reo Māori is more relevant to the discussion in 4.1 above. Language development can be subdivided into 3 aspects: graphisation (or writing system), standardisation, and modernisation. Of these, the language issues in Pūtaiao are mainly those of modernisation (although standardisation is also involved).

In the Kura Kaupapa Māori framework, language policy is generally understood to be reflected in the motto ‘i ngā wā katoa, i ngā wāhi katoa’ (at all times, in all places) (May and Hill, 2005); equally, Te Aho Matua (Education Act, 1989, s.155A) is considered the definitive statement of kaupapa (philosophy). Kiri Powick’s (2001) dissertation, written entirely in Māori (which is worth noting, in itself), is a highly relevant example of Kaupapa Māori research on language policy within revitalisation. The title is ‘Te Aho Matua. Me pēhea te whakahaere i

ngā mātāpono o te wāhanga reo i roto i te akomanga o te Kura Kaupapa Māori?’ [How are the language principles of Te Aho Matua implemented in Kura Kaupapa Māori classrooms?], and it reports a small interview study with Kura Kaupapa Māori teachers. To synthesise the discussion under the heading ‘Te Reo Pākehā’ on p.54-6, Powick discusses two conflicting statements in Te Aho Matua (one indicating introduction of English in the schoolwork at the ‘right time’, the other echoing the above ‘Māori only’ policy) and reports a division amongst Kura teachers as to which they endorse, commenting that this confusion is also a price paid by the children. Acknowledging te reo Pākehā as the language with mana (prestige, power) Powick refers to parents’ worries if their children are not competent in English. Since the research indicates a majority of teachers favour a Māori-only language policy, Powick asks why, if that was the intent, the principles relating to the introduction of English were included in Te Aho Matua:

Mō ngā tamariki, kia rua ngā reo. Ko te reo o ngā mātua tupuna tuatahi, ko te reo o Taiwi tuarua. Kia ōrite te pakari o ia reo ...’ [For the children, there must be two languages. The language of the ancestors first, English second. Fluency in each language must be equal ...]. (Mātāpono 2.2, Te Aho Matua, cited in Powick, 2001, p.56)

This tension in Kura Kaupapa Māori between the aim of revitalising te reo, and that of biliteracy (balanced bilingual literacy), has only very recently begun to appear in the research literature. An example is the description of a transition programme of English literacy for Year 6-8 Kura Kaupapa Māori students, introduced to prepare them for successful learning at secondary school ‘where they may be assessed in English, and found to have serious deficiencies in English literacy’ (Glynn, Berryman et al., 2005, p.434).

English, the Global Language

Recent accounts of the history of linguistic domination of English over te reo Māori include May (2004), Spolsky (2005) and Williams (2001, p.115-175). Ours is but one part of the larger story of how the English language has arrived at contemporary global ‘pre-eminence’, summarized as follows by David Crystal (2003) in his acclaimed book, *English as a Global Language*:

In the 17th and 18th centuries English was the language of the leading colonial nation - Britain. In the 18th and 19th centuries it was the language of the leader of the industrial revolution - also Britain. In the late 19th century and the early 20th century it was the language of the leading economic power - the USA. As a result, when new technologies brought new linguistic opportunities, English emerged as a first-rank language in industries which affected all aspects of society - the press, advertising, broadcasting, motion pictures, sound recording, transport and

communications. At the same time, the world was forging fresh networks of international alliances, and there emerged an unprecedented need for a lingua franca. Here too, there was a clear first choice. During the first half of the 20th century English gradually became a leading language of international political, academic, and community meetings. (p.120-121)

Crystal identifies two more recent events, since 1960, which finally ensured the position of global dominance which English occupies today: the creation of several new countries (ex-colonies) in which English has become the language of independence (e.g. Algeria, Ghana, etc) and ‘the electronic revolution, where here too English was in the right place (the USA) at the right time (the 1970s)’.

The history of the spread and dominance of English over ‘indigenous’ languages around the world is similar in contour to that of science over IK discussed in Wāhanga 2.1 above. There is, however, greater emotional attachment involved in the language debates, compared with those concerning science and IK. ‘There seems to be something about the intimate relationship between language, thought, individuality and social identity which generates strong emotions.’ (p.140).

With regard to the dominance of English, Crystal examines two situations involving ‘strong emotions’: first, pertinent to Kura Kaupapa Māori, ‘the rejection of English’:

It is inevitable that, in a post-colonial era, there should be a strong reaction against continuing to use the language of the former colonial power, and in favour of promoting the indigenous languages. (p.124)

The second example is the ‘official English’ movement in contemporary USA, which seeks to have English legislated as the ‘official’ language, with associated legislation enacted in 27 states by 2002 (p.140). Crystal describes this movement as arising from a backlash against recent movements in the USA to maintain cultural identity including ‘mother tongues’ (Fishman, 1986) and notes that given the polarization and name-calling, it is ‘difficult to see the grounds for compromise’. Linguists have described this movement as ‘a convenient mask for the anti-foreigner feeling’ (Spolsky and Shohamy, 1999, p.256) and a prominent example of ‘moral panic’ (Cameron, 1995).

Preventive Linguistics

Crystal favours the label ‘preventive linguistics’ for the field concerned with endangered or minority languages (May, 2001; May, 2003), covered in *Language*

Death' (Crystal, 2000), the companion volume to that cited above (Crystal, 2003). Other associated terminology (such as 'life', 'purity', 'hygiene') indicates the tendency to anthropomorphise language discussions.

Preventive linguistics is an updated label for the field of 'language revival and revitalization' or 'language regeneration' (Paulston, Chen et al., 1993). This field has generated international scholarship in the past few decades (Grenoble and Whaley, 1998; Fishman, 2001), particularly amongst and in relation to indigenous communities (e.g. Baldauf and Luke, 1990; Hinton and Hale, 2001; McCarty, 1996) with te reo Māori often cited in a role of international leadership (Wilson and Kamanā, 2001). Such cultural and linguistic resistances and resurgences are recent and contested historical processes, united and made unique by common links to poststructuralist and/or postmodernist philosophies, the West/non-West dichotomy, and the conjuncture with economic globalization and its associated Euro-American cultural hegemony. Thus Pūtaiao is part of a wider effort to regenerate (or prevent the 'language death' of) te reo Māori. Linguist Ray Harlow (1993) has commented on the expansion of te reo Māori for mathematics and science education:

Why not, then, follow the international set of terms when turning to Māori? This is not a trivial question. Firstly, ... access to scientific writing in other languages would be easier... Secondly, coinage would be easier. (p.128)

Borrowing is not in itself destructive²⁷ - but there can be no denying the strength of the ideology that places severe restrictions on its use in the present case. This attitude is called purism ... in the case of Māori ... by and large, purism is restricted to the rejection of the[se] sort of loans from English (p.129)

Undue rigour ... has led to the situation, often complained of, that older people, for whom the borrowed terms are the usual words, cannot understand what is being referred to in the language being promoted in schools. The issue of inter-generational mutual intelligibility is not a trivial one for Māori language planners, yet the trend seems to be to sacrifice it at the altar of purity. (Harlow, 2003, p.39).

In repeated references to purism as 'non-trivial', Harlow's work indicates that within the larger socio-cultural processes²⁷ of revival and revitalisation of te reo Māori, **purism** is a relevant linguistic concern (although, in my own experience, seldom identified or discussed as such in the Kura Kaupapa Māori community).

²⁷ This view is not universally accepted: '...modernization of terminology occurs mainly by way of loans from English rather than using indigenous linguistic resources... Contrary to wide-spread opinions, these loans not only affect the receiving languages' lexicon but also their deeper structures.' (Ammon, 2001, p.ix).

This analysis might lead one to question the extent to which the purism evident in past and current KKM policies and practice has been followed as a deliberate strategy, with due recognition of the complexities involved. Analogously, in the context of South America, Nancy Hornberger and Kendall King (1999) canvassed attitudes towards linguistic authenticity in the efforts to revitalize Quechua, arguing ‘that to impose restrictions on borrowing from Spanish into Quechua would project a purist attitude which might ultimately have the effect of hastening the death of Quechua’ (p.168).

In another paper, Harlow (2005) delineates purism in te reo Māori as having two aspects: one, as discussed above, against word-borrowing from English (although Harlow indicates significant **syntactical** borrowing from English occurs); and the other being dialect purism. Harlow points out two manifestations of this: the first, which he considers ‘intelligible, if perhaps counterproductive’, is related to identity politics (Watts, 1999) at inter-iwi level, and ‘emphasizes a few shibboleths at the expense of the far greater similarities between the regional variants of Māori’ (Harlow, 2005, p.139). The second manifestation of dialect purism is the rejection of any form of standardization of the reo, including rejecting any new words on the grounds that they are not part of one’s dialect. A related attitude I have encountered is for Wharekura students (invalidly, in my view) to blame ‘dialect differences’ for any comprehension difficulties in Pūtaiao, an issue particularly pertinent in senior curriculum delivery via video conferencing, where the teacher may be in another iwi area.

Linguistic Purism

As the discussion so far makes clear, consideration of language issues in Pūtaiao is likely to involve either puristic or anti-puristic (Thomas, 1991, p.81) arguments, or both. Therefore, understanding the phenomenon of linguistic purism is required, in order to adequately evaluate its role in the development of Pūtaiao.

The book *‘Linguistic Purism’*, by George Thomas (1991), is a key reference on the topic, and forms the basis of the following discussion, hence the fullness of the quotations below (most other book-length works on purism are collections e.g. Brincat, Boeder et al., 2003). Thomas locates the beginning of scholarship on language purism in pre-World War I German, later extending to other European languages (Brincat, Boeder et al., 2003) as well as modern Hebrew (Fellman,

1973; Saulson, 1979) ‘and, more recently still, the languages of the developing world’ (Thomas, 1991, p.13). While the intellectual overlap with preventive linguistics (above) is clear, the relationship of these literatures is not straightforward. Language purism is viewed ambivalently in the academy (Wildgen, 2003), owing to the acceptance of language change processes, which purism is presumed to oppose, in the successive mainstream linguistic paradigms termed historicism, descriptivism and functionalism (Thomas, 1991, p.3-8). Perhaps unsurprisingly, therefore, its treatment in applied linguistic fields, such as the literature on the intersection of culture, politics and language, has often been somewhat peremptory (Dorian, 1994; Loffler, 2003; Farfan, 2001), reflecting ‘years of its exclusion from mainstream linguistics’ (Thomas, 1991, p.10). An historical link of language purism with Herder’s views on culture (p.6) constitutes further grounds for its rejection as associated with xenophobic nationalism (Bourdieu, 1998, p.19), while also providing a link between purism and Whorfian ‘linguistic relativity’ debates (Fishman, 1960; 1980; p.117 below).

Thomas starts from basic principles, considering the notions of purity, rational and non-rational motivations (see below), the language situation, extra-linguistic factors and the diachronic (or temporal) aspect, in developing his analysis. According to Thomas, purism arises in all standard languages to varying degrees, and is identified largely with xenophobic purism, often with one or more of the following orientations: elitist, ethnographic, archaising or reformist. Three of his 10 general hypotheses about purism are particularly relevant to Pūtaiao:

- The dominant target of purism is vocabulary of foreign origin.
- Those languages are most prone to xenophobic purism which have emancipated themselves from domination by another language of culture during the period of nineteenth- and twentieth-century nationalism.
- The modernisation of society leads to two conflicting trends: (1) a retreat from purism, (2) increased opposition to loanwords. (p.195-206)

In Thomas’s final chapter, linguistic purism is considered as both a strategy and a problem in language planning processes.

If we define language planning as a rational, purposeful and organised intervention in language and the social situations in which it operates, it is not difficult to see how purism might be seen as part of the scheme. However, ... [t]o what extent may purism be described as ‘rational’ and ‘organised’? (p.215)

In order for purism to be rational, Thomas argues, purists are obliged to make compromises, which

are no more than an application to language intervention of Talcott Parsons' [1902-1979] five antinomies of value-orientation, [and] involve:

1. Maintaining personal neutrality towards the elements of the language in question: the desirability of elements should be judged on how they function in the system, not on the basis of personal preferences for elements from one source or another; these elements should be the subject of dispassionate discussion, not emotional commitment.
2. Suppressing idiosyncratic impulses: an objective approach to the problems facing a language is required, in which the speech community's needs have precedence over those of any individual.
3. Recognising the merits of features which unite the language with another code: rather than stressing its specificity, a language should be opened up to enrichment from languages having close genetic, typological or cultural ties with it.
4. Stressing results rather than resorting to rhetoric: the purification of a language is not an end in itself but is only a means to providing a language with prestige; puristically inspired criticism should not be mean-spirited and negative but constructive and goal-orientated.
5. Integrating purism into an overall interventionary response to a language's functional needs: purism should not be a single-issue ideology but an integral part of language cultivation. (p.216-7)

These suggestions are applicable to the discussions of 'kaupapa' that commonly occur in KKM whānau meetings.

Thomas concludes that 'there is no single [puristic] paradigm which satisfies the conditions of rational language planning: each speech community must identify a paradigm which reflects the situation and context in which its language is forced to operate' (p.217). Thomas then comments on the organisation of purism in language planning, and on possible conflicts between purism and 'the other objectives of language planning' (p.219). Finally, as a language planning problem, he concludes that in strongly purist language contexts, purism 'must be fully taken into consideration in the formulation of any corpus planning' as 'the reciprocal of the moral imperative imposed on the professional purist' (p.220) by the need for rational compromises, as cited above. Thomas describes possible language planning 'problems posed by purism' in terms suggestive for Pūtaiao:

1. By favouring etymological over functional criteria in judging the desirability of linguistic items, purism may be a serious impediment to the spontaneous and planned growth of a language in accordance with its socio-economic needs.
2. By stressing individuality and separateness of a linguistic code, purism may foster a decrease in inter-linguistic comprehension and communication: in situations where language planning is predicated on the need to maintain or promote socio-political or ethno-cultural bonds such differentiation between codes may be particularly inimical to its aims.
3. By preferring nativisation of the lexicon, purism may be seriously detrimental to the drive for modernisation: language planners might

legitimately consider that a language cannot afford to stagnate while adequate native equivalents are sought for items of terminology widely distributed in the languages of the world. (p.219-20)

The last point is particularly pertinent to the science terminology question discussed above. While recognising that Pūtaiao is not typical of the language situation on which the ‘traditional’ linguistic purism literature is based, the understanding provided by this comprehensive treatment is useful in considering the impact of purism on Pūtaiao development. According to Harlow (1993) the guideline against borrowing was made in order to avoid ‘an admission of defeat, an admission that in fact Māori is not capable of handling new areas and topics with its own resources’, with the aim of ‘preserving it in opposition to and distinct from English’ (p.129). There is clearly potential for this objective, arising from non-rational motivation (in opposition to Talcott Parsons’ ‘rules’,) to conflict with the educational aims of Pūtaiao.

Returning to Crystal (2000), his 5 reasons (in bold below) why we should care about language death are that firstly, as **repositories of history**, languages **express identity**. Secondly, **languages contribute to the sum of human knowledge**, in which **we need diversity** in order to most adequately confront the issues of the global future. The fifth reason, that **languages are interesting in themselves**, while subjective, is widely-held, and reflects the centrality of language to being human.

The Sapir-Whorf Hypothesis

As (Crystal, 2000, p.54) notes, ‘the spirits of Benjamin Lee Whorf [1897–1941] and Edward Sapir [1896–1941] haunt many linguistic discussions’ (Whorf, 1956; Sapir, 1933), particularly those concerned with inter-cultural communications (Kaa, 1976; Gumperz and Levinson, 1996). This alludes to their widely known hypothesis on the links between language, thought and cultural worldview, which was an explicit, structuralist formulation of a very old idea, with Francis Bacon (1561–1626) and John Locke (1632–1704) both cited for their contributions to the ‘question of what influences what: Does language affect the culture of a people, ... or is language itself merely the creation of the culture?’ (Schlesinger, 1991, p.12). The ‘a’ and ‘o’ possessive classes in te reo Māori have been cited as one Whorfian example (Robins, 1976).

Joshua (Fishman, 1960; 1982) later systematized the Sapir-Whorf hypothesis, describing it as threefold:

W1: linguistic relativity (weak Sapir-Whorf) i.e. worldviews and languages are reciprocally related;

W2: linguistic determinism (strong Sapir-Whorf) i.e. language determines worldview; and

W3: ethnolinguistic diversity (as a worldwide societal asset).

Somewhat like linguistic purism, the Sapir-Whorf hypothesis has acquired the status of an academic black sheep, subject to a range of cogent criticism from mainstream linguistics for many years (Fishman, 1980; Schlesinger, 1991), which has seen W2 conclusively dismissed as fallacy, tainting W1 and W3 in the process, and hence obscuring their value (Macnamara, 1991). Reconsidered from a contemporary view on ‘discourse’, Whorf’s ideas (perhaps no longer thought of as ‘the Sapir-Whorf hypothesis’) are enjoying renewed linguistic respectability (Lamb, 2004; Lee, 1996). Michael Halliday (2004) refers to Whorf’s work as ‘the classic statement’ on the issue of ‘the way experience is construed in language’ (p.209). Whorf’s writing also contributes to early literature on traditional Native American knowledge – analogous perhaps to such scholars as Elsdon Best (1986) and Raymond Firth (1972) for mātauranga Māori (see Wāhanga Tuarima). Whorf’s insights about language, thought and culture have also been viewed as an early contribution to social constructivism (Bowers, 1988, p.43). With its ‘antiestablishment bite’ (Fishman, 1982, p.9) moreover, his writing remains politically robust, perhaps even postmodern, in contrast with much scholarship of similar age. Whorf was an academic outsider during his short scholarly career in the 1930s, which may help explain his alignment with postmodernist and multiculturalist scholarship, evident in the pairing below of a Whorf statement, followed by an Anne Salmond equivalent:

The West ... has not bridged the intellectual gulf; we are no nearer to understanding the types of logical thinking which are reflected in truly Eastern forms of scientific thought or analysis of nature. (Whorf, 1956, p.21)

[T]he process of opening Western knowledge to traditional rationalities has hardly yet begun. (Salmond, 1985, p.260)

While most of the literature on Sapir-Whorf concerns widely different languages, W1 has also been invoked in the Ebonics (also termed Black English or BEV) debate (Delpit and Dowdy, 2002; Collins, 1999), one of the main targets of ‘official English’ arguments in the US referred to above (p.112). Eleanor Wilson

Orr (1987) identified certain common conceptual difficulties for African American secondary school learners in mathematics and science education. Her research indicated these difficulties were caused by specific language misunderstandings of students who were Ebonics speakers, thus supporting the consideration of Ebonics as a different or hybrid language (Crystal, 2003). Once this is accepted, consideration of lack of equity in education for this group of students must clearly also include issues of ESL (English as a second language) in addition to other profiles of disadvantage such as socio-economics and covert or institutionalised racism.

Finally on Sapir-Whorf, John Macnamara (1991) notes ‘one guiding principle of natural-language semantics: *science and technology apart*, whatever can be expressed in one language can be expressed in any other language’ (p.48, my emphasis). Macnamara refers to this ‘semantic principle’ in order to point out that ‘Whorf’s linguistic relativity run[s] afoul’ of it, since the two ideas, taken to their extremes, are incompatible. Clearly, this principle is foundational to the contemporary understanding of ‘a language of thought ... a language of cross-channel communication for the mind’ (ibid) which is associated with the structural linguistic notion (in the work of Noam Chomsky) of ‘the universal sublinguistic’ (p.59) or ‘universal grammar’ (Honderich, 1995, p.887), which is still pivotal in contemporary theories of mind and the relationship between language and thought (Pinxten, 1976; Walkerdine, 1994). The notions of ‘universal grammar’ and ‘linguistic determinism’ (i.e. W2) form yet another cognitive polarity where ‘truth’ lies in a dynamic balance between the two extremes, a balance perhaps best represented in this case by linguistic relativity (weak Sapir-Whorf, or W1). In this sense, language, like other aspects of human culture, is best described in relative, rather than absolute terms.

Furthermore, the highlighted exclusion by Macnamara of science and technology from this linguistic principle is obviously relevant to Pūtaiao. It indicates that ‘science and technology’ is considered by linguists to be an important exception, in terms of language domains, to inter-cultural understanding and translatability (Bloom, 1981). This supports my previous assertion (p.5) that language issues are more severe in Pūtaiao than the rest of the Māori-medium curriculum.

Language Planning for Te Reo Māori

Much of the literature on language planning concerns specific language situations (e.g. Gill, 2004; Nical, Smolicz et al., 2004). Welsh and Hebrew, two well-documented international cases, informed language planning policy for te reo Māori, particularly in the earlier stages (1980-1990) of Māori-medium education. The following discussion compares these two languages with te reo Māori, with a focus on relevance for Pūtaiao.

Baker (1993) provided a review of the role of bilingual education in the survival of Welsh, first outlining the paradoxically synchronous rise in Welsh-medium education over the previous 4 decades, even while the number of Welsh speakers continued to decline. Welsh-medium examination subjects are cited as a key factor enhancing the prestige of the Welsh-medium system. Baker concluded that while bilingual education cannot by itself accomplish language revival, for Welsh the schools have been essential in the (limited success of the) language reversal process. Jones and Martin-Jones (2004) include results of 1998 fieldwork showing code-switching in bilingual mathematics secondary classrooms, and conclude that many more ‘ethnographic classroom studies’ remain to be done in order to develop ‘greater understanding of the linguistic and social processes ... before any major interventions are made in the current system’ (p.65).

Welsh, like te reo Māori, is an indigenous language struggling to survive in a long history of domination by English. But there are also important differences that impact on decisions made about language-in-education: Welsh has been a written language in contact with English (also French, Gaelic, Irish, etc) since the 11th century; accordingly there have been past phases of Welsh lexicography, purism, academies, and other literary activities, associated with the written language, which are not found in the history of te reo Māori.

Bernard Spolsky is an important preventive linguist in the history of LPP for te reo Māori (Spolsky, 1989; 1987). Born in Aotearoa New Zealand, later moving overseas and becoming an internationally recognised scholar of Hebrew, Spolsky has compared the revitalisation processes of the two languages (Spolsky, 1996). Modern Hebrew²⁸ has a history of revitalisation dating from about 1880, and is

²⁸ Also termed ‘Israeli’ or ‘New’ Hebrew (Kuzar,1999).

associated with social circumstances widely regarded as unique (Gaita, 2002). Hence, Spolsky suggests Hebrew may be a 'special case' of language revitalisation (Wright and Bloor, 1995, p.75), very different from that of te reo Māori, even more so than Welsh. At different phases of its revival, Hebrew has struggled against French, German, and Yiddish as well as English (Spolsky and Shohamy, 1999). As the national language of Israel, however, there was ample motivation - both instrumental (functional) and ideological (identity/cultural) for individuals to make the 'Great Leap' (Moshe Nahir, see Spolsky, 1991, p.142) of switching to Hebrew. Spolsky characterises language policies for schools in Israel as following a 'three plus one' model: Hebrew, Arabic and English, plus another e.g. German or French (Wright and Bloor, 1995, p.31).

Spolsky makes a problematic statement about te reo Māori, in outlining a general typology of countries according to language situation:

New Zealand may be described as a traditionally Type I [monolingual] country, moving under the pressure of Māori revitalisation efforts ... towards Type II [bi-lingual]. (Spolsky and Shohamy, 1999, p.59-60)

This is arguable from a Māori point of view, and at odds with other accounts such as those of May (2001) and Harlow (2003), as well as Spolsky's own accounts elsewhere of the history of slow decline of te reo Māori (Spolsky, 1989). While there is no doubt te reo Māori has been 'marginalised' (Spolsky and Shohamy, 1999, p.60), this has allowed its flickering survival, since there is still life 'in the margins' (Edgerton, 1993). Pākehā may have remained largely monolingual, but since contact Māori have generally been bilingual, up until the last generation or so (Oliver, 2001).

Another relevant issue is that of educational 'separatism', of which Spolsky (1987) approved, citing religious education as a precedent (although this can hardly be regarded as politically unproblematic, according to Pinar, Reynolds et al., 1995, p.606-60), provided it is 'carried out as the result of community choice' (Spolsky, 1987 p.20). Such discussion paves the way for Māori-medium education to be constructed within the application of Public Choice Theory to state education in Aotearoa New Zealand (Devine, 2004) - a route later demonstrated to be inimical to Māori interests (Irwin, 1999; Lauder, Hughes et al., 1999; Johnston, 1999).

It is a truism that each language situation is unique, and comparisons are certainly made with that understanding. Nevertheless, in Spolsky's (1987) original report on bilingual education, commissioned by the Aotearoa New Zealand Department of Education, and influential in policy setting for Kura Kaupapa Māori, there are repeated comparisons with 'the Canadian French immersion programmes' which 'provide a useful model' (pp.18, 11-2, 24-5) without acknowledgement of the divergence between, in one case, two immigrant world Western European languages, and in the other, a colonised indigenous language resisting total obliteration. While stressing the French Canadian comparison as a model for te reo Māori, Spolsky makes no reference to **indigenous** Canadian languages (Burnaby, 1996), which seems surprising from today's perspective. Spolsky's treatment exemplifies the ambiguity in the literature regarding the distinction between 'maintenance' and 'enrichment' bilingual education models, and their limited applicability to 'heritage' language programmes such as Māori-medium education (May and Hill, 2005).

The larger issue to be taken with Spolsky's report (Spolsky, 1987) and subsequent paper (Spolsky, 1989) on te reo Māori is sociopolitical, concerning the role of schools in language planning. This relates to the argument by Robert Kaplan (1990), made in his chapter in the collection *'Language Planning and Education in Australasia and the South Pacific'* (Baldauf and Luke, 1990), which contains no contributions from Aotearoa New Zealand, a somewhat surprising omission, given the title. Kaplan defines the functions of central government as setting and resourcing (or modifying) language policy, and of the education sector as establishing curricula in accord with that plan. He notes 'it is not the function of the education sector to decide de jure what languages will be taught' and that 'a serious problem in the history of language planning has been the confusion of these two functions' (p.9). This echoes the point made for Welsh above, and emphasised throughout the language planning literature: while schooling in the medium of an endangered language is a central part of language revitalisation, it cannot accomplish the task alone, but must be part of a comprehensive societal approach.

In contrast with Kaplan's analysis, Spolsky suggests Māori-medium education has been central in the language planning efforts: 'Accompanying this educational

activity, political and legal pressure has been brought to bear to support the language revitalisation process.’ (Spolsky, 1989, p.91). Here, ‘Māori bilingual education’ is equated with a ‘major principle’ of ‘equality of educational opportunity’ (Spolsky, 1987, p.8), enabling its presentation as a unitary remedy for the historical linguistic oppression of te reo carried out by schools, and providing ‘Pākehā (European) guilt at the possibility of cultural genocide’ with a useful salve (Graeme Kennedy cited in Spolsky, 1989, p.90). Spolsky’s (1987) comment that this principle is ‘stressed in the recent New Zealand Curriculum Review’ (p.9), and his tendency to posit ‘the Ministry of Education’ (Spolsky, 1996, p.10) as responsible for revitalisation efforts, adds further substance to this interpretation.

Later, Spolsky (1996) made an extensive comparison between the two cases of language revitalisation, namely te reo and Hebrew, while noting that to start with the situations were ‘quite different: Hebrew had been unused as a spoken language for some 1700 years, while Māori still had significant numbers of older native speakers alive’ (p.25). He also acknowledged Hebrew’s ‘immense storehouse of written material’ compared with the dependence of Māori on an oral tradition. Despite these contra-indications, he applied the traditional European language planning model of H and L varieties in both cases²⁹, stating that Hebrew faced the task of ‘adding an L variety to an H language’ while ‘for Māori, the task was adding modern H functions to a language restricted in its domains’ (p.26). It is not difficult to problematise this diagnosis. At its nadir, prior to TKR and KKM, much remaining social usage of te reo Māori was in ceremonial, religious, and formal cultural situations such as whaikōrero hui mate, which constitute the traditional H language functions. Therefore the revitalisation task for te reo Māori could equally well be described in similar terms to that of modern Hebrew, as the need to develop modern L varieties, so as to revive te reo Māori as a language around the back of the marae and in homes, as well as on the taumata (paepae). To one-sidedly describe the task of revitalising te reo as ‘adding modern H functions’ carries within it an already-made judgement of cultural value.

²⁹ H and L refer to the varieties of language (or languages) spoken in different domains of linguistic behaviour, hierarchised according to the domain from highly valued (H) to less valued (L).

Further, Spolsky cites ‘control of the school system’ and ‘a pre-school component’ as similarities between the two cases, yet these are widespread in language revitalisation efforts, and thus unremarkable. His sociopolitical comparison, on the other hand, is more contentious:

The Hebrew and Māori efforts were neither of them the result of a government planning decision, but rather the activity of minority ethnic-based ideologies working to establish new identities. Both had to deal with physical, demographic, social and cultural dislocation. (Spolsky, 1996, p.26)

The problematic terms here are ‘ideologies’ and ‘new identities’ when applied to Kaupapa Māori, as prominent among the phenomena he is describing as ‘Māori efforts’. The Māori case might be more accurately described as the **removal** of an ideology (in correcting Eurocentric bias) to serve a bowed, yet unbroken (i.e. **not** new) identity – we may live in the city today, but our tūrangawaewae remain where they have always been. And while ‘dislocation’ is a shared experience for both groups (as for many minorities), the comparison is again a very general one, since the two cases differ greatly in the extent and nature of their respective histories of displacement. Given the close convergence in both cases with central nation-building processes, moreover, Spolsky’s distancing of revitalisation activities from government here seems overplayed.

Historically, non-Māori scholars such as Spolsky have produced most of the literature concerning preventive linguistics for te reo Māori. This fact in itself reflects ‘[t]he need for indigenous voices to be heard’ (Henze and Davis, 1999, p.12), indicating a role for Kaupapa Māori research in matters such as te reo Māori language planning policy. In more recent work, Spolsky has presented more complex analyses of te reo Māori ‘regeneration’ (Spolsky, 2003; 2005), noting the benefit he gained from a visiting research fellowship at the International Research Institute for Māori and Indigenous Education at the University of Auckland in 2000 (Spolsky, 2005, p.83, fn.1). Nevertheless, it was his earlier work, discussed above, which was influential in policy setting for Māori-medium education in the early stages, hence establishing the current conditions of Pūtaiao.

Languages of Science

The language domains of science and technology are considered important in ensuring English’s position of global dominance (Crystal, 2003). Concomitantly, sociologists of science and sociolinguists have intensively studied the processes

and effects of ‘the dominance of English as a language of science’. Various viewpoints and case studies are brought together under this title (Ammon, 2001), in a collection from which three papers (Kaplan, 2001; Siguan, 2001; Spolsky and Shohamy, 2001) are discussed below.

The major point of Robert B. Kaplan’s contribution is contained in its title: he makes a case for the view that English is ‘the accidental language of science’ (Kaplan, 2001), examining the conflict between two ‘amazing world resource[s]’ represented by multilingualism on the one hand and global English on the other (echoing Crystal), and the need for ‘balance between these two views’. So far unproblematic, he states ‘the spread of English in the registers of science and technology ... threatens not only the survival of small languages; it also stills the voice of science in languages other than English’ (p.19). While this sentence is clearly referring to two separate phenomena, the next collapses them together:

the spread of English – and to a significant extent the widespread use of English in science and technology – has the gravest consequences for the practice of science and technology in other languages – assuring the dependence of less developed nations on a few states, and largely in a single language. (Kaplan, 2001, p.19)

Here it is difficult to tell whether Kaplan is referring to the decline of scientific publication in (e.g.) German, or to the fact that published science has not occurred in (e.g.) Māori. The effect is to imply that development of science in Māori is an unquestioned good. This is possibly an example of international scholarship that draws on indigenous situations, without full cognisance of the indigenous viewpoint.

The contribution by Spolsky and Shohamy (2001) to the above volume gives a synopsis of the situation of Hebrew as a language of science (and science education), a topic that has been extensively discussed within the voluminous body of Hebrew revitalisation literature (Fellman, 1973; Saulson, 1979). From about 1880–1920, French and German medium schools were established by wealthy philanthropists, for the benefit of European Jews who were at that time repatriating in areas which later became part of the state of Israel. A debate began in 1913 over the choice of German or Hebrew as medium of instruction for science and technology courses at a proposed new tertiary technical institute in Israel. The struggle was won decisively by Hebrew when the Technion eventually

opened in 1924 (after World War I) as a Hebrew-only institution. This story, known as The Language War in Hebrew revitalisation history, is possibly the greatest achievement ever for a non-Western language of modern science.

Fast-forwarding to the contemporary Israeli academy, Spolsky and Shohamy (2001) note that Hebrew University is the strictest (of about seven) in adhering to a Hebrew-only policy, while The Weizmann Institute of Science is the least strict. Out of 100 dissertations ‘in scientific fields’ from Hebrew University between 1940 and 1997, ‘only a dozen’ ‘in the last 30 years’ (p.171) were written mainly in English; and of 102 recent dissertations in physics, biology, engineering and chemistry from Tel Aviv University, 62 were written entirely or mainly in English, and 40 in Hebrew.

In other aspects, namely reading lists and the requirement to publish internationally, Spolsky and Shohamy judge the encroachment of English as the accepted language for science to be even greater, although Hebrew remains ‘normal’ as the spoken vernacular ‘in laboratories and lecture rooms and common rooms ... albeit with the code switching engendered by technical terminology’ (p.173).

Regarding science terminology, the Hebrew Language Academy efforts to develop a Hebrew science lexicon are described as having ‘limited success’:

Lectures given in Hebrew are thus likely to be thickly spattered with English (or rather anglicized, international) technical terms. While high school textbooks are more prone to attempt to use the approved Hebrew words, seeing that most advanced textbooks used at the universities are in English, the English words easily slip into academic scientific discourse. (p.172)

Spolsky and Shohamy conclude by stating their belief that, while English continues to penetrate ‘Israeli linguistic space’ through the demands of science and technology and the associated education, ‘this penetration is not in itself a serious threat to the continued hegemony of Hebrew’. As the first language of the nation-state, ‘Hebrew remains the first language that one must master for social, educational and economic success’ (p.175). The gulf between the respective language situation for science and science education through the medium of Hebrew and Māori must be accounted for in any precedent claimed for Pūtaiao

vocabulary policy. Spolsky and Shohamy revert to a cost argument, necessarily even more pressing for te reo Māori:

Even if the terminological innovations of the Hebrew Language Academy were to be more widely adopted, there would still remain the issue of the shortage of scientific and scholarly material published in Hebrew in the rapidly expanding fields of knowledge. The cost of translating specialized material into national languages is usually well beyond the economic possibilities of smaller countries. Only a nation like China can make this a matter of general policy. (Spolsky and Shohamy, 2001, p.172; for a related discussion of modernization of Chinese into science domains see Grabe and Kaplan, 1986)

A final important observation regarding Hebrew and te reo Māori as languages of science is the lack of reference found in the Hebrew revitalisation literature to an alternative epistemology of science based on cultural worldviews divergent from those of the philosophy of Western science. In that case, 'science in Hebrew' is the only issue – there appears to be no equivalent to the 'Māori science' side of the dialectic.

Miquel Siguan (2001) asks, 'to what extent is knowledge – and particularly scientific knowledge – conditioned by the language in which it is formulated?' (p.59). Dismissal of the 'utopia' of a 'perfectly rational language' entails the implication that for science to be(come) monolingually English 'may eventually impoverish it' (p.68). This is possibly the key argument against monolingual global science, phrased in W-science's own terms of maximising rationality and hence knowledge. Both this paper, and that of Kaplan (2001) discussed above, however, cite social and ethical (rather than W-science) domains as examples of this process - German sociology (Siguan, 2001, p.68), and international relations (Kaplan, 2001, p.22 fn.24). Siguan refers to 'scientific areas in which the aim of objectivity means that the language in which they are expressed and the cultural traditions in which they emerge are of no consequence' - including, one is left to assume, the central areas i.e. the canons of mathematics, physics, chemistry and biology. (Objectivity in science is discussed further in Wāhanga Tuarima.)

Siguan describes a thought experiment on 'a text on atomic physics', first noting that it 'can be easily translated from English to Italian, or viceversa' (Siguan, 2001, p.64). He then considers Tagalog, the recently standardised official language of the Philippines. Despite the difficulties, 'great efforts are now being made to adapt the language to the teaching of atomic physics, law and economics'

which if successful would allow such a translation – though ‘this can only occur within the framework of certain sociocultural changes that somehow integrate Philippine society inside western patterns and dissolve the autochthonous Philippine culture into western culture, or into a synthesis of the two’. Since this amounts to saying that science can occur in an indigenous language only on condition the indigenous culture is lost, it calls into question the development of ‘science in Māori’ in the name of cultural renaissance. Finally, he considers ‘Inuki, the language of the Eskimos’, which is an oral culture, and therefore ‘alien’ to scientific concepts. While ‘this does not mean that the mind of an Eskimo is unable to grasp these concepts’, he concludes that ‘today it is impossible to translate a manual of atomic physics or a book on political philosophy into Inuki’.

The Nature of the Language of Science

The thought experiment described above by Siguan (2001) is useful to consider for Pūtaiao. Which of the three language comparisons (Italian, Tagalog, or Inuki) best applies to Māori? We might fairly say that 200 years ago, te reo Māori was most like Inuki; today, the better comparison would probably be to Tagalog. In either case, Siguan’s reasoning problematises the current widely-held assumption in Māori-medium education that any science text can be ‘easily translated’. One factor supporting this problematic attitude could be the adoption of an ‘impoverished view of language’ as merely a tool or instrument, which, according to Michael Halliday and James Martin (1993, p.4), ‘prevails in western thought’. These authors argue that, while still ‘a variety of the parent language’, the ‘distinctive quality of scientific language lies in the lexicogrammar (the “wording”) as a whole’ - ‘syndromes’ of co-occurring features in which ‘certain words, and more significantly certain grammatical constructions, stand out’ (ibid). The discussion below follows this lead by separately considering kupu (words) and hanga reo (language constructions or ‘grammar’).

- **Terminology**

The papers on the language of science, reviewed above, indicate that much science vocabulary is better regarded as ‘anglicised internationalisms’ (Ammon, 2001) rather than English as such. This is partly due to its recency, as science terminology continues to expand explosively, entailing an ongoing race to keep up for any language (such as Hebrew or Māori) that seeks to develop a parallel

lexicon. Science vocabulary is systematic and precise, in contrast to the multi-layered richness of even simple Māori words (C. Smith, 2000). Although much scientific history is encapsulated in its lexicon, a large proportion of science terms are labels (for chemicals, equipment, species, etc) rather than meaning-laden concepts: this is a possible basis for making distinctions in lexical development processes.

A relevant example in Pūtaiao concerns the terms that have been coined for the names of the chemical elements of the Periodic Table (Harlow, 1993), some of which are descriptive ‘metaphorical opacities’ (Harlow, 2005). A problematic example is **konutea** (zinc, lit. ‘white metal’), a name derived from ‘Zinc’, a **white** brand of sunblock.³⁰ The limited usefulness of lexical expansion in this area is indicated by the fact that the international element *symbols* have to date been retained in Pūtaiao materials. To coin new words clearly requires metaphors of some kind to be used, a process which perhaps deserves more deliberation than is apparent in the case of these important names. The opportunity to introduce systematic or mnemonic terms - such as hautahi (first gas), haurua (second gas), konutahi (first metal), konurua (second metal) for H, He, Li, Be³¹ - has been lost.

The sociopolitical history of the Hawaiian language is more like that of te reo Māori than either Hebrew or Welsh (Wilson, 1999). Māori and Hawaiian are closely related Polynesian languages that continue to resist total obliteration by English. The recent success in these efforts has united the individuals involved in both countries and encouraged mutual support of each other and their respective projects (e.g. regular visits and exchanges). Te Kōhanga Reo, and ex-Māori Language Commissioner Tīmoti Karetu, are cited as seminal inspirations in an overview of the history of Hawaiian language revitalisation (Wilson and Kamanā, 2001). This includes the question of science terminology:

The biggest difficulty the [Lexicon Committee] has faced is in developing Hawaiian equivalents of terms that are from categories that seem to go on endlessly - Latinate scientific terms for chemicals, species, and so on ... The committee has been torn in two different directions regarding the development of Hawaiian terms in these categories. One direction is to continue composing terms based on Hawaiian roots, and the other is to

³⁰ Zinc oxide, a common sunblock ingredient, is white (like many oxides), whereas elemental zinc is actually silver-grey in colour.

³¹ The current neologisms are hauwai (hydrogen, lit. ‘water gas’), haumāmā (helium, lit. ‘light gas’), konukōhatu (lithium, lit. ‘stone metal’), konuuku (beryllium, lit. ‘clay metal’), which also illustrate the descriptive metaphoric approach.

borrow the international term. The native-roots position has proven to move much too slowly, and although the committee has approved native-root terms, especially for very common things such as the stomata of a leaf, pukahanu (literally, “breathing hole”), it has often also adopted many terms from the international lexicon. The borrowing position is designed to allow students to move between Hawaiian, English, and other languages in the scientific area, especially in the written forms of those languages. (p.168)

The authors describe the common practice in Hawaiian immersion settings of ‘Hawaiianizing’ the spelling and pronunciation of scientific terms, e.g. ‘sodiuma bisulufahate’ for sodium bisulfate. Well-established science-related Māori examples include kāhi (gas) and mihīni (machine). Such practices for science vocabulary can be included in the term ‘borrowing’. These practices support the immersion policy for medium-of-instruction, and bring the world of science and the cultural world closer together, aims consistent with those of Kura Kaupapa Māori for te reo and for improved educational success. Bridging the access to the lexicon of international science is a strong supporting argument, as noted in the previous Harlow quote (p.113). This concludes the argument for ‘borrowing’ in favour of ‘neologism’, raised as the language question of ‘vocabulary policy’ in Whika 1 above (p.5).

- **Grammatical Metaphor**

‘But there is another aspect of scientific language that is just as important as its technical terminology, and that is its technical grammar’ (Halliday and Martin, 1993, p.6). Halliday’s analysis of early modern (post-Latin) science texts (by Newton, Galileo, et al) demonstrates that, while scholars worked to develop a lexicon that would ‘be effective in constructing technical taxonomies’, and capable of unlimited expansion, new ‘grammatical resources’ also evolved (not necessarily planned) in English and the other new European languages of science, which

were the constructions of nominal groups and clauses, deployed so they could be combined to construe a particular form of argument: a rhetorical structure which soon developed as the prototypical discourse pattern of experimental science. (p.7)

Thus, technical vocabulary and nominalised grammar are two interdependent (sets of) features, which in combination account for the characteristic nature of the language of scientific text. Halliday (1993) probed further into the difficulties (‘alienation’) experienced by many students when they encounter the language of science at secondary school, suggesting seven headings under which these difficulties can be illustrated, of which 4, 5 and 6 are discussed below:

- 1 interlocking definitions
- 2 technical taxonomies
- 3 special expressions
- 4 lexical density
- 5 syntactic ambiguity
- 6 grammatical metaphor
- 7 semantic discontinuity (p.71).

Lexical density can be measured (in English) as the number of lexical words per clause. Informal spoken English has a lexical density of about two, and more formal written English around four to six, but in scientific writing the lexical density is often higher; examples with densities of ten or more are not uncommon. The tendency of science discourse to use ‘nominal groups’ or ‘noun phrases’ is one contributor to this density. Halliday’s examples of difficult-to-understand nominal groups, ‘which consist of strings of lexical words without any grammatical words in between’, include **form recognition laterality patterns** and **glass crack growth rate**.

Syntactic ambiguity is highlighted by typical science sentences such as: ‘Lung cancer death rates are clearly associated with increased smoking’ (p.77). Here, the verbal group ‘are ... associated with’ creates ambiguity, since it could indicate a relationship either of cause, or of evidence; and if it is one of cause, it could mean either ‘causes’ or ‘is caused by’.

But the main cause of ambiguity is that clauses are turned into nouns. ... If I say **Mary announced that she had accepted**, I am making it clear who did what; but if I say **the announcement of Mary’s acceptance**, you cannot tell ... A great deal of semantic information is lost when clausal expressions are replaced by nominal ones. (p.78)

These two features, lexical density and syntactic ambiguity, are ‘both by-products of a process [Halliday refers] to as ‘grammatical metaphor’:

[I]nstead of being a substitution of one word for another, as when we say **you’re talking tripe** instead of **you’re talking nonsense**, it is a substitution of one grammatical class, or one grammatical structure, by another; for example **his departure** instead of **he departed**. (p.79)

Halliday notes the prevalence of such grammatical metaphor in scientific discourse, and suggests it is likely to have first evolved in that context, to allow the construction of a step-by-step argument, moving at each step from established to new information. The simplest way to do this in English ‘is to construct the whole step as a single clause, with the two parts turned into nouns, one at the beginning and one at the end, and a verb in between saying *how* the second

follows from the first' (p.81, original emphasis). Halliday concludes that the features of scientific language are not arbitrary, but developed in response to the needs of science discourse and method. They suit the expert, but cause difficulty for the learner. At the same time, Halliday points out that the language of science is often written 'very badly', 'us[ing] grammatical metaphor both inappropriately and to excess' (p.84). He also points to the tendency of the language of science to

take over as the dominant mode for interpreting human existence. Every text, from the discourses of technocracy and bureaucracy to the television magazine and the blurb on the back of the cereal packet, is in some way affected by the modes of meaning that evolved as the scaffolding for scientific knowledge. (Halliday, 1993, p.11)

Clearly, successful teaching and learning of 'science in Māori' depends on the development of te reo Māori into a language of science, which entails the development of a 'scientific register' in te reo Māori. This involves more than just 'kupu hou', but also the invention of grammatical ways to express nominalised Māori verbal clauses with the required precision and unambiguity. No doubt, this can be done; the question that perhaps it is already too late to raise, is whether or not traditional patterns of Māori thought and language can survive the incursion? Here, Harlow's (2005) comments on widespread syntactical borrowing from English in Māori-medium contexts are very relevant. This is an important question for KKM because it is there that **both** language aims, that of modernising the dominant register to enable a discourse of science, **and** that of retaining the depths of 'difference' of traditional Māori patterns of language and thought, are being followed. This section has attempted to show the extent to which these two aims are in conflict.

This analysis also helps to explain why the language issues in Pūtaiao are more severe than in the other curriculum areas. Part of the increasing invasion of the lifeworld (Young, 1989) by the economic rationality of the market has been the increasing global dominance of the scientific register of English noted by Halliday. Because economics and its daughter discipline, 'management', espouse a scientific form of rationality, they adopt many of the linguistic habits of science. So not only the effect of the modern products of science and technology on the lexicon, but also the grammar of science discourse, begins to dominate in all language domains.

Ideologies of Translation

The conflict in position on how to translate science terminology into te reo Māori arises from a polarity in the language revitalisation debates between ‘two language ideologies. The first one is an instrumentalist ideology, in which language is seen as a tool for transforming ideas into new linguistic patterns’ (Blommaert, 1999, p.13). Here, the parallel with the ethnicity debates is clear. Following Blommaert’s synopsis of the research on Corsican (Jaffe, 1999), in this mode, Māori ‘is used *as if* it were a language of power’ (original emphasis), i.e. a language of science. What Blommaert terms ‘penetrating into domains of power’ describes the current thinking behind Māori-medium curriculum policy (Harlow, 2003) such as Pūtaiao. ‘The second one is a romantic ideology, in which language is an abstract idea inextricably linked with a people’s “soul”’ (Blommaert, 1999, p.13). This idea is expressed in kupu kōrero such as ‘ko te reo te mauri o te mana Māori’ (the Māori language is the mauri, or life principle, of Māori mana) and ‘ko te reo te kākāhu o te whakaaro’ (the Māori language clothes Māori thought).

The concept of mātauranga as an alternative body of knowledge to that of the West is allowed only insofar as this ideology is expressed, since the role/existence of mātauranga captured in traditional language is denied or repressed by the first, instrumentalist ideology. The romantic ideology therefore aligns with the ‘Māori science’ pole. This perspective ‘see[s] translations as acts of perversion [which] would bring a foreign “essence” into the language’. Adopting the ‘canon’ analogy developed earlier, Blommaert’s comments on French-Corsican literature may be read for science texts and Pūtaiao:

Translations of French novels perpetuate the role of French as an input language, a source language... Thus translations reinforce the “colonial” ... linguistic power relations that hold... Empowerment and alienation are played off against each other in a debate of which the outcome is hard to foretell (Blommaert, 1999, p.13)

Ironically, the romantic ideology also favours the ‘native root’ or neologism approach over the ‘transliteration’ or borrowing approach to lexical development, without recognition of the covert negative effects of wholesale importation of English forms of grammar (‘extensive syntactical borrowing’, Harlow, 2005), particularly in the domain of Māori-medium science education.

The comparison with the French-Corsican situation enables us to recognise the same ‘ideologies’ at work in our own sociolinguistic situation. It appears the trajectory for current Māori-medium education policy development begins with the romantic ideology, which maintains widespread support, but during the implementational cascade, as the responsibility increasingly devolves onto individual contractors, moves towards instrumentalist ideology in order to meet output targets, culminating in the current approach to providing Pūtaiao curriculum and assessment for qualifications. This also clarifies why both ideologies remain in force, despite the paradoxical effects produced (at least in part) by the disjunction between the two. It seems this level of understanding is lost in pro-Māori discourse that fundamentalizes difference and essentialises culture, construing the relevant debate as one of a binary choice between languages. In this way, the further language polarity is invoked, of purism against anti-purism or ‘compromise’ (Dorian, 1994). This is the means by which lack of understanding of the language ideological questions involved in developing a Māori science lexicogrammar becomes manifested as a strong language purism in Pūtaiao policy (Harlow, 2003).

The language of science, though forward-looking in its origins, has become increasingly anti-democratic: its arcane grammatical metaphor sets apart those who understand it and shields them from those who do not. It is elitist also in another sense, in that its grammar constantly proclaims the uniqueness of the human species. There are signs that people are looking for new ways of meaning - for a grammar which, instead of reconstructing experience so that it becomes accessible only to a few, takes seriously its own beginnings in everyday language and construes a world that is recognizable to all those who live in it. We would then no longer be doomed, as Prigogine and Stengers³² put it, ‘to choosing between an antiscientific philosophy and an alienating science’. (Halliday, 2004, p.225)

Here Halliday goes a long way towards drawing together the debates in language and in knowledge which have been explored above. In this quote, the linguist echoes the words of indigenous poet Linda Hogan, below, evoking the utopian and ultimately universal humanist basis of indigenous politics:

We are looking for a tongue that speaks with reverence for life, searching for an ecology of mind. Without it, we have no home, have no place of our own within the creation. It is not only the vocabulary of science that we desire. We also want a language of that different yield. A yield rich as the harvests of the earth, a yield that returns us to our own sacredness, to a self-love and respect that will carry out to others. (Hogan, 2000, p.122)

³² Prigogine, I. and Stengers, I. (1984, p.96).

These thoughts point towards the potential ‘synergy’ between the language and knowledge debates, captured in the nexus of Pūtaiao.

4.3 Conclusion: Pūtaiao Politics

Not the advantages of science and technology but in whose pay it is, and for what purpose, is the real cause for humanity's concern. (Mihaka, 1989, p.78)

Pūtaiao education, along with all curriculum development and implementation, is a political undertaking, a point emphasised by each of the arguments presented so far. Although state-organised developments of Māori-medium education tend to favour and encourage an apolitical view of curriculum for those involved, it is the responsibility of the individual educator to resist any such depoliticising tendencies (Young, 1989, p.145-6). This political imperative is part of the professional workload widely acknowledged to burden Māori teachers.

How exactly does the political situation of Pūtaiao impact on the questions that have been raised about the roles of Māori language and knowledge in its development? To return to Said’s insights on the politics of knowledge (see p.88), in terms relevant to Kaupapa Māori in general, as well as KKM and Pūtaiao specifically:

where the denied or repressed native essence emerged as the focus of, and even the basis for, nationalist recovery ... the nationalist politics of identity has nonetheless quickly proved itself to be insufficient for the ensuing period. What invariably happens at the level of knowledge is that signs and symbols of freedom and status are taken for the reality ... just to be an independent postcolonial Arab, or black, or Indonesian is not a program, nor a process, nor a vision. It is no more than a convenient starting point from which the real work, the hard work, might begin ... that work [is] the reintegration of all those people and cultures, once confined and reduced to peripheral status, with the rest of the human race. (Said, 1993, p.310)

McLaren exhorts multicultural educators to ‘always totalize!’ (McLaren, 1995, p.215) in order to avoid irrelevance to the struggles of minority students (‘formlessness’ - Taubman, 1993), as is exemplified by ludic postmodernism (McLaren, 1995, p.207) or positions of extreme relativism (Stanley and Brickhouse, 2001; Rata, 2004).

In the Pūtaiao curriculum, these comments by Said and McLaren serve to warn against the replacement of one knowledge hegemony (W-science) by another - that of mātauranga Māori. This could be described as ‘knowledge purism’ by analogy with the language debate, and predicted to carry negative consequences

for students. For this reason, as well as the incompleteness, inaccessibility, property rights and non-standardised nature of mātauranga Māori, Pūtaiao is bound to deliver some form of translation of the mainstream science curriculum. Apart from the lack of alternatives, not to do so would deny Māori-medium students access to the globally-dominant form of knowledge.

While cognisant of this imperative, Pūtaiao curriculum is also obliged, by Kaupapa Māori principles, to present science realistically, as one flawed human construction (among others) of the natural world. This is how I interpret McLaren's call to 'totalize' at the level of science curriculum – telling the whole truth of science, rather than the 'final form' mythology of the standard/idealised school science curriculum, which rests on an underlying philosophy of 'the weak objectivity of objectivism' (Harding, 1998; see p.193 below). From this angle, Pūtaiao is one form of a wider project (with feminist as well as other versions) that could be described as reforming scientism and science ideology³³ in the science curriculum (Lacey, 1999).

As noted above, critical processes in cultural politics must be specific, since they rely on the details of the sociopolitical milieu in which they occur. This serves to highlight once more the importance of the Kaupapa Māori context. Nevertheless, to extend this specificity to the full extent of epistemology and rationality is unwarranted, as it effects replacement of one cultural hegemony with another, and simultaneously dis-serves the interests of the colonized, once again.

Such symbolic over-extension militates against Césaire's 'vision of integration', described³⁴ as 'a place for all at the rendez-vous of victory' (cited in Said, 1993, p.310). Extending the previous quote (see p.9), Young (1989) echoes this utopian (even romantic) note of optimism for the emancipatory potential of postcolonial projects such as Kaupapa Māori (Webster, 1998):

Once the meta-decision is made, and we turn to more limited spheres, Habermas' argument about how we may validly form our wills becomes more compelling – we do it together, sharing our experience and on the basis of treating others as ends not means, as interlocutors not objects.

³³ See p.54 above for the distinction between scientism and science ideology.

³⁴ Aimé Césaire (1913-) Caribbean poet and dramatist. Quote from poem 'Cahier d'un retour au pays natal [Return to my native land]' ([1947]1969). (A. Berger and J. Bostock, Trans.) Baltimore: Penguin.

If this modification is accepted, and the possibility of fallibility is maintained, there is room for aesthetic and moral vision ... to take on something more than the aspect of a mere analogy for the history of emancipation. Some of its genuinely theological content might be reinstated. If so, the possibility of a Jewish, Christian or Muslim critical theory must be taken seriously.

Under these circumstances, the possibility of emancipation rests even more clearly on the courage and will of individuals; who knows, perhaps it rests even upon the grace of God, in the classical sense of the concept of grace – an ultimate, spiritual reality, [which] is struggling to come into being in our lives and our history. (Young, 1989, p.170-1)

In Wāhanga 4.1 it was argued that the Māori Renaissance, in which Kura Kaupapa Māori and the Māori-medium curriculum play prominent part, is manifested mostly in the symbolic realms, and has not involved massive change in the balance of sociopolitical power held by Māori within Aotearoa New Zealand society in the last few decades. Since curriculum symbolically represents culture, its political potency is unavoidably clear (Pinar, 1998; 1993; Castenall and Pinar, 1993; Doll, 1993). So it is not valid to argue that any Pūtaiao curriculum will have exactly the same political effect as any other. Putting it this way highlights the need for Pūtaiao developments to be informed by an adequate sociopolitical analysis, since anything less will simply fail to meet the needs of Māori students for better teaching, learning and achievement in science and mathematics. Māori-medium science curriculum policy and practice that provides Pūtaiao by end-point translation of the mainstream material, such as translated science texts and NCEA examinations, is unlikely to achieve the desired curricular aims. Nor will ‘innocent’ (Hall, 1996) substitution or addition of mātauranga-based content. A critical or Kaupapa Māori science curriculum requires deliberate planning and focus.

Reflecting the lacunae in multicultural science education literature discussed in Wāhanga Tuatoru, Robert Young (1990) commented on the difficulties faced by postcolonial critique, taking the seminal work in this field, *‘Orientalism’* (Said, 1978) as an example. Like the earlier quotes from Stuart Hall, these comments can be read with ‘Māori’ and ‘Pākehā’ in mind, respectively, in place of ‘Orient’ and ‘Europe’:

What Said’s analysis neglects, therefore, is the extent to which Orientalism did not just misrepresent the Orient, but also articulated an internal dislocation within Western culture... To some extent Said himself remains unselfconsciously within that European cultural heritage. ... The Orient, we might say, operates as both poison and cure for Europe: it constitutes the greatest threat to European civilisation at the same time as it represents a

therapeutic for the lost spiritual values of the West. ... The problem of Orientalism is that without a concept of an inner dissension Said is constantly led simply to condemn Orientalism's projections of dissonance on to external geographical or racial differences - even as he repeats such a structure by identifying Orientalists as 'for' or 'against'. Meanwhile Orientalism's own internal divisions re-emerge inexorably in the series of theoretical contradictions and conflicts in Said's text. (Young, 1990 p.139-40)

Writing at an early stage of postcolonial scholarship, Said failed to fully account for the role played by Orientalism in the concept of Western self-identity, and the associated cultural differend between the West and the Other (Lyotard, 1988), as it co-evolved during successive phases of the sociopolitical processes of imperialism and globalisation (Stewart-Harawira, 2005). To that extent, although Said wrote as an Arab person, his academic perspective remained coloured by the universalist assumptions of mainstream anthropology. Postcolonial scholars who read '*Orientalism*' without understanding this limitation risk importing it into their own work (Battiste, 2000; Cajete, 1999), a point of particular relevance in the masculinist domains of science (Harding, 1998).

Various debates swirling around the topic of Pūtaiao have now been shown to contain caricatural (straw-man) argumentation, and/or polarized binary oppositions (science education, language, ethnicity, philosophy, culture). As suggested by Taubman's model of identity, and May's model of ethnicity for critical multicultural education, in order to negotiate such discursive traps, it is important to maintain a productive dialectical tension between the different viewpoints or perspectives represented in the debate. To apply this advice to the central thesis dialectic means attempting to benefit from both 'Māori science' and 'science in Māori', rather than pitting them against each other, which tends to result in having one at the expense of the other. This chapter has investigated the sociopolitical environment of Pūtaiao, and the language issues that arise in a notion of Pūtaiao as 'science in Māori'. The next chapter moves to the opposite pole, to examine the debates and scholarship in support of 'Maori science'.

WĀHANGA TUARIMA

Mātauranga Māori Motuhake

[The Māori] had not evolved any true chronological system; he was still groping his age-long way on the dim path of progress when our forebears appeared from the great ocean and arrested his march.

Never again will the Māori scan the heavens to note the appearance of the revered Pleiades; nevermore will his womenfolk greet the lordly stars with dance, and song, and tears. The appearance of Vega is no longer looked for in the chill hour of dawn; never again, from hamlet to hamlet, will resound the ringing cry, 'Ko Whānui E! Ko Whānui!' (Best, 1986, p.51)

According to Māori belief all things have a mauri or life aspect – a piece of writing or a speech therefore has its own mauri. As a writer of a paper I am engaged in the act of creation which stems from the way that I see creation occurring. Just as the carvers who carve the houses by 'hanga whare' (building houses) so too as Māori academics we build thoughts/feelings (hanga whakaaro) and build discourses (hanga kōrero). I am not alone in this work, all my ancestors, past, present and future also have to – bear with me. (C. Smith, 2000, p.43)

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This chapter focuses on mātauranga, which occupies a central, yet occluded position in current discourses of Pūtaiao education. Here notions of fixity and formlessness are again relevant, since the very notion of 'research', in a social scientific sense, is alien to mātauranga Māori, as is school and the academy, indeed print (the written language), let alone cyberspace - must all be considered tauwi (alien) abstractions of 'authentic' traditional Māori knowledge – 'so far removed through these layers of presentation and interpretation' (Jocks, 1998, p.232). This serves as a caution in *any* reading or writing about mātauranga, and indicates that 'abstraction' is an important factor (closely related to discourse notions of voice, authority and authenticity) to be considered in analysing discourses of mātauranga. A related discussion of the misleading nature of abstractions in anthropology appears in Winch (1970, p.10ff).

Another important point is that mātauranga is holistic, without the compartmentalisation of Western conceptions of knowledge. Therefore, 'mātauranga' is a whole, seamless body of knowledge, covering the entire academic territory, including all disciplines of science, in any comparative discussion. Cheryl Smith (2000) contrasts the 'defended territories of knowledge' of Philosophy, which has attracted few Māori scholars, and Māori Studies ('is it a

“real” discipline?’ p.44), and asks ‘what was left outside the gate when the language and culture began to be taught inside the university?’ (p.45). Smith issues ‘a challenge to Māori academics that we are to more strongly bring forward into our work and lived reality, the epistemologies that we so often put to one side as “separate” spheres or relegate to formalised ritual’ (p.50).

Mātauranga is central in that it substantiates the ‘point of difference’ (Hall, 1996) for Pūtaiao, and, foundationally, for the modern Māori identity overall, within which Kaupapa Māori is situated. Yet, as the previous chapters argue, it is excluded from current Pūtaiao policy and practice. While mātauranga forms a key part of the rationale of Māori science educators in favour of teaching science through the medium of te reo (McKinley, 2005; Smith, 1995), failure of the current approach to achieve the stated aims of the Pūtaiao curriculum is becoming increasingly evident.

The Pūtaiao curriculum paradox has two aspects, one linguistic, the other philosophical. The language irony is the increased difficulty of teaching and learning mainstream science (especially senior secondary) using te reo Māori only, exacerbated by the policy against borrowing from English which, followed in the science curriculum, has led to an extra barrier (already formidable for many mainstream students) to the internationalisms of science language. The philosophical irony is that the current system of Pūtaiao education acts to inhibit critique of scientism in mainstream science or science education, a critique which might fruitfully be based on consideration of *the contrast between* traditional Māori knowledge forms, texts, philosophies or values, and modern science, technology and philosophy. There is further irony in the possibility that such critique would be equally as effective in English as in te reo, possibly most effective in a mixture of both (a belief which underwrites the paradigm of this thesis), although the current separate/parallel policy trajectory for Māori-medium education militates against the promotion of such complementary approaches.

Despite the emphasis on mātauranga in the literature on Kaupapa Māori, reflecting the wider emphasis on IK in multicultural education, therefore, it is of little or no everyday relevance to Pūtaiao teachers, especially at senior secondary levels. These disjunctions echo those found in the Pūtaiao curriculum document

and current examination system, as discussed above in Wāhanga Tuatahi and Tuarua.

5.1 Historical Discourses of Māori Science and Philosophy

In science education, the term ‘Māori science’ has been used to mean ‘traditional Māori knowledge’ (McKinley, 1992), or ‘mātauranga’ (Kapua, 1997), and considered as one of several divergent issues in science teaching for Māori students (McKinley, McPherson Waiti et al., 1992; McNaught, 1993; Waiti and Hipkins, 2002). Few educators writing from this angle claim expertise in mātauranga itself, however, with their interest primarily in developing science education to better meet the needs of Māori students, so as to enhance Māori achievement in science education. Other than school curriculum policy, the mātauranga debate has appeared in few recent contexts, with conservation (Roberts, Norman et al., 1996; Peters, 1993) and the university³⁵ being the most important of these. It is necessary to go further afield, to wider disciplines and further back in time, in order to find the discussions fundamental to the investigation of the notion of ‘Māori science’ as mātauranga.

Eurocentric Foundations: Early Debate on ‘Māori Science’

Literature on Māori philosophy might be considered to begin with authors such as Elsdon Best (1952), Percy Smith (1913), John White (1887), and others, based on ethnographic field work mostly dating from the late 1800s to early 1900s - or it could reach back to traditional oral texts - such as that analysed in Wāhanga 1.5 above. Two early Pākehā examples are included here. Despite the inherent limitations of these texts, tainted by sexism, ethnocentrism, and scientism, they remain immensely important records of mātauranga, which continue to be heavily drawn on in contemporary work (Webster, 1996; Roberts, 1998). For analogous North American discussion, see Jocks (1998, p.223).

The first example, cited in Wāhanga 2 (p.45) and again in this chapter’s epigraph, is *‘The Māori Division of Time’* (Best, 1986), first published in 1922. Much of Best’s writing can be considered ‘primary’ mātauranga text, in that he recorded directly from Māori informants or personal observation. This monograph, however, is a thematic collation of his own and others’ previous ethnography on

³⁵ See, for example, www.vuw.ac.nz/home/catalogue/index.aspx?course=MAOR-124&t=_2006 (accessed 12/2005).

this specific topic, situating the Māori content within ‘the Polynesian system of division of time’ (p.5) as a further level of abstraction, including a number of comparative lists of names for the lunar nights and months, seasons, etc. I have found this monograph a useful resource for teaching topics in astronomy, one area of school science that translates relatively well, and also enables use of traditional language in star and planet names (although standardisation is the next language issue that arises when traditional language *is* available, as the various iwi lists in this monograph indicate).

The second example, by Raymond Firth (1972), first published in 1929, is titled ‘*Economics of the New Zealand Māori*’. Like the above, this is also a ‘secondary’ text, because the author reads Best (‘unrivalled’ p.17) and the other earlier scholars for information on mātauranga, in this case pertaining to the encompassing topic or theme of economics. Thus, in these texts the living Māori person has been entirely removed from the research. It is an early form of discourse analysis, where the discourse being analysed is mātauranga, or more exactly, the European transcription thereof.³⁶ The agent is referred to throughout as ‘the Māori’, ‘the native’ (used to refer both to Māori, and as a general reified racial category), or ‘he’, and consistently in the past tense (Ninnes and Burnett, 2001). These once-standard textual practices arose from the research paradigm and the science of the time, as earlier discussed. Making these practices explicit is helpful in re-reading such older texts from a Kaupapa Māori research perspective.

For example, an interesting language note is Firth’s dedication (centred in the otherwise blank page preceding the Table of Contents): ‘To Dr Bronislaw Malinowski, Teacher and Friend, under whose *Mana* this book was written’. The use of a Māori word here is clearly tactical – but what is the tactic? One possible reading is that it is an example of local Orientalism (Said, 1978), where the word adds elitist mystery (acts as gate-keeper) in this address, while demonstrating the scholar’s knowledge (appropriation/control) of the Other. It is not simply ‘a Māori word’: this particular word (mana) is one ‘item’ of mātauranga that Western knowledge has found most useful to appropriate – one of the most powerful words in ‘Māori English’.

³⁶ Evans-Pritchard reflected in 1962 that his work was ‘a kind of historiography’ (cited in Moody-Adams, 1997, p.74).

Another example is the ‘slogan’ for the frontispiece photograph of ‘Waewae Te Kotahitanga of Ohaua-te-Rangi with the spear and cloak of former days’ (Firth, 1972, Plate I Frontispiece). Centred directly under the photo, above the legend just cited, are the words ‘THE PASSING OF THE OLD ORDER’. The tone is of eulogy, echoing the admiration prevalent in such early writing on Māori, and not unexpected in any study for which the writer clearly shows such interest. Nevertheless, the point being made, by the choice of both image and words, is that Māori power is extinct (a requisite for eulogy).

Thus, the underlying premise in these analyses of Māori knowledge and society is that the people and practices being discussed no longer exist, as the Best quotation which opens this chapter makes explicit. This is consistent with the politics of ‘smoothing the pillow of a dying race’, which dominated race relations (from a Pākehā viewpoint) following the cessation of war from about 1870. While Best described Māori astronomical knowledge entirely in the past tense, Firth extends his survey to include the contemporary status and future economic prospects of living Māori communities, since a primary purpose of his work is ‘the possibility of applying our conclusions to the wider problems of economic anthropology and the science of human culture’ (p.492). Firth’s commentary on then-recent developments in Māori society are clearly more relevant to today’s situation than the earlier pre-1900 ethnography, as Webster (1996) has noted.

While most chapters treat various aspects of ‘the economic organisation of the Māori in pre-European times’, the penultimate chapter focuses on ‘the period of transition during the last hundred years and the new Māori economy as it appears today’ (Firth, 1972, p.433). This is the revised (1959) edition, published 30 years after the original, and in the Foreword the author notes that this chapter in particular was substantially updated in revision, which may account for some mismatch in textual tone. At the start of the chapter, for example, describing ‘the status of the Māori’, he notes

the Māori himself – where he is still to be seen – is greatly altered ... To the casual eye the culture change is complete. But ... despite the progress made in some circles, the transmutation is not yet everywhere accomplished. (p.437)

Here the effect of the parenthetical phrase – ‘where he is still to be seen’ – is both chilling, and at odds with the tendency of the discussion, which leads into the following caution:

It is neither necessary nor desirable ... to endeavour to turn the Māori into a European ... the best interests of the native may be served by retaining certain aspects of his social scheme and attempting to modify them ... rather than ... supplement them wholly by our own culture patterns.

The abolition or replacement of any native institution, however crude and undesirable it may seem to us, should never be lightly undertaken. To glance at the Pacific alone, it is clearly proven ... that the elimination of native customs, though well intentioned, has too often meant the elimination of the native as well. (p.438)

The bulk of the chapter describes the ‘four main phases ... in the transformation from the former to the present Māori economy’ (p.439) as:

- I. The Phase of Initial Contact (pre-1840)
- II. The Enthusiastic Adoption of Culture Forms (1840 - end of war in 1872)
- III. The Mood of Reaction (1872 - 1880)
- IV. The Acceptance of European Standards (from 1880 – 1927). (p.439-457)

An important point concerns the transition between the first and second of these phases. Firth gives two reasons for selecting the year 1840 to mark this: first, that it marks the beginning of permanent European settlement, on land purchased at Pōneke (Port Nicholson) in late 1839 by the New Zealand Company; and second, ‘by the Treaty of Waitangi the sovereignty of the lands was handed over to the English Queen’ (p.446-7). Firth’s interpretation of this event is further clarified: ‘the Treaty represents the first overt acknowledgement of the interest of external authority in [Māori lands]’ and ‘the formal notification of the first steps towards a comprehensive European control of the native lands’. This is the only mention of the Treaty of Waitangi in this substantial volume, and it indicates usurpation, rather than economic partnership, as the Treaty’s intent. Firth notes, ‘the powers of the English authority were utilised – through the Native Land Court, Acts of Parliament, and even armed intervention’ to this end, adding, ‘I pass no criticism here of our native land policy; it is sufficient for my purpose to record the facts.’

Recording that land disputes led to ‘open hostility’ in the latter stage of Phase II, Firth writes: ‘With the conduct of the war it is for the historian, not the economist or anthropologist to deal’ (p.454). The third phase is termed an 8-year fit of ‘mental depression’ on the part of Māori, brought on by military defeat and prediction of the end of their own race, and a ‘shaken confidence in the

European'. Noting the rapid increase in European settlement during these years, the transition to Phase IV is heralded by 'a revived interest' of Māori in Pākehā:

Even in the King Country, where Tāwhiao and his followers had sat with averted face, a more friendly feeling was made to prevail. A policy of conciliation was adopted, the seclusion of their land was broken by the arrangement with the Government which enabled the latter to throw open the interior for settlement... The effect on the Māori of this influx of white settlers was very marked. At first taciturn and holding rather aloof, they speedily became on good terms with the new-comers. (p.457)

The 1959 extension of this review included a further phase of 'Acceleration of Economic Development', fueled primarily by rapid growth of the Māori population from 1900 - 1950. This discussion prophetically considers the 'interesting and thorny problem' of 'assimilation or not' which the author asserts is 'a false statement of choice', reasoning that Māori will continue to retain their own identity through the **memory** of traditions and associated values, and through continuing practices of hui, tangi and marae, their own language, 'patterns of kinship and loyalty', and customary foods, all of which are 'symbols of group differentiation':

The importance lies in the symbols of group consciousness and group unity thus presented. *In themselves these things have no absolute value.* Moreover, if they assume a politically aggressive form they can be dangerous to the life of the wider community, of which the Māori now form an inextricable part. On the other hand, if they retain a cultural form, then they are exemplifications of that desire for separateness, individuality and personalisation of characteristics which are to be found in all human societies (p.481, my emphasis).

The above quotes form candid commentary on local notions of symbolic power, habitus, and cultural capital (Bourdieu, 1991) - thought-provoking for anyone involved today in the symbolic 'industry' (Widdowson and Howard, 2002) of Māori-medium education. Firth echoed the change in trajectory of the time (famously associated with the Hunn Report of 1960) from 'assimilation' to 'integration' as the prevailing Māori education policy discourse:

If the watchword be not assimilation but *incorporation* into the political, social and economic body of the New Zealand community, then the Māori and the Pākehā with whom they share the country should hope in the long run for a working solution to their relationships. (p.482, original emphasis)

From the perspective of 45-plus years later, two interesting phrases here are 'share the country' and 'working solution'. Webster (1996) 'credited [Firth's analysis of Māori kinship in the 1950s] with beginning to move beyond th[e] dogma' of cultural anthropology's primordialist orthodoxy on Māori, i.e. the waka-iwi-hapū-whānau model. 'However, because [Firth] did little fieldwork and assumed hapū

no longer functioned in contemporary Māori society, his insights were largely stillborn' (Webster, 1996, p.242).

An ambivalent note returns in Firth's florid closing words:

We have stood by him in his struggle for subsistence and the sweets of life; we have followed him in his fowling, his fishing, his planting, and his other daily tasks; we have listened patiently while he sought with muttered spells and the simple ritual of magic to bend Nature to his will; we have sat by his side at the feast and have travelled with him along weary trails in search of the precious nephrite [pounamu]. We have watched with curious eyes his first meeting with the *pakeha*, and have seen the tragedy and the courage of that encounter – to turn and bid him farewell at the last, not with the mourner's cry, but with the augury of a more lustrous future as a member of a community wider and more strongly knit than his fathers ever knew. And now we may say with the native of old: "The children of Tane, the trees of the forest, have fallen" – our task is finished. TAKOTO KAU ANA TE WHANAU A TANE (Firth, 1972, p.494)

While 'bid him farewell', coupled with the final death image, sound dire for Māori, presumably they are intended merely as a metaphor for 'closing the book', addressed (as is the entire study) to the European reader, who is perhaps assumed not to have direct contact with Māori. In a sense, however, the discursive style and choices discussed above act to reinforce, as well as record, Pākehā security. It is as though, to the reader, such ambivalences as those speculatively highlighted above, might be subconsciously reassuring - that Māori are no threat, all in the past, interesting but incapacitated now. The wider relevance is that such a text contributes to the written canons of history that construct societal truths - the 'dominant detrimental stories' referred to above, against which Kaupapa Māori theory has arisen (see p.9). Once again there is the strategic use of the voice (reo) of the Other, in the whakataukī (proverb) used to end the text (centred, in capitals, below the preceding sentence) – a final demonstration of Orientalist symbolic power.

It is time to turn to Firth's sections most relevant to Pūtaiao, and the issue of mātauranga and science. The collated information on mātauranga in this volume is substantial, since most mātauranga can be connected to some aspect of 'economic activity'. Three interesting examples of **mātauranga change** appear in the penultimate chapter. The first of these concerns heitiki, the pounamu (greenstone) neck ornaments symbolic of Māori wealth and rangatiratanga (aristocracy). Firth cites the heitiki – or rather, the 'greenstone adze' that in many cases they were carved from - as 'an interesting example of the substitution of goods and the

replacement of values'. Since these adzes were rendered obsolete as implements by the steel axe, 'they were turned into the next most suitable form of wealth – namely, ornament' (Firth, 1972, p.485-6). The second example is the description of the 'recent innovation [of] an action song consisting of haka movements, though less vigorous, with words linked to a popular (Western) melody' (p.481). The third example is a new meaning for an old whakataukī (traditional saying):

'By feathers alone can the bird fly, by clouds are the heavens covered', said the old Māori, meaning that only by means of the proper assistance can anything be performed. To this the modern Māori has supplied a new referent, so that as used today, it carries the force of 'money is the sinews of war' [often just the 'feathers make the bird fly' part is heard today]. (p.490)

These are interesting examples, since today all three cultural items – the pounamu heitiki, the waiata-a-ringa, and the modern meaning of this whakataukī – are widely regarded as part of ancestral (pre-European) Māori heritage, not post-European modifications thereof. They could be considered explicit examples of Hall's 'impure' or 'hybridised' cultural forms (discussed in Wāhanga 4.1). Such changes of meaning and nuances of history are largely invisible within the educational discourses that would draw on 'Māori culture' as curricular content for today's Māori students. This point returns to the question of relative authenticity of knowledge, which must be raised in parallel with that of language.

These two texts (by Best and Firth) are examples of the corpus of older European scholarship that is the foundation for recent literature concerning the status of mātauranga as science, discussed below (Roberts, 1998; Stewart-Harawira, 2005). In his initial purview of Māori economic resources, Firth noted 'there existed, nevertheless, a distinct and comprehensive body of scientific data founded upon keenness of observation and an acute perception of minute differences' (Firth, 1972, p.64). His discussion on 'Māori science' is worth recording here in full:

The statement has been made that the native lacks any intelligent interest in plants, trees, insects, and the like, save where they help to satisfy his wants, or by some striking peculiarity appeal to his sense of the strange or grotesque. With the Maori this hardly seems to be the case. It is only natural that the knowledge of the features of his environment should be much fuller and more detailed in respect of those objects which have a definite practical interest for him; it is unquestionable that the greater part of the fund of information pertaining to birds, plants, and minerals was accumulated directly on this basis of economic interest. At the same time this is not inconsistent with a certain desire to obtain knowledge for its own sake, to observe and describe with accuracy, with the object of better classification. This state of mind, akin to scientific curiosity, does not seem to be entirely lacking in primitive man, if one is to judge from Maori evidence. But this is

a subject which so far has attracted little attention from field workers. For further and conclusive evidence we must rely on more extensive research. A scrutiny of the mass of data setting forth the nature lore of the Maori, however, indicates that some portion of this knowledge, such as that regarding the habits of the smaller birds and the characteristics of the less important plants and insects, was not founded on purely practical considerations or on the exceptional qualities of the objects. Moreover, the native displayed considerable accuracy of observation, enabling him to discover certain of the less obvious of natural phenomena, and also to elucidate the affinities of a number of animals and plants. ... On the other hand, extensive discrimination between closely allied species seems to have been lacking, and the criteria of differentiation were often those which botanical science has shown to be subordinate or irrelevant. Also, errors in classification often seem to have been made. Thus natives attribute a difference in sex to some forest trees which the botanist recognises as being of different species, though of the same genus; also they classify the bat as a bird (*manu*). But on the whole, the categories which they employ in the classification of birds, plants, etc, are surprisingly exact, and indicate close observation. Mixed with much crude statement is a lot of real botanical and zoological knowledge. (p.59-60)

Firth's use of words such as 'surprisingly', 'crude' and 'real' is very telling in terms of an implied hierarchy of knowledge, reinforcing the view of his research paradigm as Eurocentric. Firth restricts 'Māori science'³⁷ to certain aspects of zoology (e.g. ornithology and entomology), botany, and geology (though Firth would probably agree to add astronomy and meteorology, maybe more, to this list of science domains represented in mātauranga). Curiosity, close observation of nature, and being a 'prolific name-giver' (Firth, 1972, p.60 fn.3) comprise the basis that Firth extrapolates to suggest it is valid to speak of Māori science. In terms of the Standard Account, however, this comparison is insufficient (see p.48). With cognisance of Duschl (1990)'s thesis, what is lacking in Firth's account of 'Māori science' is a framework of organising theories and concepts, and a philosophy or epistemology underlying the 'knowledge'. Firth tends to compare mātauranga with a caricature of science as nature study (also seen in the multicultural science education literature, discussed in Wāhanga Tuatoru). To take Firth as authoritative on the question of Māori science, therefore, is reckless, however tempting.

The contemporary acceptance of this 'indigenous science as nature study' interpretation is shown in the following recent version of Firth's comments cited above:

³⁷ Firth did not actually use the term 'Māori science', although in precursors to this modern usage, Malinowski made reference to 'primitive science' (cited in Jarvie, 1970, p.56) while I.C. Jarvie himself wrote of 'native science' (Jarvie, 1970).

Indigenous scientific knowledge includes minutely detailed knowledge of the natural world and a comprehensive understanding of the smallest phases of change that occur in the natural world, as demonstrated in the extremely specific inscription of names by characteristics or phases of growth. (Stewart-Harawira, 2005, p.37)

The general acceptance of this view of Māori science owes much to the successes of international indigenous scholarship, such as Kaupapa Māori, as well as the rise of pluralist notions of science (as discussed in Wāhanga 2.1), supported by politically sympathetic W-scientists (see p.65) and philosophers (Peters, 1993). While apparently politically attractive, this claim bolsters a position calling for the replacement of W-science by mātauranga in the Māori-medium science curriculum. In this way, under the banner of 'Māori science', this position heads towards the 'anti-science' pole of the knowledge dialectic of 'scientism' versus 'anti-science' (Sorell, 1991; Durie, 2005), and ultimately serves the educational interests of Māori students very poorly. The impact in Pūtaiao is discussed further below (p.161).

Firth's viewpoint on Māori science provides a final, important illustration of his Eurocentric research paradigm. While there is no reference to Māori ideas, theories or concepts of the natural world in his discussion of Māori science, cited above (except as pejoratively implied by terms like 'crude statement'), brief mention of Māori cosmology appears in another chapter, on the psychology of work, as part of 'avian mythology' (Firth, 1972, p.151), during consideration of motives for economic activities - in this case, fowling.

When anything is looked upon by a native people as being of some importance in their life, one nearly always finds some piece of mythology in connection with it, a story which purports to account for its origin, which sets it in a definite position in the scheme of existence, and as a general rule, brings it into relation with the pantheon of gods or culture-heroes. (p.149)

Firth goes on to mention Rangi and Papa as parents of Tāne, before briefly outlining the origin narratives and kōrero pūrakau ('fireside tales') relating to birds, the 'real importance of [which] is that it allows us to realise the place of birds in the cosmic scheme of the Māori ... under the direct care of Tāne ... [as] the explanation of the placatory rites and ceremonies which encrust the economic activities of the fowler at every turn' (p.151).

This example demonstrates how, in the process of abstraction, mātauranga becomes disrupted and reinterpreted through European concepts of knowledge.

Māori observational knowledge of the natural world, extracted from its matrix of value concepts and philosophies, was recognised (claimed) as scientific when viewed through economic Western eyes, while the underlying framework of philosophy was dismissed as ‘tales’. Takirangi Smith describes the process as follows:

By framing whakapapa kōrero within the context of history and myth the process commences with the decontextualising of discourses from the particular landscapes, environments, or physical and spatial context to which they relate. This objectification process then renders them into an abstraction which is then recontextualised within the lineal time frame of history where European/Western analysis has in the past applied its own criteria. (T. Smith, 2000, p.54)

If Firth’s text, and others like it, form the discursive foundation for the modern promotion of ‘Māori science’, it also throws light on the wider lacuna in multicultural science education discourse, discussed above as a disjunction between the empirical and philosophical aspects of science and IK. In contrast, a contemporary mātauranga text on the theme of conservation (Roberts, Norman et al., 1996) reverses this discursive practice, by beginning with a synopsis of Māori cosmology as the explanatory framework of analysis.

While highlighting its Eurocentric paradigm, this review indicates the richness of Firth’s book as a reference on mātauranga. At the same time Firth offers critique of the economics of his own culture, including the notion of homo economicus. In his brief final chapter, the closing words of which were cited above, Firth concluded that the ‘communal ideal’ (which he had already firmly differentiated from ‘communism’ in a previous chapter) was largely responsible for the absence of extreme poverty, unemployed or leisured classes in traditional Māori society.

[T]he compulsion to work, to save, and to expend is given not so much by a rational appreciation of the benefits to be received as by the desire for social recognition, through such behaviour. The entire scheme of motivation in industry is thus lifted from the biological to the social plane. In this conversion of instinctive to cultural drives in the case of the food-producing activities of the human animal lies one of the fundamental problems for future economic study. (Firth, 1972, p.494).

This point is expanded in the book’s Preface by R. H. Tawney (1880-1962), who discusses the usefulness of Firth’s research as a basis for economic science to critique its own assumptions, which otherwise tend towards ‘economic fundamentalism’. The relevance to Pūtaiao is that the assumptions mentioned also underwrite scientific doctrines such as evolutionism (see p.187).

Economic fundamentalism of this kind is less tyrannous than it was, but, outside the ranks of economists themselves, it is still a power. The assumption that effort is always a 'cost', and that the 'motive' which causes the cost to be incurred is the desire of the individual to 'satisfy his wants'; the crude antithesis between 'self-interest', which is supposed to be all-powerful, and 'altruism', which is supposed to be weak; the common assertion that no one will work except under the spur of immediate economic necessity ... - how familiar it all is in current discussions of industrial policy! And how fantastic and remote from human realities! ... To understand our own problems, it is sometimes expedient to stand outside them, in a world with different standards and presuppositions. Civilised peoples are disposed, perhaps, both to underestimate the part played by economic rationalism in primitive society, and to exaggerate that which it plays in their own. Studies such as that contained in the following pages, by correcting the first error, help indirectly to remove the second. (Firth, 1972, p.13)

Given the intervening development of the 'market society' since these sentences were written, nearly 80 years ago, they appear prophetic today (except for the claim that economic fundamentalism was waning). Another link to Pūtaiao is McLaren's 'critical pedagogy' challenge to schools, to resist control by the market (McLaren, 1995; see p.101). Firth's old text on Māori economics thus helps to illuminate and critique the basis of contemporary global afflictions unleashed by late capitalism.

Rationality Debates in Anthropology: Reichenbach and Māori Logic

The philosopher of science Hans Reichenbach was cited above in connection with the question of ethics and science (p.50). Reichenbach enters the Māori science arena once more in the cross-cultural epistemological debates impacting on Pūtaiao. This link is traced in the following discussion through a series of four relevant papers (Horton, 1970; Cooper, 1975; Salmon, 1978; Salmond, 1985).

Terminology, disciplinary relationships, and political contexts have gradually changed in the longstanding debate about the relationship between W-science and 'primitive' thinking (Levi-Strauss, 1978). What became clear to me, after reading the literature reviewed here, is that multicultural science education research is an important current 'inheritor' of these debates. A chapter from the classic collection 'Rationality', edited by Bryan Wilson (1970) is taken here as an arbitrary starting point, and the first Reichenbach link, while recognising (with the editor, p.vii) that the discussion of rationality reaches back to the very beginnings of social science. This chapter by Robin Horton (1970), entitled '*African Traditional Thought and Western Science*' is described as 'a brilliant paper' by another contributor to the collection (Lukes, 1970). Horton lists the similarities

and differences between IK and science, claiming the key difference between them as knowledge systems arises from the fact that ‘traditional’ culture is ‘closed’, while ‘scientifically-orientated’ culture is ‘open’ (see also Lukes, 1970, p.200). This assertion, however, was disputed by Anne Salmond (1985) on two bases: first, documentary evidence of intense 19th century Māori interest and debate around the conflicts between various iwi accounts of mātauranga, and those between Māori and European beliefs; and secondly, the existence of liminality in Māori systems of knowledge (see p.167 below).

In the second ‘Reichenbach’ reference, David E. Cooper (1975) endorsed Horton’s claim of analogy between ‘magico-religious’ and ‘theoretical science’ propositions, and extended it to ‘the question of primitive *logic*’ (p.238, original emphasis), based on classic anthropological examples.³⁸ Cooper pointed out that ‘some writers use “logic” to refer to just about any aspect of native thoughts and beliefs’, a practice he labeled ‘obfuscating’, and stated his intent to discuss logic as understood by logicians. This clarification is vital in the debate. Cooper begins with the ‘peculiarity’ of certain ‘native propositions’, and the range of responses by anthropologists, which he classifies as follows (A-C), before arguing for his own position, D:

A1: primitives are child-like, pre-logical or illogical (the ‘intellectualist’ approach);

A2: primitives are contra-logical, irrational, or value non-logical principles above logic (e.g. Levy-Bruhl);

B: native propositions appear inconsistent due to anthropological errors - expressed either as a principle of charity towards alien thought (e.g. Evans-Pritchard), or holding that a condition of adequacy of translation is that it should preserve logic (e.g. W. V. O. Quine);

C: Such native propositions are not of a type to which truth-value can be assigned, being essentially symbolic or expressive, so logic is irrelevant (e.g. Firth, Beattie, Leach, et al);

D: ‘Primitive magico-religious thought incorporates an alternative logic ... one that certain Western logicians have constructed in ... some areas of theoretical science’. (Cooper, 1975, p.240-241)

Cooper proceeds to characterise standard (orthodox/classical) logic as binary (as in true or false), explaining the logic operators ‘either ... or’ and ‘not’. He then introduces L_3 or three-valued logic, attributed to logician Jan Lukasiewicz (1878-1956), which was later (1944) applied in quantum mechanics by Reichenbach. L_3

³⁸ Zande beliefs about the heritability of witchcraft, and Nuer beliefs about the souls of twins, are the main examples of alternative logic cited by Cooper.

contains an additional truth-value of 'indeterminate'. Cooper describes the problem in drastic terms:

Faced by the anomalies of quantum mechanics [from Heisenberg's principle, that if momentum is measured for a particle such as an electron, position cannot be, and vice versa], something has to give. Either the principles of quantum physics must be rejected, or they must be amended by introducing *ad hoc* 'hidden variables'; or the principles of probability must be given up; or such apparently fundamental principles as 'No action at a distance' must be sacrificed - *or* standard, two-valued logic must be revised in this context. (p.244, original emphasis)

Clearly, the last option is best. Cooper comes to his central point:

Reichenbach's originality consists in regarding logic as one of the candidates for revision, as itself an instrument in science, and not an inviolable measure against which all other scientific instruments must be cut. The possibility then emerges of preferring the claims of some scientific theory against those of standard logic should conflict between the two arise. (ibid)

Cooper then discusses the anthropological evidence for and against the various positions (A-D above), arguing that Reichenbachian application of L_3 to primitive thought 'dissolves' its contentious anomalies better than the competing accounts. This paper dates back over 30 years, but the following sentence is still surprising: 'I do so [argue for such application] partly to show that it would be *nice* if my approach can be made out, since these others [A-C] are all more or less defective' (Cooper, 1975, p.247, original emphasis). Cooper's apparently ludic approach to the thought processes of 'natives' continues through to his conclusion:

It is quite possible, if the spirit of this approach wins favour, that different non-standard logics might be suitable for different aspects or different peoples. I hope, in other words, to have suggested an area of ethnographical research and a methodology - an area, moreover, in which philosophers and ethnographers could, and would have to, collaborate. (p.255)

Politically unsavoury aspects of Cooper's thinking are shown here, including Eurocentrism, in treating other 'peoples' as objects of study, source material for a productive programme of research (implicitly, research conducted by Euro-American scholars). This quote reveals Cooper's implicit acceptance of the 'windowless monad' view of culture, attributed to classical anthropology (in the tradition of which Cooper was writing), and shown to be grounds for modern moral relativism (Moody-Adams, 1997). Relatedly, Salmond mused that

even in a lifetime of dedicated fieldwork (as in the case of Elsdon Best), assumptions of superiority may serve to objectify the thought-world of others for scrutiny, while closing off one's own. Under such conditions and particularly in colonial and neo-colonial contexts, accounts of 'traditional thought' are likely to be ethnographically insecure and ideologically distorted, and they are also likely to have damaging practical effects for those whose thought is being described. (Salmond, 1985, p.255)

Despite the usefulness of Cooper's explication of the terms of the rationality debate, his own anthropology exemplifies the concerns of ethnocentrism expressed here by Salmon. That Cooper also adheres to strong academic-internal reductive scientism (Stenmark, 2001; see p.51) is a further, related charge, supported by such statements as 'the virus-illness connexion will, we assume, be eventually subsumable under the laws of sub-atomic physics' (Cooper, 1975, p.247).

Three years later in 1978, the same journal (*Man*) published Merrilee Salmon's (1978) rebuttal of Cooper's paper. Salmon dismantled Cooper's argument by 'show[ing] that the Zande and Nuer examples [used by Cooper] are not sufficiently similar to the quantum physics examples to justify the claim that a three-valued logic is applicable' (p.444). She examines the difference between statements that are 'meaningless', e.g. 'God exists', which are outside scientific discourse and denied truth-value, and those that are 'indeterminate', i.e. testable in some circumstances, though not in others, such as statements about the momentum of a sub-atomic particle, noting it was 'somewhat unfortunate that the expression "untestable in principle" is used to apply to these two different types of untestability' (p.447). Salmon demonstrates that Cooper conflated these two meanings, and hence made an invalid assignment of the truth-value 'indeterminate', in the sense used by Reichenbach for quantum physics, to Zande statements about witchcraft.

As part of this argument, Salmon points out Cooper's disregard of Putnam's warning that 'it is dangerous to regard any sentences about the macrocosmic world as indeterminate' (p.448). She then shows the invalidity of Cooper's appeal, in support of his claims, to Putnam's test for three-valued logic, which rests on Cooper's claim that Azande are indifferent to, or lack interest in, the contradiction shown by such statements as 'All Azande are witches and not all Azande are witches' that arise from certain combinations of their beliefs, when it is pointed out to them by the anthropologist (in this case, Evans-Pritchard). Salmon 'think[s] this is a serious misreading of Evans-Pritchard' (p.452), whose data she rather interprets as indicating *rejection* of the contradiction, as explained by two further

Zande beliefs: that witchcraft heritability weakens over generations; and that witchcraft-substance, even if possessed, may be 'cool' or inoperative.

For Cooper's other major example of putative 'non-standard logic', concerning Nuer beliefs about the souls of infant twins, Salmon points out several more mundane explanations, which do not necessitate invoking three-valued logic. These include disagreement among informants, which Evans-Pritchard suggests by saying 'Nuer hold no decided opinions about the nature of the soul' and incompleteness of data, due in part to the 'difficulty of extracting information about souls from his informants' noted by Evans-Pritchard (p.453). Salmon concludes:

However, it would be a serious mistake to equate reluctance to discuss a topic with indifference to a topic... The scanty evidence available tends to support the view that Nuer regard some difficult propositions about souls as "not known to be true or false", but this is a case of suspended belief rather than an alternative truth-value assignment. (p.454)

In critiquing Cooper's position, Salmon notes:

Explicit attention to systems of logic is not a feature of Zande or Nuer belief. Nevertheless, on an intuitive level without appeal to any formal rules of logic, they construct logically correct arguments and can distinguish correct from incorrect reasoning. (p.449)

This acknowledgement is consistent with Cooper's own observation:

What is implausible is not the postulate of 'child-like' mentalities as such, but this together with the admission that outside the magico-religious arena primitives typically think in logical, sensible ways. That whole peoples, capable of consistent thought in general, should suddenly become 'child-like' when thinking within a particular field, would imply a schizoid intelligence that we should resist having to admit. (Cooper, 1975, p.247)

These statements reflect Salmond's claim to be unable to 'find any evidence that Māori use of logic differs in any essential way from European reasoning' (Salmond, 1985, p.253). This is central to Salmond's critique of the 'populist' colonial claim that Māori 'ha[d] no knowledge, only superstition and myth; their thought was held to be inferior to European reason' (p.256). This 1985 paper by Salmond is the fourth and final Reichenbach link, and lists as references the works by Cooper, Salmon, and Wilson previously mentioned. To return to the point about logic raised by Cooper, it is an important question as to the meaning intended for 'rationality' in Salmond's assertion that 'Western thought' remains largely closed to 'traditional rationalities' (p.260). (Also see p.167.) Furthermore, how is the term 'Māori epistemologies', which is the title of Salmond's paper, to

be understood? This question is highly relevant to the task in hand, of clarifying and evaluating the possible meanings of 'Māori science'.

The relevance of the rationality debate to Pūtaiao is that references to 'alternative logic' are often included in support of indigenous science. Besides the challenging of Eurocentrism, and the alignment with traditions of critique, this is another link between Pūtaiao/Indigenous science and postmodernist/poststructuralist philosophies. Greg Cajete (1999), for example, claims that Indigenous science is 'unquantifiable [as] associated with Western Science, as reflected in the Heisenberg Principle' (p.82). This comment appears to fall into the trap of Cooper discussed above, by supporting a differend of cultural logic, and to subscribe to the 'doctrine of descriptive cultural relativism' (Moody-Adams, 1997). Unfortunately, as previously discussed (p.98), by leaving the 'royal road' to science (Phillips, 1987), such ideas collapse in practice into 'soft options'.

The collection 'Rationality' (Wilson, 1970), in which the Horton chapter was included, is a widely-cited early reference in specific fields of debate between science and other knowledges such as religion or ethics (e.g. Gould, 2004; Moody-Adams, 1997). Many of the chapters cross-refer, and/or call on the same original fieldwork data, collected by classical anthropologists such as Lévy-Bruhl, Evans-Pritchard, Radcliffe-Brown, Frazer, Firth and Malinowski. All except the final chapter had previously been published elsewhere, and the author of that chapter, J. H. M. Beattie, noted his 'grat[itude] for the opportunity to continue here this in many respects fruitful dialogue' (p.241 fn.4), in a chapter consisting mostly of responses to three of the earlier chapters, including that of Horton, engaging with the other authors' critiques of his own prior work on the subject of rationality and culture. Besides the importance of its contribution to the rationality debate, this volume as a whole exemplifies major processes of academic discourse in social science - argument and rebuttal, critique and counter-critique.

Beattie's comments on Horton's paper form an appropriate conclusion to the volume, and this section. Beattie concluded that the differences between their positions in the debate were more of emphasis than substance. Beattie summarised the differences seen by Horton between science and 'traditional' thought:

1. In ‘traditional’ thinking a special power is ascribed to symbols, [a power] not based on hypothesis or experiment, since ritual’s essential quality [is] its expressive character, from which the belief in its causal efficacy is derived.
2. In a ‘traditional’ culture ideas are seen as bound to particular contexts rather than to other ideas, as in science.
3. Concern with the nature and rules of logical inference is characteristic of science, rather than the ‘traditional’ outlook.
4. The aims of science are explicit and specific, whereas in ‘traditional’ thought a variety of non-specific ends may be sought at the same time.
5. There is in traditional³⁹ thought a gradual shading of the cognitive into the expressive; dramatic representations of the gods are thought to be both causally effective in influencing them, and enjoyable for their own sakes. This differs radically from ‘the scientific ideal’, whose primary canon is that ‘every new theory be subjected to the widest possible testing and criticism’.
6. The traditional view of the anomalous and exceptional is as something dangerous, but to the scientist the anomalous offers an intriguing challenge. Thus ‘taboo’, a characteristic concept of traditional thinking, essentially implies symbolizing; for the ground of avoidance lies not in the experienced qualities of the object itself, but in what it represents.
7. For ‘traditional’ thought the passage of time (the vehicle par excellence of the new and the strange) is dangerous and unwanted, and attempts are made to annul it through rites of renewal and recreation. To a scientist, on the other hand, the temporal process, with the associated - and now rather threadbare - idea of progress, is welcome and indispensable. (Beattie, 1970, p.265)

To see in the last sentence, ‘the threadbare idea of progress’ is heartening, because it indicates this author’s sensitivity to the political implications of this scholarship, compared with Cooper (1975), and highlights once again the close link between the science of anthropology, the scientism of evolutionism, the evolutionist doctrines of economism, and the Pūtaiao curriculum (see also p.187). Having reviewed various sides of the rationality debate, Beattie concluded that, while he and Horton agreed in most areas,

I find it useful to regard the scientific and the ‘traditional’ as *two approaches representing fundamentally different and mutually irreducible ways of looking at the world*, [but] Horton thinks that they can be understood in terms of the difference between ‘closed’ and ‘open’ societies. (Beattie, 1970, p.264, my emphasis)

Agreeing with Beattie’s rejection of Horton’s explanation in terms of ‘open’ and ‘closed’ societies, I am happy to call on Beattie’s support, in the emphasised phrase, for my argument that the ‘whakapapa/standing-reserve’ conflict, at the philosophical-epistemological-ethical level, is the key ‘differend’ between science and mātauranga.

³⁹ The use of inverted commas around the word ‘traditional’ is inconsistent in this section of the text, and the quote follows Beattie’s usages.

The 1990s: Does Māori Science Exist?

Mātauranga discourse in the 1990s generally remained focused on the relationship between traditional Māori knowledge and modern science (Dickison, 1994; Lomax, 1996), as a local strand of the wider debate on science versus IK in science and science education, reviewed above in Wāhanga Tuatoru. The local debate included views of Māori and non-Māori, scientists and non-scientists, arguing either for (Mohi, 1993; Parsons, 1992) or against (Durie, 1996; Dickison, 1994) the proposition that traditional Māori knowledge constituted a science. The formation of NAMMSAT (National Association of Māori Mathematicians, Scientists and Technologists) in the 1990s was a significant attempt to facilitate a greater level of discourse for the issues in Māori science, with conferences held in 1995 and 1996, but limited activity since (NAMMSAT, 1995). One possible reason for this (apart from lack of funding) was that NAMMSAT participants were involved in fields as diverse as forestry, primary health services, and Pūtaiao education, making meaningful professional conversations difficult to maintain.

A relevant policy discourse is that of science as an activity (reason) of the state. In a report on mātauranga completed during the mid-1990s review of publicly-funded science (MoRST, 1995), as part of the economic re-structuring of the state sector, the author, Terry Lomax, concluded that mātauranga Māori was in urgent need of preservation and worthy of research, even though '[t]he discussion whether mātauranga Māori is "science" or not is largely irrelevant.' (MoRST, 1995, p.10). The report proposed specific funding of mātauranga Māori research, as it does not fit within contestable public-good science funding criteria. Nevertheless, by emphasising its 'potentially useful knowledge' (p.6), such as 'jewels of information pointing towards methods of utilising and preserving the environment' and in noting that 'the Māori cultural paradigm has a commercial value', the report suggests utilization of mātauranga Māori by mainstream science, culture or the economy, is the underlying purpose of its preservation. This is an example (in this case, pre-dating widespread use of the term) of the 'knowledge economy' perspective on mātauranga Māori (Devine, 2001). A subsequent paper by Lomax again displayed this instrumentalist (imperialist) stance: 'The challenge for "science" is to firstly understand and then verify that knowledge base so as to distinguish fact from myth and fiction, and thereby allow

mātauranga Māori to become a valuable part of mainstream science' (Lomax, 1996, p.13).

In a seminar for the (then recently-established) Department of Conservation (DOC), Michael Peters related the development of 'postmodern science' to current issues of concern to DOC (Peters, 1993). Conservation, and hence DOC, is a relatively important context for discourse of Māori science (Roberts, Norman et al., 1996; Marsden and Henare, 2003), due to the fact that it is concerned with the 'environment'; that its establishing statute included a directive to give effect to the principles of the Treaty of Waitangi in its work (Conservation Act, 1987), and perhaps also because conservationists line up with Māori as groups whose interests have traditionally been excluded by the state and economic interests.

Peters poses a number of questions in this paper (to which he views the answers as 'quite plain') that focus on the contemporary science policy restructuring referred to above, which he interprets as the 'commodification of science', and its implications for both Māori and conservation interests:

- Can the practice of science be separated from the policy context which articulates strategic goals concerning the overall direction of research emphasising its contribution to economic performance?
- How compatible is the notion of 'sustainability' with an emphasis on science for economic growth?
- How do Māori get recognition for mātauranga Māori within the present science policy regime? (Peters, 1993, p.23-6)

Peters describes two accounts of postmodern science, one that re-integrates science with philosophy in a 'return to cosmology', the other that 'functions as a critique of contemporary science, and the way in which science as a reason of the state has been put in the service of economic development'; both accounts seeing science as 'a set of social practices belonging to a culture', and both thus 'sympathetic to the claims of those who have been excluded from science or who have suffered as a result of it' (p.14).

Peters suggests that according to these criteria, traditional Māori knowledge or mātauranga **is** postmodern science. Reiterating Anne Salmond's prophetic words, 'the process of opening Western knowledge to traditional rationalities has hardly yet begun' (Salmond, 1985, p.260), he mentions 3 examples that **have** begun this process, including a report by the Ministerial Task Group Reviewing Science and

Technology Education, 1992, which ‘acknowledges that “an enormous body of knowledge would be lost if indigenous peoples lose or are deprived of their culture and heritage” and argues for the inclusion of such knowledge in the school curriculum’ (Peters, 1993, p.27). Māori representatives on the Task Group requested that the existence of a Māori body of scientific knowledge be acknowledged. The other cited examples are the two developing discourses of Kaupapa Māori research, and of Māori intellectual property rights. Thus, Peters suggests Māori science could be a ‘postmodern science which might serve as a framework within the local context to take account of the voices of Māori and conservationists’ (p.6).

Divergent thoughts by Mason Durie were reported in a recent review of the ‘science/mātauranga dichotomy’ for Waitangi Tribunal research (Williams, 2001), which included each of the above-mentioned references. Durie states, ‘mātauranga Māori is not a type of science (even if it does contain elements of scientific thinking) any more than science is a substrate for religious beliefs and understanding’ (cited in Williams, 2001, p.21). This assertion contrasts with Peters’ argument above. Further, Durie makes a language/knowledge distinction: ‘The retention of mātauranga Māori is as important as the retention of te reo Māori. One feeds the other though the promotion of te reo Māori and the promotion of Mātauranga Māori are different issues and require different approaches’ (p.22). Unfortunately, Durie does not explicate further the two different approaches he refers to here. He identifies the major sites of Māori science discourse: ‘Education curricula, science and research goals, and environmental education make liberal use of mātauranga Māori and do so in a manner which runs the risk of distorting both context and content’ (Durie, 1996, cited in Williams, 2001, p.23).

Durie’s comments complicate the epistemological issues involved in Māori knowledge, compared with their usual treatment in contemporary science education materials. On the other hand, his comments reflect a viewpoint on science that does not explicitly problematize its claims to objectivity and ethical/cultural neutrality, as does, for example, Peters (1993). While Durie’s main point is that mātauranga Māori ‘belongs to iwi’ and ‘should be under Māori control’, he also calls on the Crown to ‘make funding available for its retention,

transmission and development’ (cited in Williams, 2001, p.20). The conflict inherent in these two claims is a dialectic that arises repeatedly in policies and issues of tino rangatiratanga, related to the argument in Wāhanga 4.1 (p.104) that ‘power-sharing’ between the state and iwi is more symbolic than real.

Regarding education, Durie comments ‘traditional Māori knowledge has been incorporated into mainstream frameworks as part of a determined bid to make mātauranga Māori widely available in educational curricula. In this process there has often been Māori support if not Māori initiative’ (cited in Williams, 2001, p.22). Such commentary, at a hui attended mainly by university academics, highlights the lack of direct communication between those concerned with mātauranga Māori in the school sector, university, state science, and conservation. This segmented and limited nature of Māori science discourse contributes significantly to the curricular problems identified above. It also reflects and further complicates the reported gaps in wider discourses of philosophy of science and science education (Benson, 1989; Duschl, 1990).

Williams concludes his review of the mātauranga/science ‘dichotomy’ by suggesting there is no point in debating whether or not mātauranga Māori is science. ‘If calling ‘mātauranga Māori’ ‘Māori science’ is seen to be a way of validating indigenous knowledge, and equating it with Western science by giving it a Pākehā name, then I believe this to be both unnecessary and unwise’ (M. Roberts, cited in Williams, 2001, p.25). Hence, the ‘validity’ of the notion of Māori science is related to an understanding of the notion of science: the use of the term ‘Māori science’ problematises the universal claims made by ‘science’. The point is not to show that mātauranga is a type of Western science, but rather to reflect that both are cultural ways of knowing about the world. As McKinley notes, ‘science knowledge is designed specifically to marginalise other knowledge (indigenous or not). I therefore make selective use of the term ‘Māori science’ to challenge and provoke thought on this matter’ (McKinley, cited in Roberts, 1998, p.69).

This politicised or strategic understanding of the term ‘Māori science’, espoused, as discussed above, in work by Parsons (1992), Peters (1993), McKinley and Roberts (1998), clearly is not shared by all participants in the debate (Matthews,

1995), as evidenced by, for example, the reference to ‘Māori scientific knowledge’ in *Science* (M.O.E., 1993). Arguments in support of ‘Māori science’ often indicate this confusion:

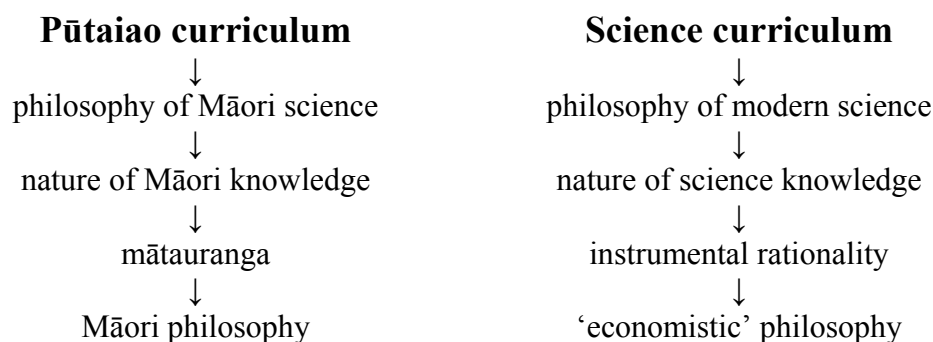
The existence of Māori science is indisputable, but as an individual term, ‘science’ is irrelevant. Science is but a small part of mātauranga, yet it permeates nearly every aspect of it. (Kapua, 1997, p.97)

This conclusion is in direct contrast to that of Smith (1995), who points out that ‘the notions of *western science* or *Māori science* can be somewhat misleading’ (p.105, original emphasis). Intended as strategy, this notion of ‘Māori science’ has at times been unproblematically accepted, aided by a sympathy towards cultural relativism (in opposition to cultural imperialism, see p.102 above) in indigenous and postcolonial scholarship (Stewart-Harawira, 2005). As with the earlier discussion of scientism (p.50), this confusion may cause problems particularly **outside** academic circles of science and philosophy. To cite a Canadian example, in evidence to the government on the role of IK in establishing a new diamond mine, an Aboriginal Dene Nation elder explained, ‘I call it Dene science because in the literature it is regarded as a science’ (Widdowson and Howard, 2002, p.31). It leads to the currency, for example, of the idea amongst the KKM community that the Pūtaiao curriculum can, and should, be based on distinctively ‘Māori’ science.

Understanding how this confusion can easily arise, based on an earlier Eurocentric notion of ‘Māori science’ as ‘primitive science’, promoted as a strategy against the hegemony of ‘Western science’, and promulgated as a purported alternative science curriculum through Kaupapa Māori networks, provides a cogent reason to discontinue the use of the term ‘Māori science’, except under close advisement, as well as a signal story concerning academic responsibilities in regard to the effects of discourse, particularly in politically charged fields (and which are not?).

As presaged in Wāhanga Tuarua, it may be more productive to make comparisons between the **philosophy** of mātauranga, and that of modern science, since ‘it is at the philosophical level that the greatest discrepancies between positivist science (as well as some other views of science) and indigenous knowledge are to be found’ (McKinley, 1995, p.69), and because it allows consideration of a wider range of literature. The sites of enquiry involved in Pūtaiao curriculum research

can be written exploratively in layers, below. On the left, however, the four terms underneath the heading are more-or-less synonymous.



In the last section of this chapter (Wāhanga 5.3), I write about my own ‘abstraction’ (hanga), and compare some key notions in philosophy of mātauranga and science, but first, the following section reviews two prominent published models.

5.2 Voice and Authenticity in Contemporary Mātauranga Discourse

From earliest contact, Māori people and culture inspired many European writers, in time joined by Māori authors, with some early names including Ngata, Buck/Te Rangi Hiroa, Tamihana-Tarapipi, Makareti and Winiata (who in 1952 became the first Māori PhD, Winiata, 1967). Many new (and republished) books on all aspects of mātauranga continue to appear, with a few recent examples including:

- Māori Games and Haka (Armstrong, 2005)
- Māori Bird Lore (Riley, 2001)
- Song of Waitaha (Brailsford, 2003)
- The Woven Universe (Royal, 2003)
- Tohunga: The Revival: Ancient Knowledge for the Modern Era (Robinson, 2005).

The first two of these, like those of Firth and Best reviewed in the preceding section, use a theme from European knowledge schema to organise and interpret mātauranga. ‘Song of Waitaha’ contains traditional wānanga narratives shared by the author’s informants/supervisors. This book is cited as an ‘identity paradigm text’ by Makere Stewart-Harawira (2005), in a way similar to my own use of ‘Te Whare Tapu o Ngāpuhi’ (p.197 below). These first three books have Pākehā authors (with varying degrees of Māori collaboration/reference), while the latter two treat mātauranga from a Māori author’s personal perspective, and focus on Māori philosophy as much as practical knowledge, or re-telling detailed narratives. While such books are outside (or peripheral to) the academic canon,

they record and interpret mātauranga as learned directly from Māori antecedents, and thus are relevant and valuable in Kaupapa Māori terms (see also quote below, p.179, from Royal, 2003).

In terms of the voice or identity represented, it seems logical to argue that new publications on mātauranga must, by definition of temporal remove from traditional Māori society, be regarded as even further levels of ‘abstraction’, in comparison, say, with the two early examples by Best and Firth, reviewed above. Yet, as the Kaupapa Māori paradigm attests, the intergenerational continuity of traditions of mātauranga, while exceedingly attenuated and modified, has never been entirely extinguished (Salmond, 1985; May, 2002). Thus the three latter examples make some claim as ‘primary’ mātauranga texts, although this claim cannot be considered to make them ‘authentic’, a notion which is inherently problematic in relation to mātauranga (and knowledge, and culture in general), as previously discussed.

The following discussion focuses on seven texts, by four diverse⁴⁰ authors, namely, John Patterson, Mere Roberts, Anne Salmond and Katerina Simon, as a small sample of the contemporary academic corpus on mātauranga. These particular texts have been selected because they illustrate two different approaches to analysing mātauranga, as discussed below.

Mere Roberts (1998) compared the knowledge systems of Western science (WS) and indigenous knowledge (IK), noting ‘theory-ladenness of observation’ leads to a ‘cultural filter’ which ‘operates to produce markedly different cultural perspectives or worldviews held by Māori and non-Māori’ (p.60-1). Roberts modelled ‘humankind’s various knowledge systems’ as circles in a simple set diagram, in which the two circles representing WS and IK begin with significant overlap, involving ‘the apparently universal cognitive properties of classification ... as well as elements of myth, magic and religion’ (p.61). The Scientific Revolution led to ‘progressive epistemological divergence on the part of WS’, which in the model is represented by a reduced area of intersection between the two circles.

⁴⁰ Since they include: two Māori, two Pākehā; a biologist, an anthropologist, and a philosopher; a professor emeritus and a doctoral student...

Roberts' analysis balances similarities against differences in comparing the two knowledge systems, thus accommodating the diversity of perspectives found in the literature, including the previously discussed (p.160) 'dissenting opinion' of Durie (Roberts, 1998, p.69), by asserting that each knowledge system 'has validity within its own cultural context' (p.68). The implications of this condition, while not discussed by Roberts, are obviously vital, as it returns the discussion to the level of politics and history (perhaps even space and time). On one hand, it could be interpreted as an uncontroversial statement that mātauranga was a valid knowledge system in traditional pre-European Māori society. On the other hand, to say that mātauranga, rather than science, is valid in contemporary Māori cultural contexts, is a far more nebulous and contentious claim, and easily succumbs to the doctrine of cultural relativism (Moody-Adams, 1997), which allows the dominant culture to ignore real moral disagreements, and thus serves the interests of indigenous ethnies such as Māori very poorly.

Katerina Simon (2003) employs a similar model containing two intersecting circles, labelled 'scientific ways of knowing' and 'Māori/indigenous ways of knowing' (p.53). Simon identifies 'scientific conservatory values' relating to the environment as an important area of overlap or 'convergence' between Māori and scientific values, which can lead to the 'synergy [of] a shared discourse that is characteristic of post-materialist green understandings of the humankind-environment relationship ... [with] potential as a means of reconciliation and of mobilisation around the notion of sustainability' (p.54). This is consistent with the previous observation that conservation is one of the primary sites of Māori science discourse. The paper can be viewed as attempting to theorise this discursive link, although some issues remain unaddressed.

For example, while Mere Roberts is referenced in this paper (though not the specific paper discussed above), there is no acknowledgement of the similarity between their models of IK and WS. Indeed, Simon states there has been 'a preoccupation with contrast' (Simon, 2003, p.69) by previous authors on mātauranga/IK versus science. In choosing to focus on areas of overlap, she fails to address the opposing arguments, such as that the Māori conservation ethic is 'more akin to game management than to conservation ... in the preservationist

sense as the altruistic management of bird species for their own good rather than for the good also of the harvesters' (Kirikiri and Nugent, cited in Roberts, Norman et al., 1996, p.12). Simon's assertion that Māori and conservation perspectives can be unproblematically aligned belies the ongoing disputes between DOC and iwi groups in many areas of Aotearoa New Zealand.

Simon frames the issue of Māori versus scientific values within notions of 'similarity/affinity and difference/distinction', stating that reconciliation of these is 'one of the most important development issues of our contemporary period' (Simon, 2003, p.44). Simon does not explicate or attribute this assertion, but it is plausibly related to the 'differend' notion of cultural difference (Lyotard, 1989) (see also p.138). The 'notions of difference and sameness' are used by Simon to link Māori values to Māori identity, arguing that these change in concert. This apparently leads Simon to the conclusion that, as Māori identity has changed under the impact of colonisation, Māori conservation values have also 'evolved' (Simon, 2003, p.49, 54) so that they are (or can be) aligned with those of science, and that focusing on this 'convergence' is beneficial for Māori interests ('greater political viability', 'more pragmatic', p.54). This reasoning seems dubious, nevertheless, considering that all the 'convergence' so far has entailed Māori adapting to science, and possibly amounts to a variant of the 'knowledge economy' argument, which is unable to account for value (or, indeed, cultural) differences from those of economic rationality (Devine, 2001).

While both Roberts ('reversing the usual assumptions', Roberts, 1998, p.61) and Simon ('the Māori/indigenous standpoint', Simon, 2003, p.49) explicitly reject a Eurocentric position on mātauranga, both papers are written largely in the universalised academic voice, and both conclude with similar general claims (below), claims which, while clearly pro-Māori, do not obviously follow from the preceding argumentation, and are couched in terms which make them difficult to accurately evaluate.

[A]ll New Zealanders stand to benefit by [mātauranga Māori]. (Roberts, 1998, p.71)

In [determining the shape of the future], Māori and other indigenous peoples have a very important role to play. (Simon, 2003, p.55)

Anne Salmond (1978; 1985) and John Patterson (1992; 1994; 2000) are two contemporary Pākehā scholars who have written extensively on mātauranga, and the following discussion of their work is based on these five texts. Both scholars employ a similar approach to representing mātauranga, which is quite different from the ‘set diagram’ approach described above. Salmond and Patterson structure their respective analyses according to what they identify as key Māori philosophical notions and institutions. Thus, they discuss certain topics in common, including mana, tapu, mauri, the cosmogonic narratives (these are included in most writings on mātauranga), and the themes of balance and opposites. Through all three texts, Patterson develops an analysis of ‘Māori philosophy’ as a set of ideas relevant to contemporary Pākehā readers; while the two Salmond papers (1978; 1985) differ from each other in level of perspective, and specific focus.

Salmond’s first paper (Salmond, 1978) presents detailed results of exploring ‘the traditional Māori cosmos’ semantically, that is, using ‘the Māori language itself [as] the main line of evidence’ (p.5). Although Salmond does not discuss it in this paper, ‘semantic anthropology’ is a ‘critical’ or ‘reflexive’ approach to anthropology (Parkin, 1982, p.xvi, 16). Salmond’s study uses various Māori language sources and modes of discourse to investigate the notion of ‘pae’ (threshold, liminal zone), defined by (and defining) the series of polar opposites or notional pou (posts), such as tapu/noa, ao/pō etc, which structure the Māori cosmos. ‘The emerging picture is one of an orderly cosmos, where meaning assigned in one metaphorical system is clearly correlated with meaning assigned in others’ (Salmond, 1978, p.15). She concludes the paper by using this model to ‘look at the hitherto unexplained and apparently eccentric ritual of “biting the latrine beam”’ (p.25). This was part of a rite traditionally conducted to forestall danger, ‘if a person became ill or was about to visit a strange area’ (ibid), and formed a specific Māori example of Cooper’s ‘peculiar beliefs’ (Cooper, 1975, p.25). But as part of the ‘web of ideas’ of mātauranga which Salmond (1978) describes in this paper, it is recognised as a rational practice, in the common understanding of the word ‘rational’, however foreign to ‘normal’ standards today.

Her second paper (Salmond, 1985) is based on old written Māori texts, early European records, and oral evidence collected from ‘tribal elders between 1964 and 1984’ (p.240), to comment from a much wider perspective on mātauranga as a system, and on the distorting prevalence of ‘intellectual evolutionism’ in past and present Pākehā thinking about Māori knowledge. The doctrine of evolutionism makes repeated appearances in the literature fields relevant to Pūtaiao, and in the following section I argue for its particular relevance to Kaupapa Māori science.

An important difference between these two authors, Patterson and Salmond, is methodological, concerned with the ‘voice’ or level of abstraction in their texts. Patterson makes reference to Salmond’s work, but not the reverse, while both refer to major authors such as Best and George Grey. Salmond’s work, which might fairly be included in Patterson’s description (below) of ‘historical or scientific’ (or both), aims to engage with mātauranga on its own terms, favouring primary sources (both historical and contemporary) in te reo Māori, in cognisance of the problems and complexities of knowledge authenticity, Eurocentric distortions, and cultural hybridity. It is especially important to relate Salmond’s observations to the discussion in Wāhanga Tuawhā of the nature of the language of science.

The mysteries of tapu and the placing of left and right are linked in the meeting house, and if contemporary informants could not reliably construe their precontact meaning, some other line of evidence had to be found. I have looked for this in the Māori language itself, particularly in the semantic structures of the lexicon. (Salmond, 1978, p.7)

In contrast, Patterson explains his deliberate aim for abstraction:

Both Māori and Pākehā writers have on occasion glossed over some of the less attractive aspects of history. ... [I]n any work that purports to be either historical or scientific, that would be regrettable, but when our interest is in values rather than facts I believe that - surprisingly - it can be an advantage rather than a disadvantage. As a philosopher I am interested in what matters rather than what happens ... Values are concerned with ideals, and ideals are only rarely achieved. So rather paradoxically, sources that romanticize the facts and present an idealized view of the past or the present can be of more use to the philosopher than sources that are strictly accurate. (Patterson, 1992, p.13)

Patterson carefully frames his work as ‘an attempt by a Pākehā to explore Māori values’ (p.9): in Tuhiwai Smith’s words (cited in Wāhanga 1.3), ‘positioning [himself] as a non-Māori’. The later book (Patterson, 2000) begins with a personal introduction, in avowed contravention of academic norms, and ends with a waiata

(song), a final piece of discourse analysed as supporting his thesis for non-Māori to become ‘people of the land’. These formatting choices could be considered a more subtle appropriation of Māori symbolic form than the emblematic use of te reo by Firth (1972), discussed above. Patterson explains his perspective on ‘abstraction’ issues in research on mātauranga:

I am not a Māori. Even if I were, I would not have access to all of the ideas that could be included under the heading ‘Māori Philosophy’. Further, I have taken notice of some Māori ideas but not of others. Even if I could, I would not be interested in trying to give a ‘complete’ picture (although I would love to be able to meet one). So all that I am offering is a series of fragments which I hope add up to something of interest, something of value, to my fellow Pākehā and maybe to the world at large. (Patterson, 1992, p.9)

In contrast, Salmond’s personal voice is less obvious, as she writes (in these two papers) largely in the neutral academic voice of ‘science’. Nevertheless, it is apparent Salmond has far greater knowledge of te reo me ōna tikanga than Patterson, who makes transparent his lack of expertise, making it work for (rather than against) him. At the end of the first book, recalling the words of Te Rangi Hiroa (Sir Peter Buck) ‘that the traditions of the Māori are also the traditions of New Zealand and therefore also the traditions of the Pākehā’ (Patterson, 1992, p.184), Patterson turns to the issue raised by Cheryl Smith (2000) at the start of this chapter (p.139), noting ‘the fact that the traditions of the Pākehā [including academic philosophy] also form part of the traditions of New Zealand and therefore belong as much to the Māori as to the Pākehā’ (Patterson, 1992, p.184).

Despite the fruitfulness of Patterson’s approach for usefully articulating the major characteristics of similarity and difference between mātauranga and Western knowledge, the thesis that ‘Pākehā really can also become people of the land’ (Patterson, 2000, p.11), could be seen by Māori as irrelevant, if not unhelpful. For example, the claim has appeared in recent political discourse that Pākehā are now tangata whenua (e.g. in debate surrounding the Foreshore and Seabed Act, 2004), undermining the traditionally accepted status of Māori in this country. This indicates how worthy ideas such as Patterson’s can be distorted into new, more subtle levels of colonisation. Patterson explains that his ‘people of the land’ notion, which is the title of his second book (Patterson, 2000), is

a translation of tangata whenua, and this concept presents a model of harmonious interdependence between all creatures based upon a web of universal kinship’. (p.131)

The problem is, ‘people of the land’, while common, is an inadequate translation of ‘tangata whenua’, at best shorthand for its actual meaning, which is better approached by a combination of ‘landed people’, ‘hosts’, and ‘indigenous’. While Patterson’s ‘people of the land’ concept is certainly consistent with Māori genealogical notions of cosmology, these cannot be extrapolated from the actual meaning of ‘tangata whenua’, which expresses political relationships between groups of people, and *specific* relationships between people and the natural environment. Patterson acknowledges this point by making a distinction between his universalised version and the ‘authentic’ meaning⁴¹:

The idea of tangata whenua (people of the land), though, usually relates to particular places and particular people. We are all children of Earth and Sky, but we are not all tangata whenua in all places. (p.16)

While not invalidating Patterson’s thesis, it is important to pay attention to ‘authentic’ meanings in a Kaupapa Māori research perspective, where te reo me ōna tikanga are paramount. The concept ‘people of the land’, as Patterson employs it, would be better conveyed in te reo as ‘iwi nō te whenua’,⁴² where the word ‘nō’, usually translated as ‘from’ or ‘of’, literally means ‘belonging to’.

The distorted representation of mātauranga by European writers is the focus of the second Salmond paper (Salmond, 1985), which ends with the observation, cited above, that ‘opening Western knowledge to traditional rationalities has hardly yet begun’ (p.260). Salmond uses the terms ‘not adequate’, ‘dangerous’ and ‘potent colonial ideology’ to describe past and present research praxis concerning mātauranga. In self-reflexive critique, she addresses her own paradigm:

In anthropology, the discipline where epistemological hazard and challenge could perhaps most readily proceed, Western thought is often closed by premises of intellectual superiority to radical cross-cultural reflection and thorough-going enquiry. (p.260)

Comparing Māori and Pākehā texts from 1840 – 1860, Salmond finds the following faults with mainstream discourse:

1. A ‘harsh disparity in the evidence of Māori philosophical speculations and debates in the 1840s and 1860s, and European accounts of Māori intellectual capacities in the same period ... which became institutionalized with ... the suppression of Māori language and culture in education and official life’;

⁴¹ The ambiguity could be related to ‘the two senses of “of” in the phrase ‘people of the land’, a language point raised by Tom Sorell (1991, p.3).

⁴² This is a translation from the English phrase ‘people of the land’ and does not imply that ‘iwi nō te whenua’ is an example of ‘authentic’ Māori phraseology (although the idea, of course, is captured in traditions of whakapapa ki a Papatūānuku).

2. Lack of openness and curiosity about a different knowledge system or culture;
3. Self-contradiction in 'claim[ing] both superiority and freedom from evaluation'. (p.238-9)

Salmond attributes these faults to 'implicit, sometimes explicit, evolutionism', and gives some contemporary examples of its ongoing influence. Her final paragraph in this discussion, where the personal voice emerges most fully, is exceedingly relevant to Pūtaiao:

It is true that guns, for instance, offered a retort to Māori reasoning that could not be gainsaid, but this does not mean that Māori reasoning was fallacious or unwise. Power in the sense of control implies no necessary moral advantage; Western science may have achieved a measure of truth (and so efficacy) in its accounts of the physical world, but this guarantees nothing whatsoever about its thoughts on other matters. I do not accept the proposition that technological control is a final form of wisdom, nor that other forms of thought simply do not count. That is an old idea in New Zealand and a very destructive one indeed.

The last sentence uses a country name to localise a point about rationality that is universal ('locating the global', McKinley, 2005). Also, calling it 'New Zealand' implies the scale of 'old' in this sentence begins with European experiences. A similar critique of Eurocentrism appears in Patterson's discussion of the divergence between Māori and scientific ideas on kinship with nature, which leads into more general commentary on ethics and knowledge:

Although biological science provides links between humans and other species in so far as it sees all creatures as linked through evolutionary chains, typically it claims to deal only with matters of fact, disclaiming any conclusions about how we ought to treat others. That at least is the theory or the dogma. *It is not always borne out in practice, as we see when some scientists unthinkingly and unhesitatingly draw prescriptive conclusions from the officially descriptive data and theories of evolutionary biology.* We might insist on the theory that science is purely descriptive and explanatory and simply say that scientists are being slack when they do this, but if it happens at all frequently we might consider rejecting the idea of scientific objectivity as a myth - maybe even a totally unrealistic myth - which overlooks the intimate relation between facts and values (Patterson, 2000, p.29, my emphasis).

Clearly, the research paradigm in these texts by Salmond and Patterson is very different from that found in the scholarship of Best and Firth, discussed above in Wāhanga 5.1. For example, both Salmond and Patterson explicitly refer to 'Māori sources' to validate their analyses; and both also make the point that mātauranga is a living system. Despite the different ways they deal with authenticity and abstraction in their work on mātauranga, from divergent perspectives in Philosophy and Anthropology, their conclusions are similar, in arguing that

mātauranga contains much value that the mainstream ('metropolitan', Salmond, 1985, p.240) has consistently overlooked, due to Eurocentric chauvinism.

Salmond offers a very concise definition of mātauranga as 'reliable knowledge ... almost synonymous with mōhiotanga, knowledge acquired by familiarity and the exercise of intelligence'. Patterson concludes that mātauranga constitutes an 'environmental virtue ethic' containing the following values:

- Mana
- Tapu
- Mauri
- Whanaungatanga
- Manaakitanga
- Kaitiakitanga
- Balance (Utu)
- Respect for life
- Collective responsibility.

Māori values are not like Pākehā values. ... the differences are not only differences of content – there are also differences of structure. The recent development by philosophers of the idea of a virtue ethics – as opposed to the predominantly rule-based ethics more familiar to the Pākehā – is a valuable aid to understanding. Māori values can fruitfully be conceived as being concerned in the first instance with what you are, as opposed to what you do, as concerned with character, as opposed to action. Rather than provide a list of rules to follow (or break at your peril), they can be seen as providing a range of models of ideal persons. These are the famous ancestors. ... Although the details of the model may vary from tribe to tribe and from time to time, the basic ingredient is the same, at least for free males – the rangatira. At its highest level, Māori ethics consists in displaying the values of a great chief. (Patterson, 1992, p.115)

This conclusion aligns with that of indigenous American scholar Leroy Little Bear (2000, p.83): 'Aboriginal cultures attempt to mould their members into ideal personalities'.

In the later book, Patterson (2000) extends his analysis to the level of metaphor, shown by selected chapter headings, below, in developing a model of mātauranga relevant to non-Māori:

- People of the Land (Ch. 1)
- Cousins of the Trees (Ch. 2)
- The Unity of Life (Ch. 4)
- Making Mana (Ch. 6).

The mihi/waiata format of this book is a personal and metaphorical way of adopting Māori cultural forms. The analogous appropriation/abstraction at the philosophical level is Patterson's 'development' of the 'philosophy of mana' so as

to differentiate between ‘soft mana’, acquired by cooperation, and ‘hard mana’, acquired by competition. While this is an extrapolation of Māori traditions, it is cogently based on the same general understanding of Māori cosmological oppositions as that expounded by Salmond (1978). Patterson concludes:

In a world in which the way of hard mana has become the norm, the scope for personal growth through soft mana is enormous. In turning to this way of soft mana we can benefit not only ourselves but also many of the creatures with whom we share the planet. The way of soft mana can and should be at the heart of our environmental philosophy, for the sake of the planet and for our own sakes as well. (Patterson, 2000, p.109)

Patterson’s conclusion thus also aligns with that of Firth (1972), discussed above, insofar as cooperation-competition (Patterson) and communalism-individualism (Firth) can be taken as closely related pairs.

5.3 Mātauranga, Science, and Pūtaiao

The previous section examined two approaches to representing mātauranga and its relationship to science: first, what I termed the ‘set diagram’ approach, used by Roberts and Simon, where two intersecting circles represent areas of overlap and difference between the two systems of knowledge. A second prominent approach, used by Patterson and Salmond, is to list, define and discuss central Māori concepts or notions (such as mana, tapu, etc), which allows for the analysis of mātauranga on its own terms, or as philosophy rather than science.

This section starts with a variation on the ‘set diagram’ model, in which W-science is represented as a subset, or smaller circle, encompassed by the superset or larger circle of mātauranga. This visualization is consistent with the observation (at the beginning of this chapter) concerning the holistic nature of mātauranga compared with the ‘defended territory’ (C. Smith, 2000) of science, although this was not the reasoning behind my original construction of it, in 1992-3, in preparation for teaching Pūtaiao at Te Wharekura o Hoani Waititi Marae. Following most contemporary writers on mātauranga (e.g. Roberts, Norman et al., 1996), I took as organising philosophy the Māori cosmogonic accounts that begin with Te Kore, leading through many godly generations to the major atua or ‘departmental gods’ of the natural world. Since science restricts itself to the phenomenal world and cuts out the other worlds or states of existence acknowledged within Māori cultural texts, this can be thought of in Māori terms

as dealing only with these atua and their domains, focusing on the whakapapa from Rangi and Papa downwards, and hence dealing with a subset of mātauranga. In the Pūtaiao document (M.O.E., 1996), members of this ‘whānau atua’ are assigned as kaitiaki (guardians) in each ‘contextual strand’, as follows:

O Mataora:	Tānemahuta, Tangaroa, Rongomātāne, Tūmatauenga, Haumiatiketike, Papatūānuku
O Ahupūngao:	Ranginui, Tāwhirimātea
O Kawekawe:	Papatūānuku, Rūaumoko

Although my ‘superset’ model was developed for the specific purpose of enframing science knowledge within the Kura Kaupapa Māori curriculum, it may be compared with that of Roberts/Simon above, in that both models contain two circles to represent the ‘bodies of knowledge’ of W-science and IK. The strength of the ‘superset’ model for curriculum policy is that all domains of science become relevant and appropriate to include in Pūtaiao programmes.

In line with previous suggestions (McKinley, 1998, p.56), the following discussion attempts to gain insight into the question of incorporating mātauranga into the Pūtaiao curriculum, by analysing discourses of mātauranga/IK relating to two basic, meta-cultural notions, namely those of **space-time**, and **classification** of natural phenomena. To explain the choice of these notions: space-time is fundamental, as noted above in the discussion of canons of literature and science (p.97); and

humans are classifying beings who create order at the symbolic and social levels by distinguishing between kinds or classes of phenomena. Classification is a kind of native theory whereby the infinite complexity of the experienced world is reduced to a finite number of categories. (Eriksen, 2002, p.60)

Māori Concepts of Space, Time and Classification

Mātauranga/IK has frequently been asserted to hold different notions of space and time from those of modern science/Western philosophy, although published details of the exact differences are more difficult to find. For instance, according to T. Smith (2000), ‘whakapapa kōrero [tangata whenua discourse] belongs to a different spatial and temporal reality than the lineal temporal sequence of European ideas of history and myth’ (p.54), but this is supported only by the assertion: ‘Western thinking divorces the notions of time and space’ (p.53)⁴³.

⁴³ A precise contradiction appears in Prigogine and Stengers (1984, p.62): ‘... space and time are inextricably tied together in the world of classical dynamics’.

Related statements in North American indigenous scholarship include the following:

In Aboriginal philosophy, existence consists of energy. All things are animate, imbued with spirit, and in constant motion. In this realm of energy and spirit, interrelationships between all entities are of paramount importance, and space is a more important referent than time. (Little Bear, 2000, p.77)

Aboriginal languages ... treat time as being continuous ... in contrast, the English language ... has a fragmented and objectified (three-dimensional) concept of time. (Youngblood Henderson, 2000, p.263)

Aboriginal knowledge has developed a privileged place for space and all its energies instead of time as the most important ordering concept of reality. (ibid p.264)

These examples rely on weak Sapir-Whorf (W1) or language relativity (p.117), in arguing that mātauranga/IK philosophies or central concepts are built into indigenous languages, while Eurocentric philosophies are built into English. Describing her experience of Māori Studies at Auckland University ‘during the time of “revival” [1989 onwards]’, learning ‘te reo Māori and the culture’, Cherryl Smith reflects how

conceptual shifts were required in order for you to fully understand what [the lecturers] were saying. Even simple words such as ‘mai’ and ‘atu’ which appear in English to be just ‘directional particles’, but nonetheless position you into the fold of the speaker, or position you into ‘degrees of otherness’ by subtle changes of use and tone. They are not only directional in terms of space but also in terms of time. (C. Smith, 2000, p.44)

This powerful underlying rationale for indigenous language revitalisation programmes once again highlights issues of authenticity and translatability as key problematics in mātauranga/IK research and education (Jocks, 1998). It is a compelling argument in favour of the ‘semantic’ methodology (Salmond, 1978) for studying mātauranga, based on ‘the Māori language itself’ and ‘early Māori texts’ (p.5). Salmond spells out the link to critical epistemology: ‘[G]aps in translatability make room for political thought to enter discussions of Māori thought’ (Salmond, 1985, p.260).

Salmond’s research pointed towards

a spatial understanding of genealogy [as a double spiral marked by chevrons to show successive epochs] which is quite unlike our own representation of descending vertical lines. The genealogical description language of the cosmological chants, then, cannot be simply assumed to fall in parallel with our notion of historical time, and our conceptions of Māori theories of cosmological formation have consequently to be rethought. (Salmond, 1985, p.247)

In this case, observed differences between mātauranga and Western knowledge become the ground for Salmond's reflexive critique, as noted above. Later, Salmond (1997) summarised the differences between the worldviews of Māori and Pākehā at the time of contact, providing particularly clear descriptions of the philosophical differences in both notions (space-time and classification) between first, science, and second, Māori knowledge:

Emergent modern science supposed that all bodies are alike. No motion is special. Every place is like every other, each moment like any other . . . The natural process is nothing but the **space-time** determination of the motion of points of mass. The cosmos, so defined, was framed in standard grids and measured, processes made visible in the instruments, tables, charts and logs of the explorers. At the same time, those aspects of the world that resisted measurement - for instance plants, animals and people - were brought under other kinds of standardised description (particularly the languages of taxonomy).

According to the cosmological accounts of Māori kin groups, the universe had emerged in genealogical stages, from a surge of energy to states of potential pattern, including thought, memory, the mind-heart and desire. Once earth and sky were formed, ancestor gods generated various forms of life, including plants, animals and people. Ancestors could collapse **space-time** to become co-present with their descendants, moving from an invisible dimension of experience variously described (as Hawaiki, Poo, Tawhiti, etc) into the being of their descendants. A contemporary self as the 'living face' of their ancestor could share their experiences, or act with them in Te Ao Marama (The World of Light).

These genealogical nets joined people to each other and to other kinds of being in relations of various kinds. Utu (the principle of balance) was the stuff of life, where relationships were constantly being negotiated in reciprocal exchanges. Tapu (the power of the gods) marked out those people, places and things where ancestors were present in the world. Mana, or efficacy, was a sign that relations with ancestors were working well, allowing transactions with others to succeed. Mate, or ill-being, showed that relationships were out of kilter, while ora was well-being, when all relations were in balance and of good heart. (Salmond, 1997, p.32-3, my emphases).

The following corresponding comments by Patterson, from his first book, form an important step in his overall thesis concerning the ways Māori philosophy can be useful for, and used by, all:

As well as giving an account of the origins of the various natural and supernatural kinds, the creation stories also give an account of the value-relationships between the various elements of the natural world. For example, Tū-mata-uenga, one of the sons of Rangī and Papa and an ancestor of man, holds his brothers collectively responsible for not defending him against the attacks of their brother Tāwhiri-matea, thus setting down the principle of whanaungatanga in which the members of a whānau or family are collectively responsible for supporting each other. So even if we find it difficult to accept that, literally, the elements of the universe came into being as stated in the creation stories, we can still accept the value-relationships built into the stories.

These relationships consist of a network of responsibilities between kin, like the responsibilities found amongst groups of human kin. Interpreted in this way the creation stories are not about a **space-time** causal order, but are about the ways in which the constituents of the world depend upon each other for their wellbeing. (Patterson, 1992, p.144, my emphasis)

Liminal Zones of Science

But a contradiction seems implied by Patterson's last sentence (or at least, a movement outside the boundary of 'science'). How can the world's inhabitants be interdependent for wellbeing in a way that does not involve space or time? This could be an example of the point 'that even robust moral realists have come to expect that they must accommodate belief in the inevitability of fundamental moral conflicts' (Moody-Adams, 1997, p.33). It arises from an influence of the contemporary position by which morals are conveniently deemed irrational. By accepting that moral disagreements are incommensurable, sociopolitical writing is enabled to ignore moral disagreements and refuse to take them seriously. Thus, while Patterson's analysis retains much explanatory value, the fatal result is that 'Māori values', being irrational, lack power. As Roberts (1998) notes:

Because of their specificity to place and to culture, the explanatory power of IK systems appears to be of limited heuristic potential compared with the explanatory power of WS [Western science]. (p.66)

Examples of the results of this power imbalance abound in institutions like the Environment Court and the Waitangi Tribunal, since the relationships of 'wellbeing' asserted by mātauranga/IK will always be found (by the legal system, and ultimately by technocratic rationality) to be based on non-science. In terms of my 'superset' model (outlined above) this equates to dealing with a part of mātauranga that lies outside the smaller circle representing W-science.

Nevertheless, as Roberts also notes (in terms markedly similar to the descriptions of CDA and Kaupapa Māori research in Wāhanga Tuatahi, see p.18 above),

many areas of science, including modern ecosystem theory, have moved towards a more holistic methodology which emphasises interrelationships. Acknowledgement is also made of an emerging scientific paradigm in which planet Earth is conceived of holistically, as an organism called Gaia ... the concept of Gaia is most useful as a way of guiding our thinking about what we study, why we study it, and what hypotheses to test. Gaia is not a hypothesis in itself; it suggests things that are hypotheses. (Roberts, 1998, p.68)

In my set diagram, this trend could be visualised as the boundary of the science circle moving, or becoming porous. Similarly, Bill Barton (1993, p.47) observed that mathematics, 'like a wide-angle lens', is 'blurry at the edges'.

Thus, in philosophical discourses of truth, there is often slippage between the two meanings of tika (i.e. factually and morally correct) - the ‘link between thought and morality’ (Morris, 1992, p.242). This is used in the arguments of both T. Smith (2000) and Salmond (1985), where metaphysical incommensurability is held to effect or facilitate Eurocentric distortions of mātauranga. Salmond notes: ‘Power claims in English often slip insensibly into claims of moral advantage.’ (p.261 n.14). This slippage relates to the boundary between science and ethics. A distinction is commonly made between ‘moral values’ and ‘cognitive values’ (Laudan, 1984) in discussing this boundary – a distinction that often goes unstated in comparisons of mātauranga/IK and science, including many of those discussed in Wāhanga Tuatoru. Attention to the boundaries of science would be a fitting function for Pūtaiao, given the importance of ‘border thinking’ in postcolonial scholarship (Carter, 2006). This is the territory occupied by critical discourses such as Kaupapa Māori or the Gaia hypothesis, discourses which aim to extend the boundary of science by claiming status as epistemologies or ‘whare mātauranga’ (houses of knowledge⁴⁴), and simultaneously to keep W-science ‘in its place’.

Considering all the arguments presented above on various sides of the debate over science, mātauranga, knowledge, philosophy and values, it is clear that rationality, in the sense of logic, agency and morality, is universal (Gaita, 2002; Moody-Adams, 1997, Siegel, 2006). This reflects the fact that all humans are of common biological and (unevenly) shared historical heritage, on one planet. To ‘offer mankind as the [epistemological] relativization’ as Protagoras suggested (Honderich, 1995, p.757) becomes obvious as processes of globalisation approach completion. Based on the ethics of Levinas, David Blades extends the scope of universal morality to include the non-human Other, and explores the implications of this for science education (Blades, 2006), in an analysis similar to that presented here. If science is in the control of scientists, there is no excuse for science to refuse to take ethical responsibilities seriously. If not, who or what *is* in control of science? To repeat Young’s answer (see p.49):

...the advertising industry, [those] who manage political campaigns and [an] increasingly research-guided entertainment industry. (Young, 1989, (p.20)

⁴⁴ ‘Whare’ in Whare Wānanga is a metaphorical reference to a particular type of knowledge (Salmond, 1985, p.260 fn.7).

Māori Marsden [1924–1993], nō Ngāi Takoto, nō Patukoraha⁴⁵, was among the final attendees of the traditional Taitokerau wānanga (traditional learning institutions). This is his account of a conversation concerning mātauranga, science and politics:

After the war, I returned to the Wānanga and was questioned by the elders of the Wānanga about my war experiences. In the course of my sharing our experiences I mentioned the atom bomb. One of the elders who had of course heard of the atom bomb asked me to explain the difference between an atom bomb and an explosive bomb. I took the word *hīhiri* which in Maoridom means ‘pure energy’. Here I recalled Einstein’s concept of the real world behind the natural world as being comprised of ‘rhythmical patterns of pure energy’ and said to him that this was essentially the same concept. He then exclaimed “Do you mean to tell me that the Pākehā scientists (tohunga Pākehā) have managed to rend the fabric (kahu) of the universe?” I said “Yes” “I suppose they shared their knowledge with the tūtūā (politicians)?” “Yes” “But do they know how to sew (tuitui) it back together again?” “No!” “That’s the trouble with sharing such ‘tapu’ knowledge. Tūtūā will always abuse it.” (Marsden and Henare, 2003, p.57)

As the above discussions have indicated, there is every reason to discard the notion of moral relativism (Moody-Adams, 1997). A critical perspective on knowledge, and therefore on science, demands that each person be held accountable to each other person (Gaita, 2002). What, then, of cultural incommensurability, which is, after all, the basis of postcolonial scholarship in general, and Kaupapa Māori research in particular?

The shared key conclusion of many scholars, including Patterson, Roberts, Salmond and Simon, is that mātauranga Māori/IK has much to offer mainstream philosophy and/or science, as yet overlooked. One reason for this is the ongoing influence of systemic societal racism, more common nowadays in more concealed guises such as ‘evolutionism’ (Salmond, 1985; Wetherell and Potter, 1992). It is on these grounds that the globalised indigenous academy has recently emerged (Stewart-Harawira, 2005; Semali and Kinchloe, 1999). So what, exactly, are the advantages of mātauranga over science? The following discussion explores this question, and its implications.

The Western notion of humanity as ‘outside’ nature has led to totalitarian commodification and economic thinking, with its endemic (and ultimately self-destructive) refusal to engage rationally with values (Putnam, 2004), and hence

⁴⁵ The word ‘nō’, here followed by a kingroup name, means ‘belonging to’, as discussed on p.170.

with knowledge (Moody-Adams, 1997). Canguilhem noted: ‘Mankind makes mistakes when it places itself in the wrong place, in the wrong relationship to the environment, in the wrong place to receive the information needed to survive, to act, to flourish’ (Delaporte, 1994, p.20). This is the basis of the multiculturalist (feminist, postcolonial) charge that science is not fully rational (Harding, 1993) while the influence of such ‘unconsciousnesses’ (Gough, 1998) remains. Sandra Harding terms the current dominant paradigm ‘weak objectivism’, labelling ‘epistemological relativism’ as its ‘mirror-linked twin’ (also see p.193). The concept that constitutes the most relevant science/mātauranga knowledge dipole (pou) is the notion of *whakapapa* underpinning the Māori worldview, which is incommensurable with W-science’s construction of nature as *standing-reserve* (Heidegger, 1977).

Support for this notion is suggested in a recent important chapter on Pūtaiao by Mason Durie (2005), which contains a model showing ‘IK’ and ‘science’ at either end of a double-headed arrow, with what Durie labels ‘research at the interface’ (the chapter’s main focus) occurring in between (Figure 6, p.141). According to contemporary arguments, which recognise processes of cultural hybridity as inevitable and ubiquitous, Kaupapa Māori research would be located in the heterogeneous area labelled ‘research at the interface’. On this reading, Durie’s model is consistent with mine. We diverge however, when Durie states:

‘research at the interface’ should be differentiated from mātauranga Māori research – that is research that is conducted entirely within the context of Māori knowledge and Māori methodological approaches.

But from my reading of Kaupapa Māori theory (Smith, 1997; Tuhiwai Smith, 1999), such ‘mātauranga Māori research’ is deemed impossible in principle. This divergence widens when Durie discusses a typology of research developed by Chris Cunningham (below). First, Durie states that ‘interface research typically involves the second and third types’:

- 1: research not especially relevant to Māori (e.g. quantum chemistry)
- 2: research involving Māori (as participants or possibly junior members of a research team) (e.g. analysis of ethnic differentials in disease rates)
- 3: Māori-centred research (Māori participants, largely Māori researchers, methods of analysis using mainstream standards for research)
- 4: kaupapa Māori research (Māori researchers and participants, analysis based on Māori knowledge systems). (Durie, 2005, p.144)

Identifying kaupapa Māori research as ‘purely’ ‘Māori only’ (and eliding it with mātauranga Māori research, as Durie appears to, in these two models) appears to

conflict with important understandings of Kaupapa Māori research in the literature (Tuhiwai Smith, 1999; Smith, 2002). A case in point is the *'Te Kotahitanga'* report which claims to be based on Kaupapa Māori research principles (Bishop, Berryman et al., 2003, p.4), yet would clearly fall into Type 2 or 3 in the Cunningham typology above.

Secondly, issue can be taken with Type 1 itself, which is at odds with the dominant theme in such discussions of 'more Māori involvement in science' (Durie, 2005, p.146), despite the qualification by 'especially'. The whole point of increasing Māori participation in science is that ALL of science is relevant to Māori citizens of the contemporary world.

Durie also discusses a recent MoRST (2003) policy framework concerning Māori and science, which, in addition to 'more Māori in science', expresses a second aim:

advancing mātauranga Māori (and particularly its potential contribution to the sciences and innovation) ... (Durie, 2005, p.146).

The problem here is how to interpret words such as 'advancing' and 'contribution'. While Durie expounds a strongly pro-mātauranga stance, the above comment can also be read as paraphrasing earlier scientific 'knowledge economy' conclusions (MORST, 1995; Lomax, 1996). In other words, this argument can be interpreted as (covertly) bringing mātauranga within the 'Māori branding' notion of economic thinking (Young, 1999). Mātauranga indeed does have a 'potential contribution' to make to science - that of correcting its underlying premise towards the object of knowledge - but this must be explicitly distinguished from other possible (mis)interpretations.

Spiral Whakapapa Kōrero

There is another level at which mātauranga can be considered incommensurable with Western thought, in the sense discussed by T. Smith (2000) and C. Smith (2000), which is discursive structure, as Salmond (1982) argues. While this difference may be encompassed in general claims for IK, such as those discussed above, it is seldom closely examined in terms of its relationship to the anthropological debates on 'primitive rationality' and science. Discussions often adopt a poetic (Graveline, 2000) or mystical perspective ('misty-eyed discourse', (Tuhiwai Smith, 1999, p.12), which can be confusing in discussions about

knowledge. Generally speaking, this is a weakness in many presentations of 'indigenous science' (Cajete, 1999).

Salmond (1982) explores cross-cultural descriptions of knowledge, and concludes that different 'theoretical landscapes', composed of argumentative structures, habits of thought, cultural metaphors and values, in addition to lexemic differences, offer 'support for a position of limited relativism' (ibid p.85). This conclusion supports weak Whorfian language-mediated cognitive diversity (W1), and relates to the liminal zones of science:

The neatly worked inner stretches of science are an open space in the tropical jungle, created by clearing tropes away. (W. V. O. Quine, cited in Salmond, 1982, p.66)

Clearly, discursive incommensurability is relative, rather than deterministic, as is implied by the 'windowless monad' notion of culture (Moody-Adams, 1997), promulgated by earlier structuralist and functionalist paradigms of anthropology. As cited above (p.175), Salmond described a Māori 'spatial conception of genealogy' 'as a double spiral marked by chevrons to show successive epochs', 'quite unlike our own [!] representation of descending vertical lines' (Salmond, 1985, p.247). As this implies, carving design was also a physical mnemonic from which whakapapa could be read (recited). Hence the discursive form, the philosophical metaphor, and the value concepts each inform and reinforce each other in contributing to the 'cultural filter' (Roberts, 1998; cf. the 'web of belief' of classical anthropologists such as Evans-Pritchard, described in Moody-Adams, 1997, p.45).

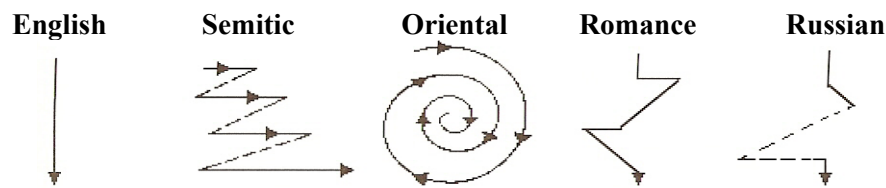
It therefore seems reasonable to regard Māori discourse as preferring spiral structures, rather than the typical linear structure favoured by Western notions of knowledge, particularly in logic, mathematics and science⁴⁶. In this way, the 'spiral' trope, metaphorical for and of the great family of Rangi and Papa, fits with the notion of 'whakapapa' itself, as a 'way of thinking' (Barton, 1993, p.59), a value and a concept ('both a noun and a verb', McKinley, 2003, p.21), together with the notion of 'pou', each holding apart one of the primal dichotomies, and

⁴⁶ Although Salmond (1985) recalled Shortland's note on the best way to convince Māori: 'Only get him to assert that your proposition is "tika" or straight, and you will soon obtain his consent to it' (p.251). Also: 'The subject had been thoroughly discussed by [the Māori chiefs], and every knotty point argued according to principles recognized by Māori law, till they had arrived at conclusions which, as [the informant] quaintly expressed it, were as straight and even as a board planed by a carpenter' (p.254).

collectively structuring both taiao and hinengaro, in the process forming the ‘pae’ or liminal zones where actual moral discourse occurs. These elements combine to form a coherent value concept structure, which is both *part of* and also *represents* (i.e. models) te reo me ōna tikanga, through which mātauranga engages the phenomenological world. ‘In other words, language is related to culture in both a metonymical and a metaphorical way’ (Hastrup, 1982, p.153). From this engagement arise the ‘Māori values’ (Patterson, 1992) frequently rehearsed (Durie, 2005). In combination, these ideas provide a reasonably robust overall sense of how mātauranga differs from Western rationality, accounting for the sense in which linguistic relativity (W1) is often experienced as valid through contact with a non-Western language and culture such as Māori. As noted by Roberts, Haami et al. (2004), ‘Māori use of whakapapa and narrative creates a “metaphysical gestalt” or whole, integrated pattern, for the oral communication of knowledge’ (p.1).

According to Robert Kaplan (2005), ‘Contrastive Rhetorics has, over the past 40 years, tried to look at language from a more multidimensional perspective and also to look across languages’. Here Kaplan cites his own ‘Doodles Paper of 1966’ as foundational in this branch of linguistics, of which the following diagram and explanatory paragraph support the above argument, and in so doing, help clarify the grounds of the knowledge/language/culture debate:

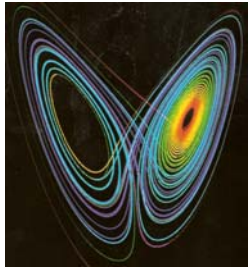
Whika 9: Kaplan's Contrastive Rhetoric Doodles



When the Doodles were first published in 1966 (Kaplan, 1966), they were intended to demonstrate a variety of paragraph movements that exist in writing in different languages, such as English, Semitic (e.g. Arabic), Asian, Romance, or Russian. The purpose of highlighting the various types of paragraph structures and movements was to educate the teachers of L2 writing who have to be aware of the differences in rhetoric in different languages in order to point out differences in English rhetoric to their students. (Kaplan, 2005) p.387. [Footnote 12 p.389: Reprinted from Kaplan, R. B. (1966): Cultural thought patterns in intercultural education. *Language Learning*, 16, 1-20, with permission from Blackwell Publishers, Oxford, U.K.]

It is tempting to explain the depiction of 'English' as a straight line (over and above the Eurocentrism of taking English as the 'yardstick' of comparison) in terms of Halliday's (2004) description of the step-by-step grammatical metaphor of science discourse (see p.131). The similarity to Salmond's previously cited description of notions of genealogy (p.182) in terms of 'descending vertical lines' versus a 'double spiral' is also intriguing. Speculatively, the comparison between 'English' and 'Oriental' can perhaps be extended to the language/knowledge debates between English and te reo Māori. Supporting points in favour of this analogy include similarities between Māori and Chinese philosophy (J. Patterson, personal communication, 2006), and the contention that Taiwan is the original homeland of the Polynesian diaspora. This 'spiral whakapapa kōrero' notion connects together the discussions of mātauranga and Māori discourse, as encapsulated in te reo me ōna tikanga, reviewed above (C. Smith, 2000; T. Smith, 2000; Salmond, 1985). It also links to other 'spiral' appearances, such as in Stewart-Harawira (2005), who uses it as an organising metaphor (a 'hermeneutic spiral of understanding', p.24) in her research on indigenous politics and globalisation, and the spiral from chaos theory (the Lorenz Attractor, see Whika 10 below) used to represent the critical postmodern perspective on curriculum (Doll, 1993). This in turn echoes Jerome Bruner's 'famous' "spiral curriculum" model (ibid p.124) and Dewey's idea of the education of experience, which he described as 'a continuous spiral' (Dewey, 1938, p.79).

Whika 10: The Lorenz Attractor



A phase space diagram of a nonlinear system, a common symbol for chaos, named for Edward Lorenz, who first used this type of graph for weather patterns. (front cover, Doll, 1993)

Although not a conceptual incommensurability, therefore, in the same sense as the whakapapa/standing-reserve conflictual notion of humanity's relationship with nature, this spiral versus linear discourse idea can still be understood as a 'thinking differend' that contributes to epistemic and epistemological diversity (Siegel, 2006). If disparate discursive structures, such as te reo me ōna tikanga, are lost in displacement by English, humanity loses diversity of thinking, in the sense of cognitive tools. This is the connection between the debates in knowledge and language. This version of the 'incommensurability thesis' (Hoyningen-Huene and Sankey, 2001) was the object of Joshua Fishman's (1982) extension of the Sapir-Whorf hypothesis to include 'W3', or ethnolinguistic diversity as global resource. (In this regard, it is interesting to speculate on 'Kaplan's doodles' as a visual representation of W3.)

Nevertheless, this recognition also provides an imperative to the effect that the traditional forms of language and discourse must be retained. Recognition that these forms, both in lexicon and in syntax, are unsuited to the translation of science (see Wāhanga 4.2), provides logical grounds for arguing that the activity of translating science into Māori either does not contribute, or is actually hostile, to the aims for the retention and revitalisation of **original forms** of te reo me ōna tikanga. This conclusion is in line with that of Siguan (2001) for translating science into Tagalog (p.127 above).

A Role for Kaupapa Māori Science?

How might the overall notion of mātauranga, developed above, be put to work for Kaupapa Māori science?

First, by discussing the key incommensurability between W-science and mātauranga, which is the question of the role of humanity on the planet. This is a

question which can be considered in diverse legitimate ways, in various domains of science and philosophy. Mātauranga has been shown by philosophical analysis to be an ‘environmental virtue ethic’ (Patterson, 2000). Mātauranga is therefore useful in environmental science to provide guidance to research questions and strategies (Lacey, 2001). It is vital to note that his stance differs from the ‘usual’ understanding of claims for mātauranga as (or to contribute to) science, in which science knowledge is ‘abstracted’ (or extrapolated) from mātauranga, such as in pharmaceutical research on rongoā.

Roberts, Haami et al. (2004) present another application of mātauranga to science, in this case in the domain of biotechnology, where the implications of ‘whakapapa as a Māori mental construct’ are being researched in terms of the GMO (genetically modified organism) debate current in Aotearoa New Zealand and globally.

These suggestions point towards an epistemic role for Kaupapa Māori science. This assertion responds to Graham Smith’s call (for pro-/Kaupapa Māori scholars) to engage with Matthews’ claims concerning Māori forms of knowledge (Smith, 1995, p.105). A key claim by Matthews is that the notion of Māori science is not only invalid but harmful, because ‘Western science and indigenous knowledge are in *different* categories of human endeavour’ (Matthews, 1995, p.147, original emphasis). One might, in reply, point out that they are not *entirely* in different categories, in the sense that mātauranga *does* claim to inform science, in certain areas. As a Kaupapa Māori scientist, while I do not look to traditional Māori knowledge to inform the central canons of chemistry, physics, biology or mathematics,⁴⁷ I accept, in principle, the validity of research in the human sciences and in ecology that draws on mātauranga (e.g. Roberts, Haami, et. al., 2004). In accordance with the role of ‘consensus’ in the Standard Account of science (p.48 above), the existence of contemporary international scholarship in support of this view, such as Boyd (2001) and Lacey (2001), suggests this is a scientifically ‘legitimate’ position to take, according to the contemporary canons of post-positivist science. This demonstrates that Matthews, in this argument, falls prey to the trap of science ideology, if not scientism (see p.54).

⁴⁷ This is a different point from that imputed to Durie and Cunningham (p.180 above), to the effect that ‘much of science is irrelevant to Māori’.

At a fundamental, ontological level, since evolutionary processes can be expressed only through succeeding generations, evolution can be conceptualised, from a Kaupapa Māori perspective on mātauranga, as ‘whakapapa writ large’ (to use a Platonic phrase). Since evolution is a central biological theory to explain the origin and development of life on this planet, this conceptualisation carries the logical implication that the ‘whakapapa’ notion attributed to mātauranga (Patterson, 1992) - or more generally, to IK - is a more rational, scientifically valid concept of the role of humanity in the natural world, in comparison with the W-science and technology concept of nature as ‘standing-reserve’ (Heidegger, 1977). To put this idea into a scientist’s words, ‘The evolutionary unity of humans with all other organisms is the cardinal message of Darwin’s revolution for nature’s most arrogant species’ (Gould, 1997, p.354).

This highlights another way to understand the intended meaning of the notion of ‘Kaupapa Māori science’. Kaupapa Māori research has established a position in opposition to ethnocentric social science (see Wāhanga 1.3). Analogously, Kaupapa Māori science takes a position against scientific natural science. The key scientific areas of concern occur in two main domains: those concerned with **ecology**, and **evolutionism**.

Malignant Darwinism: Doctrines of Evolutionism

The analogy between whakapapa and evolution suggests that the critical, politicised epistemology of Kaupapa Māori science may be especially useful in relation to uses and misuses of evolutionary theory. Evolutionary debates are many and varied, and include a range of extreme positions along the scientism-anti-science spectrum. Examples include ‘creation science’ at one pole, and ‘selfish gene’ theories at the other, both occurring in the same social context of the contemporary US. The roles of both lay and academic evolutionary ideology, or ‘evolutionism’, have already been noted in several debates examined above (Salmond, 1985; Wetherell and Potter, 1992), relating to the socio-historical context out of which Kaupapa Māori theory and Pūtaiao have arisen. It seems likely that a science-internal Kaupapa Māori critique would be most useful in those research traditions where evolutionary theory is central.

This suggestion is supported by Boyd's (2001) detailed examination of the incoherence and lack of scientific rigour in 'the emerging but highly influential tradition of research in "evolutionary psychology"' (p.3), which is an offshoot of sociobiology. Boyd demonstrates this incoherence is embedded, and hence invisible to practitioners, within 'malign meanings' that constitute key concepts in the research paradigm. Such meaning malignancy as this, argues Boyd, causes incommensurability between two or more research traditions taking the same object, 'indicative of a sort of relativism about scientific rationality' (p.57).

Boyd's conclusion

is that there are important cases in which the operation of scientific methodology - even when practiced conscientiously and rationally by smart people - is inadequate, *in the absence of political transformation*, to overcome the ways in which social ideology introduces malignancy into findings, methods, and even concepts and meanings in the sciences. (p.55, my emphasis).

Boyd extends his analysis to ethics, arguing that moral inquiry is even more likely than the human sciences to suffer from (non-permanent) incommensurability brought about by ideological forces. Boyd connects the debates on epistemological and moral relativism to each other (also Moody-Adams, 1997), and also to a consideration of 'the proper understanding of the notion of objectivity', which, he argues, is used ideologically to support political rationalisations.

Boyd makes the key point that the objectivity (and hence, reliability and epistemic success) of scientific methods is dependent on freedom from political influence, not the other way round, as is held by stereotypical conceptions. 'Scientific objectivity, when it obtains, is thus *always* a (partly) political achievement' (Boyd, 2001, p.58). From this perspective, he argues that the postmodern critique of science's claims to objectivity (and associated notions of truth and knowledge) is correct, insofar as the *concept* of objectivity, as manifest in contemporary intellectual discourse, is primarily ideological, and hence used as a 'tool of oppressors' (p.59) in politics and in the human sciences. He then states:

On the other hand, the *phenomenon* of objectivity - the epistemically reliable deployment of scientific methods - is essential to projects of social criticism and ideology critique. In the human sciences and related domains, scientific objectivity cannot - absent wholesale political and economic change - be achieved within the normal workings of institutional science, except in rare contexts of sustained political struggle. It can be obtained outside the normal workings of institutional science only in the contexts provided by oppositional movements. (ibid, original emphasis)

This perspective largely reconciles the position on the epistemological universality of science, defended by Matthews (1995) and Siegel (2006), with the postcolonial critique of science offered by Haraway (1989) and Harding (1998), as Siegel notes (see p.193). Boyd's concluding comments offer support for the notion of Kaupapa Māori science outlined above:

It is probably also true that only in the contexts provided by political struggle can the concept of objectivity be freed from its malignant meanings. In almost every respect the critics of scientific objectivity are thus correct about the depth of the ideological association between the concept of scientific objectivity and processes of economic and political oppression. They are right as well to think that the situation can only be remedied politically. But they need not - and indeed must not, if they are to succeed, abandon the projects of criticism to which concepts of objectivity, knowledge, and truth are essential. (Boyd, 2001, p.59)

This position clarifies the role of Kaupapa Māori science as a counter to scientism, in the interests of objectivity, knowledge and truth (the characteristic claims of science). As we have seen, examples of scientism cited in the literature (Boyd, Salmond, Stenmark) frequently involve the doctrine of 'evolutionism' (Delaporte, 1994, p.38), which can also be described as the misuse of evolutionary theory. Canguilhem discussed the work of Herbert Spencer (1820-1903) on evolutionism as an 'instructive [example of the] genesis of a scientific ideology' (ibid). This aligns with Gould's (1999, p.146) description of Spencer as 'the apostle of social Darwinism'.

[Spencer] used von Baer's and, later, Darwin's biology to lend scientific support to his views on social engineering in nineteenth-century English industrial society, in particular, his advocacy of free enterprise, political individualism and competition. (Delaporte, 1994, p.39)

Canguilhem reflects on the boundaries of science violated by Spencer for political gain:

The laws of mechanics, embryology and evolution cannot validly be extended beyond the domain proper to each of these sciences. To what end are specific theoretical conclusions severed from their premises and applied out of context to human experience in general, particularly social experience? To a practical end. Evolutionist ideology was used to justify industrial society as against traditional society, on the one hand, and the demands of workers, on the other.

Canguilhem emphasised the relevance of this discussion to the debates considered above:

Spencer's views had a lasting effect on linguists and anthropologists. His ideology gave meaning to the word primitive and salved the conscience of colonialists. A remnant of its legacy can still be found in the behavior of advanced societies towards so-called underdeveloped countries, even though

anthropology has long since recognized the plurality of cultures, presumably making it illegitimate for any one culture to set itself up as the yardstick by which all others are measured.

Canguilhem considers the trajectory of such an ideology, compared with that of the science on which it draws:

In freeing themselves from their evolutionist origins, contemporary linguistics, ethnology and sociology have shown that an ideology disappears when historical conditions cease to be compatible with its existence. The theory of evolution has changed since Darwin, but Darwinism is an integral part of the history of the science of evolution. By contrast, evolutionist ideology is merely an inoperative residue in the history of the human sciences. (p.40)

More recent perspectives (Boyd, 2001; Stenmark, 2001) indicate that, while evolutionism may have disappeared from the social sciences named above by Canguilhem, it still survives under various guises in the disciplines of human science. On both political and epistemological grounds, therefore, attention to such ‘incompatible’ traditions is likely to be important, in both the development **and** the deployment of Kaupapa Māori science.

Te ‘Whakapapa’ o Pūtaiao

This section recapitulates the complex philosophical heritage of Pūtaiao, ready to return from the liminal zones of science to the pragmatics of curriculum policy. While cognisant of global philosophical history from the time of Ancient Greece, a useful starting point is Logical Empiricism (p.49), which was the dominant form of philosophy of W-science up until recently (Benson, 1989). One attitude under this paradigm held that: **Science is objective and value-free. Science is concerned with facts, which are meaningful true statements about the world** (sub-branches of the paradigm, such as Logical Positivism, advanced the most extreme scientific versions of this view). The Incommensurability thesis, often attributed jointly to Kuhn and Feyerabend (Hoyningen-Huene and Sankey, 2001), has been important, over the past few decades, in the process of shifting the philosophy of science from positivism to post-positivism.

Incommensurability provides a serious challenge to the form of logical empiricism that was dominant in the 1950s. But to take this as a challenge to science is to make the dubious assumption that science must operate in accordance with logical empiricist methodological strictures if it is to be a genuine source of knowledge ... *we are thus engaged in a process of philosophical reconstruction* [which] should include a genuine break with two of the foundation stones of traditional empiricism: its theory of concepts and its theory of evidence. Together, these moves away from the empiricist tradition open the way for a view that ... the development of incommensurable concept systems is one important tool for the advancement of science. (Brown, 2001, p.138-9, my emphasis)

In another branch of the philosophical family tree, incommensurability also contributed to the recent rise of the anti-realist philosophy of constructivism, which has been described as beginning from the Kantian ideas of ‘the phenomenal world’ and ‘the noumenal world’, and the separation between them. To these are added the idea of relativism, which depends on the concept of incommensurability. The types of ‘group’ listed in the following explanation highlight the relevance of this issue for Pūtaiao:

Constructivism: The only independent reality is beyond the reach of our knowledge and language. A known world is partly constructed by the imposition of concepts. These concepts differ from (linguistic, social, scientific, etc) group to group and hence the worlds of groups differ. Each such world exists only relative to an imposition of concepts (Devitt, 2001, p.145).

On this account, Whorf, Putnam, and the ‘structuralists and poststructuralists’, as well as Kuhn and Feyerabend, are all listed as adhering to some form of constructivism. At the strongest, ‘incommensurability’ is applied here in a far more comprehensive sense than in the epistemological account above.

Kuhn’s and Feyerabend’s incommensurability thesis accounted for epistemic breaks in the history of science, while Popper’s idea of falsifiability sought to explain human dimensions of the steady accumulation of knowledge within a paradigm. Both were important in deconstructing the classical ‘pure knowledge’ conceptions of science and bringing forth the contemporary (realist post-positivist) philosophy of science. The central role of falsifiability and critique in Popperian science links it to critical theory (in Habermasian terms), as does the concern with democracy, with both of these aspects reflected in the ‘education of experience’ called for by John Dewey (1938).

Incommensurable ways of thinking contribute to liminality near the boundaries of science, and in the face of the homogenising tendencies of global culture, IK and indigenous languages hold out the promise of ‘real’ epistemological diversity, or W3 (Fishman, 1982). The same goal is sought by critical theory (at the philosophical level), and by the related standpoint epistemologies, including Kaupapa Māori, in particular socio-historical contexts. In such contexts, productive tension is produced by the interaction between local and global, relative and universal perspectives. In Kura Kaupapa Māori, for example, strong

local identities can complement and enrich the development of students' self-perception as global citizens (McKinley, Stewart et al., 2004).

An influential development in the philosophy of education, reflecting the emphasis on the notion of paradigms, in seeking to rationally organise the curriculum (in the face of the knowledge explosion and the 'science crisis' of the late 1950s), was the 'structure of knowledge' approach (associated with the 1959 Woods Hole conference and the names of Joseph Schwab, Paul Hirst and R. S. Peters (1977)). This influenced a pseudo-scientific approach to education (curriculum and pedagogy), which has retained relatively more influence in science and mathematics, compared with other subjects (Pinar, Reynolds et al., 1995) - hence the difficulty of science education reform, dubbed a 'double nexus' (Blades, 1997).

Prevailing views on philosophy of science have also been important to understandings of the science status of social science disciplines, including that of education. 'In the domains of social science and educational research, epistemological confusion reigns' (Phillips, 1992, p.80). Those who claim that social science is a scientific domain do so either on a traditional view of science (such as behaviourists), or by adopting (to varying degrees) a 'softer', less positivistic view of the nature of science. Opposing views hold that social science is more like philosophy or the humanities, and that 'truth' or 'knowledge' is not a valid aim of social inquiry. The stronger views of this type result from anti-realist, relativist, and/or constructivist notions that have been shown to be incoherent, self-undermining, and based on distortion or exaggeration of notions attributable to Hanson, Kuhn, and Polyani (Phillips, 1987). As Phillips points out, for example, relativist ideas overlap, in their anti-realism, with logical positivism, which is ironic, since positivism is a favourite target of relativists (p.97).

Recognition of the centrality of hypothetico-deductive reasoning, moderate ontological realism, and universal morality forms the basis for all 'authentic' science (taking as object either the non-human or human worlds). In Popper's words, 'if you are interested in the problem which I tried to solve by my tentative assertion, you may help me by criticizing it as severely as you can...' (Karl Popper, *Conjectures and Refutations*, cited in Phillips, 1987, frontispiece), one

hears the ‘moral moment’ of science, which is closely linked to the concept of liminality (metaphorised above as the notion of ‘pae’ in traditional Māori cosmology). Here Popper also highlights the betrayal of science, philosophy and morality (Moody-Adams, 1997) that results when acceptance of ‘epistemological diversity’ slips from plurality to relativity (Siegel, 2006), in regarding the perspectives of ‘groups’ immune to criticism (‘unchallengeable’ p.10). This is the major point made by Matthews (1995) and Siegel (2006) in arguments against the existence of ‘Māori science’, which nevertheless fail to take full account of the complex of ideas to which the term refers, according to its supporters. Thus, while weak (W1) relativism may be called for in comparing languages, psychological states, or the ‘texts’ of symbolic culture, strong universalism is required in science and epistemology, with obvious ethical and political implications.

The standpoint epistemologies call for recognition of a historical or sociological or cultural relativism - but not for a judgmental or epistemological relativism... They require, as judgmental relativism does not, a scientific account of the relationships between historically located belief and maximally objective belief. So they demand what I shall call *strong objectivity* in contrast to the weak objectivity of objectivism and its mirror-linked twin, judgmental relativism. (Harding, 1991, original emphasis, cited in Siegel, 2006, p.8)

The first sentence also demonstrates two distinct ways ‘epistemology’ is used in this discussion, equating firstly to ‘research paradigm’, and secondly with its more strictly philosophical meaning, ‘theory of knowledge’.

Another school of thought still influential in education (although now largely abandoned in the academy) is behaviourism, an approach closely linked to positivism. Such influences as behaviourism, and the ‘structure of knowledge’ approach to curriculum, interact to produce a ‘scientific’ approach to science education, which has been widely criticised as being scientific rather than realistic, exclusionary rather than empowering. Constructivist science education can be viewed as an approach which attempts to move beyond these pedagogical influences, while not necessarily reforming the outdated views on the nature of science reflected in the traditional science curriculum. Smith (1995) argued such reform could be achieved by developing Kura Kaupapa Māori science curriculum, although this requires objectivity to be strengthened, rather than weakened by further moves towards relativism or constructivism. A conception of Kaupapa Māori science, as attempted in the previous section, must be developed through its relationship with compatible accounts and areas of science, such as the Gaia

hypothesis, and detailed critique of incompatible areas of science, such as those based on evolutionist doctrines.

A key step in the move towards strong objectivity is for science to stop ‘evading the issue’ that ‘knowledge of facts presupposes knowledge of values’ (Putnam, 2004, p.145). The following passage encapsulates much of the philosophical heritage of Pūtaiao, highlighting several of the major issues discussed above, and relating them to curriculum development:

I believe the Tyler rationale, Frederick Taylor’s scientific-efficiency movement on which the rationale is based, and the behavioral curriculum movement both have spawned, have all ‘misconceived the problem.’ And from this misconception of what education is about and how development occurs, we have adopted an inappropriate concept of curriculum - one firmly rooted in modernism. The Tyler, Taylor, and behavioral movements have not dealt with the ferment, but rather have denied, bypassed, or overlooked it. However, in this ferment, or in Schon’s messes, Prigogine’s chaos, Dewey’s problems, Piaget’s disequilibrium, or Kuhn’s anomalies lie the seeds not only of development and transformation but of life itself. To deal with curriculum as a transformative process means to utilize the ferment to develop both precision (discipline) and generalization (abstraction). How we will handle this issue of creative development is by no means clear; it is a problematic we will need to live with for generations. Only through the intimate contact of living with this idea, though, will we be able to frame the issue. As we worked for centuries developing the modernist paradigm, so will we need (at least) generations to develop a post-modern paradigm. However, I agree with Whitehead that the beginning lies in recognizing ‘the radically untidy, ill-adjusted character’ of actual experience. ‘To grasp this fundamental truth’ - the nerve center of Whitehead’s epistemology, the keystone of his cosmology, and the central tenet of his sense of process - ‘is the first step in wisdom’ (1933, pp. 157-158). From this it follows, I believe, that an essential criterion in the examination of a post-modern curriculum is the richness of its quality, not the precision with which its goals are stated or met. (Doll, 1993, p.148)

From the perspective of a Māori-medium science curriculum developer, this passage is heartening, since it suggests the *lack* of a tradition (the ‘vacuum of professional practice’ referred to earlier) may actually be advantageous, rather than a formidable handicap, as is generally assumed. It also serves as a reminder and a warning (like the ‘wrong way’ sign on a motorway offramp) not to chase headlong after the Science curriculum. The task of Pūtaiao development demands something other than simply re-producing (translating) mainstream science education.

An Analogy and a Qualified Notion of Science

An analogy with the Sapir-Whorf hypothesis in the debates on language (see p.117) clarifies the contested notion of ‘multicultural science’ in the knowledge

debates. Here, the ‘knowledge incommensurability’ between science and mātauranga is likened to (but not elided with) the ‘language incommensurability’ between English and te reo.

Fishman (1960) systematized the Sapir-Whorf hypothesis into three distinct parts or ideas that he labelled W1, W2, and W3⁴⁸ (Fishman, 1980; 1982). A corresponding argumentative structure can be made out for multicultural science, arising from and related to these three Whorfian ideas. The analogy is presented in Whika 11 below, using strikethrough text for the discredited concepts:

Whika 11: Multicultural Science and the Sapir-Whorf Hypothesis

<i>Fishman’s systematization of Sapir-Whorf:</i>	<i>Multicultural Science:</i>
W1 - linguistic relativity - different languages embody different worldviews. Collapse of Eurocentric views on language	MS1 - different worldviews entail different value concept structures - liminal science. Collapse of Eurocentric views on science
W2 - linguistic determinism i.e. language determines thought	MS2 - alternative rationality or ‘primitive logic’ (e.g. posited as L₃)
W3 - ‘ethnolinguistic diversity as a worldwide societal asset’ (Fishman, 1982)	MS3 - epistemological (strategic) diversity in science as a ‘worldwide societal asset’

As argued earlier, a critical view of linguistic and cultural diversity entails an acceptance of W1, from which W3 arises; and the rejection of W2 as fallacious. Similarly, I have argued for what is termed MS1, in the notion of Kaupapa Māori Science, on which rests MS3, while rejecting MS2. I think this is one (not the only) route to or version of ‘critical science’, although in contemporary postpositivist understandings of epistemology, this qualifier for ‘science’ verges on tautology, more-or-less synonymous with ‘anti-scientism’ (Geertz’s ‘anti anti-relativism’?), or in Harding’s terms, ‘strong objectivity’ (p.193).

It is in this vein that I advocate for the adoption of a novel qualifier for science, in the notion of ‘poststructural science’. In this view it acts as a ‘universalisation’ of the notion I have developed above of ‘Kaupapa Māori science’. In other words, ‘poststructural science’ is a qualified notion of science which may help to resolve the longstanding problems with the notion of ‘multicultural science’. This notion of ‘poststructural science’ is similar to that of ‘postmodern science’ as argued for

⁴⁸ W3 was added later (Fishman, 1982), which is why the W1, W2, W3 codes are non-sequential.

by Peters (1993), but which has run into problems elsewhere, problems possibly caused or exacerbated by the nature of science education itself. Poststructural science aligns with ‘postpositivist science’ (as discussed above), but has a wider philosophical compass, since poststructuralism (along with postmodernism) has been influential in wider domains, including education. At an epistemological level (argued above to be universal), the notion of poststructural science is the global version of Kaupapa Māori science, which is a local, perspectival notion of science.

Recent publications (e.g. Siegel, 2006; Mercier and Harris, 2006) suggest a move is underway towards reconciliation between universalist and multiculturalist views on science and science education, from a range of perspectives, but along these lines. This is a positive sign, since a stronger level of consensus and resolution will be helpful for all, not least those teaching, and researching how best to teach, science in KKM (and other) classrooms.

WĀHANGA TUAONO

Pūtaiao as Kaupapa Māori Science Education

He mea hanga tōku whare, ko Papatūānuku e takoto nei te paparahi, ko Ranginui e titiro iho nei, te tuanui. Ko ngā pou pou o te Whare ko ngā rārangi maunga [my house is constructed with Papatūānuku as the floor, and Ranginui the roof. The posts of the House are the mountains].

Thus begins ‘Te Whare Tapu o Ngāpuhi’ (The Sacred House of Ngāpuhi), which appears in full as the Kupu Whakamutunga/Epilogue below (p.219). As a paradigm Ngāpuhi text, it is a key identity marker. The rest of the kōrero traces the maunga (mountains) encircling Tai Tokerau. The inclusion here of ‘whare’, ‘hanga’ and ‘poupou’ echoes their appearance at various points above.⁴⁹

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This Ngāpuhi text exemplifies a Māori worldview ‘built’ around the ‘pou taiao’ or cosmic houseposts, also envisaged as ‘pou hinengaro’ (psychological poles), since the traditional narratives are replete with images of cosmos and psyche, reflected one in the other (Salmond, 1978). It provides a metaphor for the dialectical nexus of Pūtaiao, where these ‘pou hinengaro’ represent the various dialectics (argumentative polarities and/or continua), reviewed above, in language, knowledge, and culture. Each maunga (or pou) has different characteristics, which can be, and often are, misrecognised, particularly by those from other ‘territories’ or disciplines. This thesis has been concerned, firstly, to identify, examine and describe these dialectics, and secondly, to make suggestions about addressing these dialectics in future Pūtaiao curriculum policy, in the interests of students and teachers, whānau and iwi. What has been achieved is to answer some of the initial questions, while opening others up for further exploration. Some of these further questions are of a fundamental philosophical nature, while others offer the

⁴⁹ ‘Whare’ was used as a metaphor for Kaupapa Māori research in Wāhanga Tuatahi, and again in Wāhanga Tuarima in ‘whare mātauranga’ as a notion of epistemology. ‘Hanga’ (make, construct) appears in the C. Smith (2000) quote for the process of bringing Māori thinking and mātauranga into academic work, and is also implied in the earlier references to the constructedness of identity, language and knowledge. ‘Poupou’ (or ‘pou’) are found in Salmond’s (1978) semantic mātauranga analysis, discussed in Wāhanga Tuarima, as the ‘orientational opposites’ that structure ‘the traditional Māori cosmos’ in both the physical and metaphysical sense. The threshold (paepae or pae) that mediates them is associated with the ‘institution of an intermediary zone of utu’ (Salmond, 1978, p.25), or balance, where life occurs.

possibility of fresh directions for future developments in Pūtaiao praxis, such as those associated with the national Curriculum Marautanga Project.⁵⁰

The issue for Kura Kaupapa Māori curriculum development, of which Pūtaiao is part, is to carry the challenge to Eurocentric stories about Māori past the level of identity - to engage in epistemological critique. A Kaupapa Māori perspective on science is necessarily concerned with scientism, over and above the more generic tripartite concerns of racism, 'classism' and sexism, so a Kaupapa Māori perspective on science curriculum requires the philosophical 'differend' (Lyotard, 1988) between science and mātauranga to be negotiated.

To see the issue of Māori science curriculum as one of science/English/Pākehā versus mātauranga/te reo/Māori is to seriously oversimplify the debates, and to veer towards unconstructive 'oppositional politics' (McLaren, 1995). What is needed is a Māori way of 'how' to regard science that moves beyond an understanding of the 'what' of Māori science either as traditional knowledge, or as translated modern science (McKinley, 1995). Developing Pūtaiao curriculum along these lines (as a Kaupapa Māori science curriculum) would aim to produce a local, critical science curriculum, not based on 'indigenous' or 'postmodern' science, but informed by multicultural and postcolonial analyses of society and education, and sociology of science (Doll, 1993). One way to do this is to re-articulate the notion of Pūtaiao education as **Kaupapa Māori Science** education, based on a notion of science education with the following characteristics:

- a critical perspective on W-science - a critical science for Aotearoa New Zealand, which remains aware of its own limitations, and includes history and philosophy of science, while rejecting 'final form' (Duschl, 1990) and other scientific representations of science in the curriculum;
- an awareness of processes of cultural hybridity and interdependence, and of science as a product of (multi)cultural knowledge, while rejecting the 'windowless monad' notion of culture (Moody-Adams, 1997);
- an acknowledgement of the validity of science knowledge found within mātauranga Māori, i.e. a pluralist perspective on knowledge while rejecting radical epistemological relativism (Siegel, 2006);
- an awareness of the importance of Māori philosophy, principles and practices including language and culture;
- an awareness of the position of Pūtaiao curriculum within language shift and change processes, and of the balance between aims in language planning and in science education; and

⁵⁰ www.cmp.ac.nz, accessed 28/11/06.

- a political stance mandated by the Treaty of Waitangi to underpin its legitimacy and entitlement to state resources (Smith, 1997).

Critical theorists of education have emphasised (Young, 1989), however, that in order to critique a discipline it is first necessary to ‘master’ it. What this means in each of the domains of the curriculum is likely to vary widely. For Pūtaiao, I believe it is valid to ask: is construction of a parallel science lexicon past Level 4-5 the best way to help achieve the required increase in participation of Māori in the world of science? The vocabulary issue in Pāngarau is considerably less of a problem than in Pūtaiao. Since mathematics ‘is’ a science, the comparison between the two is relevant. If the answer to the above question turns out to be ‘No’, much work for Pūtaiao educators still remains to be done, as this thesis has attempted to indicate. For other curriculum areas, other considerations are likely to lead to different questions they would like to address in their development processes.

Following the analysis of science language by Halliday (2004), I surmise that, for a number of reasons, including the influence of language purism (Harlow, 2003), the characteristic science discourse associated with senior secondary science curricula has not yet emerged in Pūtaiao, or Māori-medium science, classrooms. This suggests the question of whether, or when, such discourse will develop, if current policy trajectories continue unchanged.

We want, therefore, to avoid, while developing the capacity to critique, scientism and science ideology,⁵¹ but not to do away with science. This approach can be characterised as follows:

1. The best possible W-science education in a strong kaupapa Māori school environment, cognisant of the need to ‘master’ the discipline in order to critique it, while continuing to support Māori student identity as tūranga (standpoint) of critique.
2. Relaxation of the ‘Māori-only’ language policy for senior science classes, possibly by viewing te reo Pūtaiao (the language of science) as international rather than ‘English’.
3. Recognition of the requirement to develop a science register of te reo, in order to express complex science situations, processes, etc, with the required precision and unambiguity - going beyond that of the current ‘word-list’ approach to lexical expansion in Pūtaiao.

⁵¹ See p.54 for the distinction between scientism and science ideology.

4. Inclusion of the critical perspective where possible throughout the curriculum: ‘ngā kete e rua’ (the two kits, or systems of knowledge) approach. Explore the possibility of using narrative pedagogy for teaching about the nature of science (Barker, 2004), including the history and philosophy of science (not canonical science content; Gilbert, Hipkins et al., 2005).

Summary

The first chapter introduced the topic and outlined the research question, which can be stated as follows:

How does Māori knowledge and language articulate with current discourses of Pūtaiao education? Are there alternative articulations?

Discussion of Kaupapa Māori research, drawing primarily on Smith (1997), Tuhiwai Smith (1999) and Bishop (1998), included the theoretical issue of ethnicity, for which May’s model based on the ‘habitus’ notion (Bourdieu) is adopted, and later updated with a postmodernist view on dialectical polarities, using the metaphor of eclectic ‘bricolage’ of elements from both sides of an argument. The thesis research methodology of ‘Kaupapa Māori discourse analysis’ is developed as a synthesis of ‘Kaupapa Māori theory’ and ‘critical discourse analysis’, with reference to Habermasian traditions of critical theory, particularly as applied to education (Young, 1989).

This methodology was applied in exploratory analyses of two contrasting 'texts' of relevance to the knowledge/power nexus of Pūtaiao: first, results of three years (2002-4) of translated NCEA L1 examinations in Mathematics/Pāngarau and Science/Pūtaiao. The analysis indicates that current Pūtaiao teaching strategies have not moved far, if at all, beyond ‘bilingual science’ as defined by Jesson (1991) to be the teaching of the mainstream science curriculum in te reo Māori. The NCEA data indicate greater disparity in science outcomes between Māori-medium and non-Māori candidatures, compared with mainstream Māori. Speculations concerning language and science knowledge, to account for these negative results, are proposed. Secondly, some traditional oral texts are analysed as examples of ‘authentic’ Māori knowledge.

Wāhanga Tuarua begins by examining how science is linked with economics, politics, scientism, and philosophy. Heidegger’s philosophical analysis of the ‘essence’ of W-technology, together with the work of Canguilhem on philosophy of science, leads to the identification of a central ‘differend’ between W-science

and mātauranga/IK discourses as the conflicting notions of humanity's rightful relationship to the natural world, termed 'whakapapa' versus 'standing-reserve'.

The second section of this chapter reviews past phases of Pūtaiao curriculum discourse, from the 1980s (Science Aotearoa) and 1990s (Pūtaiao i roto i te Marautanga o Aotearoa). These two sections together inform the final section, which situates Pūtaiao curriculum development within the wider debates in science education and critical science.

Wāhanga Tuatoru reviews the literature of multicultural science education research, from 1981 to the present state of the debate. The trenchant and longstanding nature of the debate between multiculturalists and universalists in this literature appears to relate to several lacunae, which conflate science and philosophy, science and IK, or sociological versus psychological views on ethnicity, culture and the curriculum. Suggestions in the literature for multicultural science curriculum are classified into five different types, of which three are matched with the border-crossing pedagogies recently identified in a national science education review (Hipkins, Bolstad et al., 2002). The lack of progress in multicultural science education is situated in relation to the 'failure' of science curriculum reform in general, given the inevitable role played by political (i.e. socio-economic) power.

Wāhanga Tuawhā extends the theoretical background in language and knowledge with an examination, firstly, of the important role played by identity in the topic of Pūtaiao, leading to the conclusion that Pūtaiao provides one route whereby ethics may be re-integrated into science, as part of wide-ranging reform of science and science education; whilst remaining sceptically cognisant of the impact of discourses of cultural commodification in terms of enhancing the policy environment for Māori-medium curriculum development.

The second section examines language purism (and its link to values) and the Sapir-Whorf hypothesis (and its link to culture), relating these linguistic debates to Māori language revitalisation processes. The history of language planning policy discourses for te reo Māori, and international debates concerning languages of science, are briefly reviewed, before examining Halliday's (2004) linguistic

analysis of the English lexico-grammar that co-evolved with science, in the centuries after Latin was overturned as ‘the’ language of science. This suggests that successful teaching of senior secondary Pūtaiao requires the development not only of science vocabulary but also grammatical innovations to produce a scientific register of te reo Māori.

Comparison with international analogies reveals the effect of two conflicting ideologies of translation (of W-science into Māori), which follow from the dialectic between cultural relativism and cultural imperialism, in current discourses of Pūtaiao. These are the romantic ideology, which implicitly accepts W1 or linguistic relativity, while (ironically) favouring vocabulary purism; and the instrumentalist ideology, which tends towards producing (problematical) translations of mainstream educational endpoints.

Wāhanga Tuarima turns to a reading of the historical and contemporary discourses relating to mātauranga. The Eurocentric origins of one prominent (arguably incoherent) account of ‘Māori science’ are investigated, as is the question of ‘alternative rationality’ in classical anthropology, debates of which multicultural science education research is a present-day inheritor. The strategic adoption, in the 1990s, of the notion of ‘Māori science’ as a way to problematise ‘Western science’ is surmised to have contributed towards support in the KKM community (and more widely, that of education in general) for the suggestion that science can and should be replaced by mātauranga in the Pūtaiao curriculum.

An original model of mātauranga and science for the Pūtaiao curriculum is outlined, in which mātauranga is represented as a superset of science. In mātauranga terms, science restricts itself to the final layers of whakapapa atua (‘cosmogogenesis’), so science is a subset of mātauranga. All of science is therefore validly included in the Pūtaiao curriculum, which avoids the pitfall of the current dominant notion of ‘Māori science’ as consisting of one or both of the following:

- only those *parts* of mātauranga involving W-science-like praxis
- only those *parts* of science involving ‘nature study’.

The literature on mātauranga is used to investigate the cross-cultural notions of space-time and classification. This reveals the important (covert) role of the following issues in notions of mātauranga:

- the implicit acceptance of W1, or linguistic relativity (weak Sapir-Whorf)
- the opposition between cultural relativism and cultural imperialism
- the ‘knowledge economy’ notion of mātauranga as a resource for science
- scientism, in the form of partisan discourses masquerading as science.

This leads to the conclusion that epistemological relativism is not valid, since logic, agency and morality demand to be acknowledged as universal. The adoption of such ‘unconsciousnesses’ in science has resulted in the current dominance of ‘weak objectivism’, ultimately based on limited (compromised) rationality. Objectivity, as an aim and claim of science, depends on freedom from political influence, *not* the reverse, as is often claimed. On the other hand, the literature supports the validity of weak relativism with respect to patterns or structures of discourse, which can be understood as encapsulating particular cultural perspectives.

This is where the debates in language and knowledge collide: in the realm of discourse. Accordingly, an analogy can be drawn between the Sapir-Whorf hypothesis for language and multicultural science for knowledge. Because values always involve knowledge, and vice versa, different cultural values can and do affect the direction of science. Incommensurable cultural discourses concerning the natural world represent one of humanity’s better options for maintaining knowledge of ways of thought other than those founded on economic rationality. These considerations occur in what may be termed science’s ‘liminal zone’, between the central canon and the boundary of science, which is the epistemic and epistemological home of Kaupapa Māori science (and other forms of critical science). Thus, the two main roles for Kaupapa Māori science are:

- Extending the range of strategies available to science, by providing different underlying philosophical assumptions.
- Challenging scientism, and maintaining the boundary between scientism and science.

Key Findings

1. The contemporary post-positivist understanding of the nature of science allows science to be differentiated from anti-science on one side, and scientism on the other. This dialectic aligns with that of cultural relativism versus cultural imperialism, and in both cases, neither of the extreme positions is helpful for the interests of Māori students, teachers or iwi. Cultural relativist approaches to the science curriculum quickly collapse into ‘soft options’

which do not overcome the disparity in science achievement. Cultural imperialist approaches, on the other hand, are prone to Eurocentric and scientific assumptions.

2. Even strongly pro-Māori views on mātauranga can be unhelpful by failing to explicitly reject scientific 'knowledge economy' objectives and processes. The strategic usage in recent decades of 'Māori science' for political purposes is asserted to be problematic, given its potential to cause confusion, such as when it migrates from the academy into the education community.
3. The Pūtaiao curriculum paradox has two aspects, one linguistic, the other philosophical. The language irony is the increased difficulty of teaching and learning mainstream science in te reo Māori, exacerbated by the policy against borrowing from English, which leads to an extra barrier to international science language. The philosophical irony is that, currently, Pūtaiao education does not allow critique or reform of scientism (or racism, sexism, etc) in mainstream science or science education.
4. Given the political role of the Māori-medium curriculum as part of the symbolic representation of the Māori identity, it is vital that Pūtaiao policy is informed by an adequate sociopolitical analysis, in order to meet the needs of Māori students for better science teaching, learning and achievement.
5. There is a need for science teacher training to include the history and philosophy of science (and of education), in order for teachers to be able to present science realistically to their pupils. This is in line with recent calls from mainstream science educators for better teaching of the nature of science, including the suggestion that stories from science can be useful to achieve this (Barker, 2004), ideas which are equally as relevant and applicable in Māori-medium science education.
6. Successful teaching of senior secondary science in Māori is likely to require the development, not only of science terminology, but of a scientific register in te reo Māori. This issue is important for KKM because this aim is likely to conflict with that of retaining traditional Māori patterns of thought and language.

Conclusion

The conundrum of Pūtaiao within my own professional life was the original reason why I enrolled in the doctoral degree, for the opportunity to come to better understand why a teacher/learner's experience of Pūtaiao is so dominated by

‘kupu hou’. Initial understanding of my research topic as a problem in science education deepened into viewing it as a topic in philosophy, particularly the philosophies of science, language and education, all of which are connected to basic notions of mind, identity, and society. As well as an understanding of these ideas and debates, in order to think about the problem of Pūtaiao curriculum, I had to formulate a position for myself in relation not only to the notion of ‘Māori science’ but also ‘social science’. In what way could this research itself claim the status of ‘science’? Hence the reference to an ‘epistemological journey’ in Wāhanga Tuatahi.

Analogy and metaphor (despite my initial positivist suspicions) have proved their rightful place in this work in two ways. Firstly, because of their role in the philosophies of language, mind and culture (‘symbolic power’ Bourdieu, 1991), particularly in the grammatical metaphor of the language of science (Halliday, 2004), and secondly in heuristic worth, in constructing the argument – helping to organise and update my thinking, and see the complex issues concerning Pūtaiao in different lights or patterns. Indeed, this recognition is itself analogous (!) to the role of Kaupapa Māori science *qua* science, argued for above, which is to widen the range of ‘strategies’ through which the methods of science are applied (Lacey, 2001) in the pursuit of knowledge. This is also expressed as a ‘variety of metaphors as cultural openness to the future’, attributed to symbolic anthropologist Victor Witter Turner (1920-1983) by Moody-Adams (1997, p.71).

The notion of ‘mataora’ (living face) as the power attributed to tūpuna (ancestors) to collapse space-time, and become co-present with their descendants, was highlighted by Salmond in her description of the traditional Māori world-view, discussed above on p.176. In my research, this idea came to stand for the notion of authenticity in mātauranga, as distinct from translated Western knowledge, linked to ‘the power of language to connect us through time and space with the traditional thinking of our ancestors’ (Yamane, 2001).

This chapter began with a Ngāpuhi metaphor for the ‘theoretical landscape’ (Salmond, 1982) of the Māori cosmos, both physical and symbolic, where these elemental pou are represented as maunga, which in the metaphor form the posts of a cultural construction to ‘house’ the iwi. The complementary notion of ‘paepae’

or 'pae', as 'thresholds' or 'liminal zones' in these cosmic/symbolic dipoles, was explained (Salmond, 1978) as the zone of utu, of human life and real moral conflict. As well as linking into the mataora notion above, it seems reasonable to connect this with Turner's idea of 'liminality' or cultural marginality (Moody-Adams, 1997, p.69) as one important source of human openness to the future, critical spaces of diversity and change in paradigm and metaphor. Hence, marginality is an important Cultural Studies theme (Edgerton, 1993). Following Salmond (1985), recognising this 'liminoid' tendency in mātauranga provides another reason to contest the 'closed' versus 'open' analysis made by Eurocentric anthropology about Māori versus European thought/society (Winch, 1970), which has influenced important contemporary pro-Māori analyses of mātauranga (Roberts, 1998).

The centrality of whakapapa, as the key differend between mātauranga and science, at the symbolic level as a primary trope of mātauranga, and at the personal level in Māori identities, underscores the particular relevance of Kaupapa Māori theory (which synergistically combines these levels of tangata whenua discourse) in Pūtaiao curriculum development. This research has turned out to be concerned with identity as well as science in the Pūtaiao curriculum. Identity forms perspective, which links knowledge/science (epistemology) with ethics (values), both in our lives, and in its representation (or not) in the curriculum. This thesis has examined the consequences of a focus on maintaining integrity with the Kaupapa Māori identity in developing Māori-medium science curriculum. This either matters only to me personally, or it is important for all of us - I am no longer sure there is any other possibility.

KUPU WHAKAMUTUNGA/EPILOGUE

Te Whare Tapu o Ngāpuhi

He mea hanga tōku whare, ko Papatūānuku e takoto nei te paparahi,
ko Ranginui e titiro iho nei, te tuanui,
Ko ngā poupou o te Whare ko ngā rārangi maunga;
Whakarārā titiro ki Tokerau,
Tokerau titiro ki Rākaumangamanga,
Rākaumangamanga titiro ki Manaia e tū kohatu mai rā i te ākau,
Manaia titiro ki Tūtemoi,
Tūtemoi titiro ki Maunganui,
Maunganui titiro ki Pūhanga-tohorā,
Pūhanga-tohorā titiro ki Te Ramaroa e whakakurupae ake rā i runga,
Te Ramaroa titiro ki Whiria, ki Te-Paiaka-o-Te Riri, ki Te Kawa-o-
Rahiri.
Whiria titiro ki Panguru, ki Papata, ki Te Rākau-patapata e tū ana ki
Te Hauāuru;
Panguru, Papata titiro ki Maungataniwha,
Maungataniwha titiro ki Tokerau,
Tokerau titiro ki Whakarārā.
Ēhara aku maunga i te maunga nekeneke,
ērangī he maunga tū tonu, tū te ao, tū te pō.
Ko te Whare Tapu o Ngāpuhi tēnei,
tihei mauri ora.

ĀPITIHANGA/APPENDIX

NZQA Data

Year	Type of candidate	Standard Number	Count N	Count A	Count M	Count E
2002	All	90147	13634	11511	11136	1988
2003	All	90147	19576	12873	4974	1713
2004	All	90147	14301	14382	10223	570
2002	Māori	90147	2206	1276	627	54
2003	Māori	90147	2693	908	171	34
2004	Māori	90147	2627	1452	465	5
2002	Translated	90147	34	4	1	0
2003	Translated	90147	46	7	1	0
2004	Translated	90147	47	18	2	0
2002	All	90148	15391	17530	3746	1201
2003	All	90148	18660	10794	8528	494
2004	All	90148	18854	16425	1789	1163
2002	Māori	90148	2281	1556	179	36
2003	Māori	90148	2629	777	335	4
2004	Māori	90148	3108	1187	48	20
2002	Translated	90148	34	5	0	0
2003	Translated	90148	41	7	3	0
2004	Translated	90148	56	4	0	0
2002	All	90151	9230	17150	12810	1288
2003	All	90151	13247	14687	8829	3897
2004	All	90151	9082	15590	15283	853
2002	Māori	90151	1708	1977	845	29
2003	Māori	90151	2079	1457	492	113
2004	Māori	90151	1936	1902	1020	22
2002	Translated	90151	27	10	2	0
2003	Translated	90151	41	21	3	0
2004	Translated	90151	52	16	3	0
2002	All	90152	11837	15508	7557	5110
2003	All	90152	14500	12455	13465	96
2004	All	90152	15505	17764	6487	655
2002	Māori	90152	2047	1681	488	230
2003	Māori	90152	2214	1151	731	1
2004	Māori	90152	2783	1642	345	8
2002	Translated	90152	23	10	4	0
2003	Translated	90152	14	15	7	0
2004	Translated	90152	43	24	0	0
2002	All	90153	10487	12182	13299	1662
2003	All	90153	11925	18784	6026	818
2004	All	90153	6735	20057	7713	682
2002	Māori	90153	1778	1342	900	62
2003	Māori	90153	1797	1640	276	8
2004	Māori	90153	1379	2223	409	11
2002	Translated	90153	24	10	2	0
2003	Translated	90153	34	18	5	0
2004	Translated	90153	34	20	4	0
2002	All	90188	13785	9826	3107	474
2003	All	90188	11767	10736	3552	1243
2004	All	90188	12587	11582	2230	191

Year	Type of candidate	Standard Number	Count N	Count A	Count M	Count E
2002	Māori	90188	2029	766	138	14
2003	Māori	90188	1693	881	170	53
2004	Māori	90188	2050	980	88	4
2002	Translated	90188	12	0	0	0
2003	Translated	90188	18	10	1	0
2004	Translated	90188	34	5	0	0
2002	All	90189	11373	14182	7864	2011
2003	All	90189	13535	13083	8551	1347
2004	All	90189	15785	11957	4779	1304
2002	Māori	90189	1801	1335	382	45
2003	Māori	90189	1962	1082	368	25
2004	Māori	90189	2513	1027	217	36
2002	Translated	90189	13	0	0	0
2003	Translated	90189	22	8	0	0
2004	Translated	90189	34	4	0	0
2002	All	90190	15231	11489	1960	53
2003	All	90190	8494	14218	1682	59
2004	All	90190	10806	8549	2879	1226
2002	Māori	90190	2226	821	78	2
2003	Māori	90190	1285	1166	72	1
2004	Māori	90190	1740	749	159	48
2002	Translated	90190	11	2	0	0
2003	Translated	90190	26	7	0	0
2004	Translated	90190	22	5	2	0
2002	All	90191	8916	19442	4343	767
2003	All	90191	17382	12740	3761	826
2004	All	90191	9289	17563	5712	810
2002	Māori	90191	1422	1828	199	20
2003	Māori	90191	2350	830	143	31
2004	Māori	90191	1710	1752	258	11
2002	Translated	90191	6	7	0	0
2003	Translated	90191	22	6	0	0
2004	Translated	90191	22	12	0	0
2002	All	90192	7558	12341	4046	310
2003	All	90192	7697	10575	3248	575
2004	All	90192	6655	9519	1223	569
2002	Māori	90192	1147	1127	195	6
2003	Māori	90192	1064	894	142	18
2004	Māori	90192	1087	814	50	17
2002	Translated	90192	11	2	0	0
2003	Translated	90192	16	6	0	0
2004	Translated	90192	22	8	0	0
2002	All	90194	18902	13025	5132	1476
2003	All	90194	15025	12735	9915	996
2004	All	90194	16758	12036	7876	1272
2002	Māori	90194	2800	1172	237	34
2003	Māori	90194	2214	1157	484	13
2004	Māori	90194	2857	1171	369	39
2002	Translated	90194	37	2	0	0
2003	Translated	90194	48	11	0	0
2004	Translated	90194	58	8	1	0

WHAKAPOTONGA/ABBREVIATIONS

CDA	Critical Discourse Analysis
CSSE	Culture Studies in Science Education
IK	Indigenous Knowledge
ISS	Ideal speech situation (Habermas)
KAWM	Kaupapa Ara Whakawhiti Mātauranga (video conferencing distance education initiative)
KKM	Kura Kaupapa Māori
MOE	Ministry of Education
NCEA	National Certificate of Educational Achievement
NZCER	New Zealand Council of Educational Research
NZQA	New Zealand Qualifications Authority
TEK	Traditional Ecological Knowledge
WMS	Western Modern Science

RĀRANGI KUPU/GLOSSARY

Note: Meanings given are as used in this thesis; there may be others. Major place names only are listed; kingroup names and smaller place names are not.

a	(particle used before a proper noun), of
akomanga	classroom
anake	only
anga	shell, skeleton, framework
anō	also, again
ao	world, daytime
Aotearoa	New Zealand (North Island in some accounts)
ara	path
atua	god
au/ahau	I, me
e ... ana	(verbal particle for continuous condition/action)
haka	dance (in common usage, 'war dance')
hanga	make, build
Hangarau	Technology
hapū	'sub-tribe'
harirū	shake hands
Hauora (marautanga)	Health and Physical Wellbeing (curriculum)
he	(indefinite particle) a/some
he aha?	what (is/are)?
hei	as, in order to
heitiki	carved necklace ornament
heke	descent line (in genealogy)
hinengaro	mind, 'psyche'
hou	new
hui	meeting, tribal gathering
hui mate	tangi, tangihanga, funeral
i	(transitive particle), in, at, from
i roto i	in, inside
iwi	'tribe'
ka	(verbal particle indicating change of action)
kai	consume, food, contents
kaiako	teacher
kaitiaki(tanga)	guardian(ship)
kapa haka	performing arts group
karakia	prayer, incantation
katoa	all
kau	just (adverb)
kaumātua	male elder
kaupapa	policy, philosophy, cause
ki	(transitive/directional particle) at, to, with, for
ko	(definite particle)
koha	gift, contribution
kōrero	speak, speech, text
koutou	you (3+)
kupu	word, saying
kura	school
Kura Kaupapa Māori	schools based on principles of Te Aho Matua

manu	bird, kite
māori	ordinary, normal
Māori	indigenous people of Aotearoa New Zealand
marae	community meeting place
marautanga	curriculum
mātāpono	principle
mātauranga	knowledge, education
mātua	parents
mātua tupuna	ancestors
maunga	mountain
mauri	vital essence
me	and
mea	thing (person, object, action, statement)
me pēhea?	how?
mihi	greeting, acknowledgement
mō	for, concerning
moana	ocean
moe	sleep, ‘marry’
mokopuna	grandchild, young child(ren) in general
motuhake	unique, original
ngā	the (plural)
nō	belonging to, of, from
o	of
ōku	my (plural)
ōrite	same, equal
pae	horizon, horizontal beam
pakari	matured, strong, hard
Pākehā	non-Māori
Pāngarau	Mathematics
pēpi	baby
pou, poupou	post, housepost
pounamu	greenstone, jade (nephrite)
pōwhiri	formal welcome
pukapuka	book
pūrākau	traditional narrative
puta	appear
Pūtaiao	Science
rangahau	research
rangatiratanga	kingdom, aristocracy
rārangi	list
reo	voice, language
rongoā	medicine, plant remedy
taha	side
tai	sea coast
taiao	environment (modern) =ao (traditional)
Taitokerau, Tai Tokerau	Northland
takahē	moho, Notornis hochstetteri (flightless bird)
takoto	lie down
tamariki	children
taonga	treasured possession
tātou	we, us (3+ inclusive)

tauīwi	alien, foreign(er)
taumata	paepae, seating for tribal speakers in marae
te	the (singular)
Te Aho Matua	philosophy/policy of Kura Kaupapa Māori
Te Kohanga Reo	Māori Language Nest pre-school movement
te reo (me ōna tikanga)	the language (and its customs)
Te Tiriti o Waitangi	The Treaty of Waitangi
tēnā	that
tēnei	this
Tikanga-a-Iwi	Social Science
tino rangatiratanga	Māori sovereignty
tohunga	expert in traditional Māori knowledge
Toi	Art
tuakana	older sibling
tuaono	sixth
tuarima	fifth
tuarua	second
tuatahi	first
tuatoru	third
tuawhā	fourth
tuku iho	inherited
tūrangawaewae	ancestral home (lit. place to stand)
tūtūā	person of low status (trad.)
wā	time
wāhanga	section, chapter
wāhi	place
wai	water
waiata-a-ringa	action song
waka	canoe, ‘confederation of tribes’
wānanga	live-in, professional development course
whaikōrero	oratory
whakaaro	think, thought
whakahaere	organise, facilitate
whakamahi	use
whakamutunga	final
whakapapa	genealogy
whakataukī	proverb
whakawhanaungatanga	mutual introductions, with genealogical links
whakawhiti	cross, transfer
whānau	family (extended)
Whānui	Vega, a star (Alpha Lyrae)
whare	house, building
Wharekura	secondary Kura Kaupapa Māori
whika	figure

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