

Science and Mathematics Education Centre

**HEROES FROM THE PAST: THEIR BELIEFS AND
PRACTICES, AND INFLUENCE ON CURRENT
SCIENCE EDUCATION PRACTICE**

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ABSTRACT

This study reflects my own search to clarify the process of cultural change in an educational setting. In particular it clarifies for me the process through which State-wide science curriculum reform was enacted in the late 1950s and into the 1970s. This period is interesting because of a continuing perception amongst science teachers that the system-wide changes of the time were widely supported by teachers and influenced classroom practice. My aim in this study was to explore how the characteristics of this cultural change process may be applied in the current climate of school reform.

The members of the local science teacher community of the 1950s, 1960s and 1970s engaged in similar activities and conversations as they attended the same University then continued to enter into similar school-based activities. As a group of people with shared experiences and values, who made decisions based on similar understandings and priorities, this group may be regarded as an identifiable culture.

The day to day activities of this community of science teachers were underpinned by each teacher's beliefs about scientific knowledge and processes and school science, as well as understandings about the teaching and learning process. Many of these beliefs were so fundamental as to be unquestioned, and may be referred to as *referents* or *myths*. For the members of a culture to change their practice then, new referents must be introduced, or existing referents modified.

In searching for the process by which this culture was able to access new understandings, this study examined the comparative influence of two highly visible science educators who promoted science curriculum change in the State. As a result of data collection involving interviews with twenty-five key informants and the examination of private and public archival records, the crucial role of these unique

personalities emerged consistently. Each of these men have been characterised as a *Hero* because each brought new understandings to their existing culture (Campbell, 1949).

In reviewing the extended career of each Hero it was possible to draw strong parallels with mythical Greek heroes, Perseus and Theseus. This metaphorical representation not only effectively mirrored the life history of the modern-day heroes but also served to reconnect the logic of science along with that of the emotion of art — a balance well understood by the Greeks.

The study found that the successful Heroes promoted significant long term change by instituting new rituals, ceremonies and artefacts throughout the science education community. Over time, these activities effectively modified older referents and created new ones, leading to new practice in the curriculum enacted by science teachers.

In drawing together the stories of Perseus and Theseus, it was possible to recognise common elements in the processes by which these influential individuals were able to effect new practice in their community. Thus the study provides a template for the cultural change process in the future.

In the final discussion, focus shifts to the relevance of this research to the everyday enterprise of schools and school systems. As a school practitioner I always read scholarly papers with the underpinning question, "So What?" The final chapter then, is largely hypothetical as it poses possibilities, makes predications and offers advice for readers seeking to improve the change process in their own context.

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CHAPTER 1

INTRODUCTION

I come to this study as a privileged person.

Throughout my life I have been engaged in a sequence of conversations about education, particularly about school science education. My choice of the subject and context for this thesis is my attempt to extend into a scholarly framework the sum of the multitude of my lifetime understandings and experiences. In presenting this study, story has become a central element in my analysis.

Where Do I Come From To Enter This Journey?

I recognise that I am a long time member of the culture about which I write. Until the completion of my school education I lived at home with my teacher parents, Dad a science teacher and Mum a mathematics teacher. As the oldest child in the family, I observed and participated in the frequent household debates which revolved about what constituted an appropriate secondary school education. As a participant engaging in these activities and conversations with my parents and their friends, I shared common understandings about knowledge and pedagogy, the value of the school curriculum and structures, the worth of teachers and the operations of the centralised Education Department¹.

For most of my life I have lived in a geographically large state in Australia. Prior to the second World War, the State population was very small and relatively isolated from the rest of the country. Both of my parents originated from farming families.

¹ In this thesis I have decided to use the title convention for certain institutions, locations and positions to portray their importance and power within the culture of the day. Examples include the Education Department, University, State, Director General, Superintendent and Head Office.

They each received scholarships to attend the same rural senior high school prior to studying at the only state University. In the mid 1940s, they knew all of the students of their own year group at the University, and most of the full-time student population. They found strong social networks through University sporting teams, the library and academic classes, as well as social clubs and gatherings. My parents were members of a small, select community participating in a variety of activities with the same group membership. These future leaders and decision-makers had many opportunities to test their ideas within the group. By the end of their undergraduate years, the members of this University community had formed many shared understandings and cemented lifelong friendships founded on common knowledge, experiences and perceptions.

Following their university studies, my parents left the State to teach in other more populous states of Australia. Five years later, they returned to teach in their home State with two small children. My earliest memories are of moving house from country town to larger country town and then the city, as my father was transferred by the Education Department to fill vacancies in different schools.

The State education system of the 1950s was governed from the Head Office in the State capital, where education policies were determined. These policies included the rules concerning staff selection and placement in schools. According to these rules, beginning teachers were assigned to rural postings with the promise of transfer to larger towns or the city as soon as a position became available. Teaching situations in the city usually became accessible when experienced teachers were promoted to higher-level roles in a smaller country school. The cycle of country appointment and transfer to the city, country promotion by seniority and transfer to the city and so on, was unquestioned and immutable. In the sprawling rural economy, the State education system was expected to be of uniformly high quality and deliver to rural children the same curriculum, teaching expertise and quality of facilities as that

accessed by city children. To this end, the personnel in Head Office determined the broad curriculum outlines, clarified the expectations to be placed upon schools, assessed teachers' expertise through a centrally located inspectorial system, determined where and which new classrooms/schools would be built and what facilities would be provided. All major policies relating to education were developed and transmitted from the central Head Office, and many career-minded teachers aspired to be promoted into this Office. Head Office personnel had high credibility among the teaching community. Teachers perceived that the powerful Director General of Education drew from the specialist knowledge of Head Office personnel to advise government ministers about the appropriate directions for education in the State.

Teaching was a life-style. When my parents were appointed to a rural town, they often followed a day's work with coaching various local junior sports teams and inevitably attended meetings for school or local sport authorities. Later in the evenings they maintained their school preparation and marking loads. Other school-teacher friends ran the local repertory clubs, gave adult classes in pottery, arts and crafts and were centrally involved in rural social life.

In the post-war years, the State government applied a "breadwinner" policy to employment. This policy meant that only one member of the family was permanently employed and able to access promotion and other leave entitlements. My science teaching father was the permanent teacher in the family. He was promoted to the position of Head of Department² then Deputy Principal before entering the Head Office of the Education Department. My mother, unable to participate in the promotional stakes because of the breadwinner policy, was re-employed at the beginning of each school year as a temporary mathematics teacher. Despite having two parents who

² Until 1987 the term used to describe the head of a subject department or faculty was Senior Master or Senior Mistress. In an endeavour to reduce confusion I have used the present title, Head of Department, throughout this thesis.

worked full-time, I remember few baby sitters. As a young child I spent numerous hours in school rooms (with homework, reading or board games) while meetings were in progress, on tennis courts or football ovals and at school halls while student dances were underway.

In the 1950s in rural Australia, children accompanied parents on evening excursions, and as such I was privy to the activities and conversations in which my parents participated. I learned through the actions of my parents and their friends about teachers' commitment to their students and their profession. I overheard discussions about issues such as new school sites, increasing student numbers, class sizes and the availability of good young teachers. These conversations seemed to revolve around the decisions of someone else, far away. My parents seemed to accept that "big picture" policies and procedures were not theirs to make.

I loved listening to the classroom anecdotes of my parents and their friends. When they talked about their classes I couldn't help but feel that teaching was what really mattered in schools. Whether discussing incidents with students, other teachers or Head Office people, they came alive and seemed in control. In this context, they knew enough of the answers to enjoy the unexpected. They shared the wonderful moments of teaching and the humorous anecdotes. For example:

"Sorry Miss," said the student as he stepped diagonally across the desks, "but you did say the shortest distance between two points was a straight line!" There was also the uplifting story of the hardworking student who finally looked up from complicated chemical calculations with, "I can do them. They're not so bad you know sir."

My parents shared their colleagues frustrations about teaching an inappropriate curriculum to students and having to contend with external examinations. There were also stories of students jumping out of windows to escape the confines of a classroom. When my father was a Head of Department he talked about having to

manage the behaviour of students from a range of classrooms. The incredible stories of high school student behaviour made me wonder whether Dad was severe enough in applying sanctions.

As the 1950s progressed and I inched towards high school age, I listened more carefully to the adult conversations. I came to understand the post-war population growth created enormous pressure in classrooms with classes of up to fifty students. My father worried about the basic facilities required to maintain quality of instruction in his subject. As one of his peers later explained:

Most of the time we were worried about getting bums on seats. That is, a chair and a desk for every student, preferably in a room with a teacher. If the kids and teacher had books, that was a bonus. (L, reminiscing about teaching in the 1950s, interviewed in 1994)

In the late 1950s the talk shifted to forthcoming changes in the lower secondary science curriculum³. Now resident in the city, my father attended afternoon meetings with other Heads of Department and the subject Superintendent, a person who seemed all powerful. There were discussions over cups of tea at home, about what content should be in the new curriculum. This was a time for crinkled foreheads, disagreement and compromise.

As a high school student in the 1960s, I was able to experience the result of these deliberations as the "new" science curriculum, called Science A (which everyone studied) and Science B (for the more able students). No longer was science offered in the form of traditional physics, chemistry, biology, geology or physiology and

³The term curriculum is used in different ways throughout this thesis, reflecting the understanding of the local community at different times. In the 1950s the word curriculum was used to describe the subject content and concepts to be taught to students while by the 1970s the term had expanded to include the range of classroom activities forming a part of the practice of teaching and learning.

hygiene subjects. Once again back in a rural school, my now Deputy Principal father ensured I was well tutored as he taught me science. My mother taught me mathematics. I was a conscientious student and as a participant in the new curriculum, I now took part in the conversations. I questioned the concentration on physics and chemistry in Science B. I wondered why all students studied Science A but not Science B. My parents and their friends reiterated similar messages. Chemistry and physics were important for further academic study. The breadth of Science A made it interesting and approachable to most students, while the knowledge included within it was of wider value. It began to make sense that different students were required to engage with different knowledge.

As I left home to attend University (the same one as had my parents), there were new conversations at home. The problem of lack of school facilities and resources had eased although the availability of quality science teachers remained a perennial concern. Even the content base of the compulsory science curriculum seemed relatively uncontested. The means of assessment was now the subject of debate. Many people in the educational community were questioning the value of an external examination at the end of Year 10. My acting Superintendent father, now in the Head Office in the city, was immersed in discussions about alternative assessment procedures.

While at University, my annual return home during the Christmas break was a time for brisk discussion about science knowledge and school science. I completed a science degree majoring in chemistry and biochemistry. I accepted the value of chemistry and physics in the compulsory school science curriculum. My part-time employment and sporting commitments and friendships reaffirmed the view that not all students wished to study the same school science. Consequently, at the conclusion of my schooling and university studies, my understandings of what should constitute a school science curriculum concurred with those of my parents and their generation of education

friends. I now shared similar understandings with my parents about school and the place of a compulsory school science curriculum.

Following the completion of my degree, I moved to another state to work in a pathology laboratory where I was able to participate in research as well as diagnostic work. I found that science laboratory-based research was repetitive and largely removed from people. I had made a major mistake in predicting my lifelong calling! After twelve months I made the change to the career path I had least expected to follow. Having reiterated throughout my youth that I would never become a teacher, I returned to university to study science education. As a qualified teacher, I then spent another six years teaching science in two more states of Australia. I found myself making some interesting comparisons. In other states, when I was uncomfortable with the curriculum or annoyed at the lack of guidelines, I would compare the situation unfavourably with my own experiences as a school student.

It was in the late 1970s, with two children of my own, that I returned to the site of my own school science education to teach science. I came home to a curriculum which in many ways had hardly altered in my twelve years absence. Yet the actions of some science teachers had changed considerably. Local teachers told me stories about a major science curriculum change — called Achievement Certificate science - which had been undertaken only eight years previously. With Head Office support in the form of in-servicing and teaching materials, there had been a major shift in the lower secondary curriculum. I had to search widely. Where was the evidence of this shift?

Gradually I began to unpick the similarities and differences between the curriculum I was now teaching, and the one I had learned while at high school. It seemed to me that most of the school science knowledge base for Years 8 to 10 was the same, just re-arranged and given a new name. This 1970s curriculum did incorporate conscious definitions of appropriate school science pedagogy, in particular a commitment to

hands-on, laboratory based experiences. This was a new facet to my understanding of the way in which science had been taught in schools in my home State. However, interest in laboratory and student-centred pedagogy also had prevailed in the states from which I had so recently departed. It wasn't particularly new or different to me, just a reflection of new understandings about teaching and learning based on recent educational research findings.

What was singular in this State was the effort expended by teachers in ensuring assessment comparability⁴ between classes and between schools. I had not encountered this requirement in other states, yet no-one questioned its necessity here. As a consequence, I was locked into a common teaching sequence, the use of identical assessment tools and a common end of topic test. Although this process ensured that teachers talked together about their classroom actions, the structures they created constrained teachers' flexibility to experiment with modifications to the content and sequence of curriculum.

In my new world of full-time teaching, small children, re-establishing a friendship network and supporting my husband in his decision to follow a new career as a mathematics teacher, I became too busy to do more than try to keep up with the demands of teaching my students and adhering to the requirements of comparable assessment procedures. However, we all had time to talk school with my father, now a Director in the State Education Department, and my mother, who continued to teach mathematics. We compared state school systems, noting similarities and differences.

Because of my parents' longevity in the school system, they were able to pass on their perspectives about the recent changes in the secondary school curriculum. I was

⁴ Comparability is the term used in my State to describe the expectation that a grade given to a student in one school by one teacher, will describe the same achievement level as that given to another student by another teacher in the same or another school. The extensive use of common tests and other assessment tasks are used to moderate different teachers' grades.

reminded that until the mid-1950s there had not been a review of curriculum since 1934. Until the late 1950s, only the elite students accessed secondary education. In 1960 and 1970, as a result of major reports into secondary education, the secondary curriculum had undergone significant changes. My father had helped write parts of the new 1960 science curriculum. This was the Science A and B curriculum in which I had participated as a student. As a Superintendent of science from 1966, he helped develop and implement the 1970s Achievement Certificate lower secondary science curriculum.

My parents argued that each new curriculum change had brought about definite improvements in teaching and learning. In addition, they claimed that each change had responded to teacher needs and had been welcomed by teachers as being overdue and appropriate. While my parents might be expected to espouse such beliefs, I found that my colleagues at school held similar understandings. The new 1970s Achievement Certificate curriculum was accepted and teachers felt that they had some input into the directions of these changes and their associated materials. My peers at school told stories about their secondary school teacher colleagues who had participated in directing the new curriculum. This was unlike my experience in other states where new curriculum materials had arrived with some fanfare from outside the system. Written primarily by scientists and sometimes by educators, some of these materials were adopted while others languished unused in classroom cupboard corners. It was interesting to observe that my own home State could design and adopt curriculum change in such an uncontested manner.

A number of very challenging but satisfying teaching years passed and in the mid-1980s I became a Head of Department (Science). For a short time I was the only female in such a promotion position in the State, although happily more have followed. As Head of Department, and still overseeing common assessment procedures for lower school science classes, I again recognised my discomfort. My

colleagues and I found the constraint such procedures created in confining teachers' flexibility in modifying classroom curriculum was frustrating. At different times we each wished to follow the interests of individual classes. Under the constraints of our comparable assessment policies this was not possible. In addition, students performing poorly under this arrangement were stuck with a compulsory course of defined content and processes increasingly at odds with their interest and inclination. Our own staff began to make school-level modifications to the State mandated curriculum. Teachers in other schools across the State expressed similar concerns. Together, a representative group of Heads of Department requested that our Superintendents increase the flexibility of our science curriculum. It was in this context that the value of post-graduate study became relevant and attractive. I enrolled.

Why Do We Teach As We Do? Contexts And Perspectives

During the past eleven years my professional life has expanded considerably. I commenced part-time postgraduate study and the reading and research avenues helped inform my school-based experiences. My husband and I completed Master's degrees and continued on to doctoral study. This continuing journey as a student and educator included a memorable and mind-expanding year in 1990 studying and teaching at Florida State University in Tallahassee in the United States. The experience of being able to participate in another culture with our alien eyes enabled us to question our own culture more critically.

Once again at home, I had already received promotion from Head of Department to Deputy Principal in 1989 and served in this role in several schools. Most recently I was promoted to become the Foundation Principal of a new school. Here I have an opportunity to create a unique school organisational structure and practice. With the advent of this challenge, my research interests have extended beyond science

education to include teaching and learning in all aspects of the school curriculum. In particular I am drawn to clarifying the processes of negotiation, influence and compromise which act to move curriculum in new directions.

The synthesis of the experiences and learning of recent years has opened new windows to my own understanding of why we teach as we do. I firmly believe that we teach in a way which makes sense to us, with the expectation that our classroom actions will make a difference to the learning outcomes of our students. The fundamental beliefs upon which teachers justify their knowledge and action may be recognised as teacher myths, or referents, where these referents are unconscious and often unchallenged understandings. These underlying referents are the powerful organisers of teacher practice. Despite this influence, it may be that they are not written or codified and may exist only as the understandings of participants (Tobin, Kahle & Fraser, 1990). Teachers' use of metaphor, customs, rituals and artefacts in their everyday practice and conversations reflect their beliefs about knowledge and the practice of teaching and learning.

When I returned to my home State as a teacher, I had been struck by the similar ways in which science teachers in different schools acted. It seemed that they operated in almost identical ways in their classroom practice and in their understanding of what constituted legitimate school science knowledge. I looked first at the centralised State education structures and school organisational structures as constraining and identifying the boundaries within which science teachers functioned. However, this inference conflicted with teachers' stated perception of their own power over their curriculum and influence in determining previous curriculum change. It seemed that teachers' beliefs about best practice determined the way each created his or her own curriculum structures. At times these confined classroom action. It was then that I examined the context in which secondary school science teachers lived and worked.

Despite post-World War II population growth, my State has a relatively small population. As university educated individuals, my colleagues and I belong to an even smaller group of academic elite. As science educators within this State, we attended local primary and secondary schools then studied at the local University in order to attain qualifications relating to content knowledge. Although I gained my initial teaching experiences in another state, most of my teacher friends remained here. Since embarking on our teaching careers, my colleagues and I have continued to share similar school-based experiences. Throughout our lives we have participated in activities and conversations through which each of us has been able to test our beliefs and understandings about learning and teaching practice. The sum of these experiences have shaped our use of language, traditional customs, understanding of the implicit rules of working in the centralised education system, and ensured that as teachers we share common understandings and values. As a group of people with shared experiences and values, my teacher colleagues and I now make decisions based on similar understandings and priorities. We constitute an identifiable culture (Deal & Kennedy, 1982; Schein, 1989).

As one of a community of science educators, how might I now exemplify the culture peculiar to the science educators of my State? It seems to me that the science curriculum best represents the global outcome of beliefs about science knowledge and pedagogy held by the science education community. Classroom action and curriculum policy and structures interconnect with teachers' beliefs about school science. For science teachers, the curriculum is the "stuff" that teaching their discipline is all about. It represents what is important for the next generation to know. This is where the human interactions occurring in science teaching and learning take place. As a social construction, the beliefs and values of the community will be embedded in the science curriculum (Tobin and Espinet, 1989). Disparate beliefs within the community will be the site of contestation (Goodson, 1992).

Curriculum: Immutable Or Evolution Or Reformation?

When I look back on my own learning of science in secondary school and then my experiences as a science teacher in the same schools, the most overwhelming feeling is one of the familiarity and security and the lack of change of the school science curriculum. Perhaps this perception is clouded by my age and my own departure and return to the community. My slightly older colleagues consistently reaffirm that there were two important science curriculum changes in this State. The first was introduced in the 1960s (just prior to my entry into high school) and the second in the 1970s (just as I departed for another state). Members of the science education community continue to tell stories about these changes: ascribing responsibility to influential individuals; attesting to the value of outstanding science teachers of the day for their support of these individuals; describing the resources invested in creating such changes and recognising the resultant modifications in the practice of the science teaching community. It seemed to me that the members of the community were pleased to have been a part of such processes.

Such perceptions create a paradox. This positive acceptance of supposed widespread changes in curriculum conflicts with the view amongst current educators that the curriculum change process is problematic, especially in getting past the classroom door (Sarason, 1990, 1971). Despite the widespread observation that schools and the subject curriculum and its instruction are impregnable and unchangeable, many school insiders might concur with Goodson (1992, p. 25) who contends that in reality it is "a recurrent terrain of contestation." However, my colleagues affirm that these new system-wide directions for school science curriculum were widely supported by science teachers. These teachers also perceive that classroom practice was influenced as an element of the new curriculum. There were contests, but the science education community participated in these deliberations, found the compromises and then accepted the new understandings of what should be appropriate content and strategies

for the teaching and learning of science. In this context, which components of curriculum are compromised, and which untouched?

In reviewing the impetus for curriculum change, it is inevitable that the consideration of differences in power will become relevant. Giroux's (1981) reference to a dominant culture within any society will be useful in such discussions. No matter how homogeneous the experiences of science educators might have been, each will have constructed for him/herself a meaning for science teaching and learning. This meaning must then be renegotiated with colleagues at each site of teaching and learning and with the personalities of Head Office. In each site of educational discussion, such an exchange between individuals will also become an unequal dialogue between different representations of power (Foucault, 1980). This consideration of inequality of power must have relevance to teachers' perceptions of the processes by which change was implemented.

As a school-based educator, along with others in my community, I am currently preparing for further substantial changes to the school science curriculum. I perceive that changes in our society and the context of our student population make the demand for system-wide and classroom-based change critical to the future success of secondary education and our societal well-being. I now feel a frustration that the current policy makers seem to lack an understanding of the history associated with changes in the science curriculum. In today's climate of changes of policy and rapid turnover of policy makers, it is increasingly likely that innovations heralded as new and exciting are, in reality, minor alterations of previous practice. While experienced teachers like myself decry the reinventing of the wheel we also admit that many outdated principles remain entrenched in our curriculum without due critical evaluation. Many of us are ready for changes to our curriculum and are already experimenting at school-level despite the lack of authority to do so. However, as already recognised by Cuban (1990a), Eisner (1994) and Kliebard (1992), the paucity

of historical information as to how curriculum change has been conceptualised and implemented limits our policy makers' and our own understanding of the curriculum reform process. For any future reconstruction of the curriculum to have widespread effect, it would seem desirable for decision-makers and education community members to have an improved understanding of the processes and achievements of successful reforms of the past.

This study is primarily about clarifying some of these past achievements. The understanding of my generation of the science education community is that credible and effective science curriculum reform has already been successfully enacted across this State during the late 1950s and into the 1970s. As a long-time and continuing participant in this culture, I am particularly attracted to the role of the influential individuals who are perceived by teachers to have initiated, designed and promoted particular directions for curriculum change. Who were these change agents, and what were their beliefs about science and science teaching and learning? In this thesis I will refer to these individuals as "Heroes". As my fellow educators and I embark on a continuing cycle of change in the 1990s, is it possible to clarify the process through which change was implemented in these earlier times? What were the components of the curriculum change process which achieved such apparent consensus amongst the community? How fundamental was the presence of the Hero to this process? In the current climate of rapid transition and continued questioning about appropriate schooling and school curriculum, school educators are searching for the means by which effective and consensual changes in our school culture may progress. The explication of these elements is the purpose of this study.

CHAPTER 2

CURRENT PRACTICE: NEW SCHOOL, OLD WAYS

The Context: The Foundation Principal

Becoming part of a new school, especially as Foundation Principal, has required that I confront my own understandings of the complexities of curriculum change. As in all schools, the challenge for my own team of school educators is to foster models of exemplary teaching and learning practice. Unlike the majority of schools in my system, we are able to explore questions about how best to engage students in learning without the imposition of external curriculum parameters or pre-existing organisational structures. Many of our previous understandings are being re-examined. Which elements of the knowledge and processes currently integral to school curriculum, should be retained? What of the continuing negotiation between teachers and students in each classroom? In our school, change involves recasting curriculum components. We are reassessing the ways in which we approach learning and teaching in the classroom. In addition, we are reorganising the school structures that support teachers and students.

I was already well into this study, writing and re-writing embryonic papers, when I joined a lunchtime conversation between two of our teachers. Diane — a foundation staff member — and David — a new arrival to the school.

Diane and David

Diane is an excellent teacher of five years experience with terrific rapport amongst her students. In her previous school she taught social studies including geography. In our school she teaches in a team of six teachers with one hundred and twenty students

of years 8 and 9 (thirteen and fourteen year olds). After twelve months in the school, Diane is very realistic about the extent to which the school structures and organisation have actually changed her teaching style. While many learning outcomes are reinforced by all teachers (for instance, narrative writing) Diane states that she more often contextualises students' learning skills in the historical, geographical and economic realms, although she also touches on outcomes related to mathematics, language, health and other areas.

David joined the staff in the second academic year of the school's history. He came to us with almost twenty years of experience in science class rooms, wishing to do schooling differently. David felt that his long-held desire to change his own practice of teaching and learning had been impeded by the traditional structures at his previous school. He perceived that while his classroom presence and skills were acknowledged by students, parents and teachers in his last school, his ideas for change in science curriculum and organisation found less favour amongst peers and superordinates. David tells me that he sees our new school as meeting his need to "do things differently." I see him as a man on a mission and is absolutely resolute. This conversation between Diane and David took place during a two-day induction at the beginning of the year.

The Conversation

David: I'm still coming to grips with this collaborative teacher planning time each week. I guess I'm used to being told what content is to be taught to whom, and which common assessment tasks are to be given and when. Basically that's been the extent of science teacher collaboration as far as I've experienced it for years. The rest of my teaching in a science department has been fairly individual. I love this working in teams idea, but I'm not sure how it works.

Diane: You'll get used to it soon enough. I'm probably not the best person to talk because all of the others will tell you that I still do a fair bit of my own thing. Just me I suppose. If I know the kids like something, and I think its valuable, I'll still do it even if no-one else does. That's what is so good about this way — you have some fairly up-front discussions but in the end agree to work together in some aspects and work, individually on others. But you do let others know what great ideas you have. It's just good teaching practice I think and it suits me because I'm a bit of an individual.

David: So is it a bit like open slather? Do whatever you want?

Diane: (horrified) Oh no! Even I surprise myself at how much I do work as a team member. And it works! Part of our meeting time includes reaching agreement on how each of us will approach common learning skills, like report writing or narratives or drawing graphs or whatever — it's amazing when you begin to talk to see how many skills and concepts we each used to teach quite differently in each of our old fashioned subjects. The overlap is incredible! This way the students learn the same message about a skill or process although it may be approached in different contexts. They're happier, and we keep reminding them that this is the same as they did the day before with whomever else.

David: OK, so we agree on overlapping skills and content. But how do we make sure that all students get the required English, mathematics and science learning? Surely we have to make sure that all kids have a minimum time in each of these, and even more for those bound for physics and chemistry or literature or calculus.

Diane: I used to worry about that too. More for those who will study economics and geography in upper school. But when we plan it always works out that the classroom programs include enough of each. In the end we've all come as experienced teachers

from existing schools in the same system. While we're keen to do some things in a new way not many of us are revolutionaries.

David: OK, but I still don't see how the meetings work. For example, our next theme is "Communities." I'm keen to be responsible for the outcomes which relate to plants and animals and their interdependence, and lead into ecology and environmental concerns. So how do I work out which outcomes I'm supposed be teaching in my own classroom planning?

Diane: First you'll need to negotiate with each of us in your team. I like doing that stuff too. In my previous school I took all of the environmental studies for year nines in social studies classes.

David: But classification and inter-relationships is science. We do it in the labs, with hands-on experiences and real life observation. The kids love it and make sense of it so easily. Social studies is more book based and, well, not as objective as science.

Diane: You're lucky I have a sense of humour! You sound like all of my old stuffy science teachers. Why do you think science should have ownership of particular concepts and knowledge? It doesn't. Using data collected from descriptions on the internet or researching through original papers can be just as interesting and certainly viable for school students. At least they remember what they're researching rather than getting lost in the organisation of doing an experiment. In the end, it is the skills of investigation that are important — the search for valid information, its analysis and the interpretation of it. That's what we mean by learning skills, not just remembering lots of facts, like what makes a plant a moss!

David: That's a pretty negative view of science. Sorry if I was a bit out of order. I am an older science teacher — but hopefully not really old fashioned. I've never

really known what other subject areas teach at school. For me, one of the unique aspects of science has been its rigour and objectivity. That knowledge has been developed as a result of observation, not just because someone plucks an idea out of the air.

Diane: Yeah, well Einstein didn't do too badly. I suppose I'm used to having to justify my area to science snobs, so I'm quick to jump in. For us at school though, we don't look at knowledge and concepts as "owned" by any one traditional subject area. It often takes us a while to get to work on that basis because we've all come with our special habits and established practice. Inevitably what we want to teach to our kids is pretty much what we've always taught when it comes to content. For our school though, that's really the context of what's taught. The real "stuff" of our students' learning lies in developing learning skills, the research, the investigation — clarifying the problems, investigating, analysing and interpreting critically and being able to communicate this. That becomes the crux of our teaching.

David: You mean scientific methodology?

Diane: For you, more or less. For me I'd call it research and investigation skills, which are just as valid via our methods as via traditional experimental science. But it also includes communication skills which is a bit of the traditional English literacy like writing, reading, listening and viewing, as well as bits of information technology and some numeracy and probably lots of other bits from the different traditional subjects. That's what I mean — students' learning isn't owned by anyone in particular. Rather, in our meetings we sit together and explode the theme into multitudes of contexts and skills, then negotiate who will take responsibility for different groupings. We also agree that in our teaching and learning programs we will approach common skills in the same way.

David: This sounds awfully complicated, and time consuming.

Diane: It is. That's why we meet for one hundred minutes each week. Not only that, but as we go along we find we have to modify our original programs to fit in with something the kids bring up or that we identify is needed.

David: But surely we make the decisions about what the students need to learn?

Diane: We do, mostly. But if we don't listen to our students we could miss some terrific opportunities. Like last year when Twister was on at the theatres. We spent a few weeks looking at what conditions create different weather. The kids loved it and had lots of fun using the internet to access first hand data from the United States. They learnt about air pressures, warm and cool air densities and all of the objective stuff and then through their own research came to appreciate what it was like to live somewhere with real tornadoes. Great fun for us all!

David: It sounds like you learnt a bit? I guess there are more ways to collect first hand data and still learn through hands-on activity than just in the lab.

Diane: You're learning!

David: But if we're looking to develop these learning skills, how do we test for achievement and still retain comparability? The idea of a common fifty minute test for each class seems a bit inadequate.

Diane: You're right. Funny how science and maths people worry endlessly about achieving comparability. Inevitably there is still a place for some tests, to check for conceptual understanding for instance. But we're also looking at open-ended assessments and problem solving exercises where we all spend time with a pool of

student work samples and grade comparably. You science people really like that. We're looking towards portfolios as providing better evidence of student performance for parents and ourselves. At the moment we're using the new outcome statements to give us a bit of a "dip-stick" in terms of evaluation. We still have lots of work to do to get assessment right for us and the community. In the end though it's always teacher judgements that describe where student achievement lies.

David: I like the idea of recognising teachers' expertise, although it seems the long way around to ensure comparability of assessments. The assessments I'm used to using are always limited by time so basically they evaluate a student's recall and perhaps some mathematical problem solving. Looking for how a student investigates or solves open ended problems will be quite a challenge. I can see this next year will be different.

Diane: You'll get used to being different especially at district teachers' meetings. But when different seems better, it's a great feeling!

Déjà Vu: I've Heard This Before

This very gentle discussion was between two almost strangers who will become close colleagues in the year ahead. Recognising that this is their future, neither was quite ready to confront the other's understandings. Yet clearly David and Diane were already aware that they held some discrepant beliefs which inform how each engaged in the practice of teaching and learning. For the moment they were content to test each other's boundaries in a polite and genteel manner. Their collegial meetings of the future promise to be more animated!

"Just like science and social studies teachers," I caught myself musing as I half listened to this exchange ripple around me, "although Diane is progressing more than

she cares to admit!" In the midst of a busy induction day, my mind had been working through a number of other concerns. As we sat together I had begun to jot notes of the conversation — a practice I'd adopted over the years so that our de-briefing sessions might pick up on such casual observations. At that instant however, the significance of what had been said banished other thoughts and I raced to my office to record the extended dialogue more comprehensively.

In that five minute interchange, I heard some of the specific understandings which teachers in our education system recognise as differentiating teachers from different traditional subject areas. Although my colleagues and I are dispersed over large geographic distances, we have developed many similar perceptions. Amongst these, my peers and I continue to identify secondary school teachers by the traditional subject area in which they had been educated or now teach. Unthinkingly. Yet in overhearing this conversation I came to appreciate where these differences lay.

Both David and Diane voiced their own understandings about knowledge and learning and teaching. In David's science voice in particular, I recognised a number of very familiar sentiments. David reiterated that *science knowledge is rigorous and objective*. He had long since accepted that science knowledge emanated from the observations and data gleaned from carefully controlled experimentation. As a science teacher he saw that data was indisputable and reproducible under equivalent conditions. Data spoke for itself, and interpretations and conclusions followed logically. The rigour associated with scientific methodology ensured the objectivity of the ensuing relationships. David perceived that, unlike studies linked to language and the humanities, scientific studies have little space for subjectivity. Thus he inferred that knowledge learned through scientific studies must have greater certainty and status than that of others.

As David continued to question Diane he also articulated his beliefs about science in schools. Very clearly he believed that *all students should study science* in school. Also, those who are likely to study physics and chemistry (the more academic students) should do more science.

In relation to learning and teaching in school, David assumed that the teacher should have control of the knowledge and processes making up the overt classroom curriculum. Although he didn't disagree with Diane's declaration about the value of listening to students and renegotiating some parts of the curriculum, David seemed to ignore this concept and concentrate instead on the pedagogy accompanying Diane's statement. David's understanding that teachers should maintain a firm grip on the classroom curriculum reflects his unassailable belief about the *teacher as expert*.

Moments later, when discussing possible means of making judgements about student achievement he again reinforced his belief in the expert knowledge of the teacher. In this belief Diane and he are at one. Further, neither questioned the need for *comparability between teacher assessments*: in my State, there is a long standing acceptance of teacher expertise in accurately evaluating student performance. A part of this acceptance is linked to the public perception of coherent and rigorous procedures in place to ensure State-wide comparability of assessment. Thus the notion of comparability of student assessment at school-level is relatively uncontested.

Rather than debate Diane's suggestion about student input to curriculum, David replied with his own justification for using the science laboratory (rather than books and papers) to collect data. David commented positively about hands-on, active learning. For David, good classroom teaching and learning should involve students in activity, preferably *hands-on laboratory investigations*.

None of David's statements surprised me. As a former science teacher and Head of Department I have probably been a part of similar conversations on many different occasions. As colleagues for more than two years now, David and I continue to enjoy opportunities to clarify our beliefs about science knowledge and school science teaching and learning. Many of these beliefs are also my own. I believe that these understandings are representative of those of David's and my larger community, that of secondary science teachers in my State.

David's Beliefs As Myths Or Referents

David has spent years clarifying what practice works best for his students. In the classroom his actions are designed to ensure that his students make sense of their world in the most effective ways possible. David's planning is informed by his own beliefs about scientific knowledge and processes and school science as well as his understandings about the teaching and learning process (Tobin, Kahle & Fraser, 1990).

It seemed that some of David's beliefs remain so intrinsic to his identity as a science teacher that he might not recognise them as beliefs. These beliefs are so fundamental as to be understood as unquestioned as "the way we do things around here" (the definition of a culture given by Bower in 1966). As David proceeded through his own school education, his science studies at the University and his practice as a science teacher, he consistently interacted and communicated with similarly engaged individuals. David remembers progressively feeling "more like the others." As he worked and talked with older teachers, lecturers, professors and colleagues, David's understandings about science and school science and teaching and learning gradually became merged with theirs, until he belonged to their culture, that of secondary science teachers.

In searching for a framework to describe the beliefs which underpin many of the day to day activities of a culture, the idea of a "myth" or "referent" (Cobern, 1991) seemed very appropriate. This concept appealed particularly because few contemporary science teachers are able to explain why these beliefs remain so unquestioned and yet so inexorable. It seemed as if the earlier events and people who moulded these community understandings had disappeared leaving only the referents — much like the indeterminate traces of footprints in the sand. Current teachers of science in my State appear to have a diminishing individual and collective memory about where or in what context some of these beliefs arose. The words of Roland Barthes leap to mind:

Myth is constituted by the loss of the historical quality of things:
in it, things lose the memory that they once were made.
(Barthes, 1972, p. 142)

Cultural Change And Myth

The combination of these deeply-held beliefs or referents reflect the fundamental understandings of a culture. I recognise these referents as the powerful organisers of a culture. However I was still searching for a clear understanding of the process of change within my own culture.

When my older colleagues described major changes in curriculum in the late 1950s and into the 1970s, I had imagined major discontinuities of expectation, organisation and classroom practice accompanied by rumblings of discontent. Consequently, part of my data collection¹ included a search for such evidence. Early in this study, when I expected to work within a more traditional historical research framework, I spent many hours in the State archives reading about many aspects of schooling in my State.

¹ My methodology is described in greater detail in the Appendix. I hope that in this way the methodology will not interrupt the flow of the thesis nor create a discontinuity to the reflections of the reader as audience, or myself as writer.

However, there was only limited information about science curriculum change. In rethinking my data collection, it became clear that I needed to sit down and talk with the long-term participants of my science education community. These respected members of the culture talked freely about the curriculum changes they recalled. Each provided many anecdotes and stories. As time passed I found my own discussions and analyses increasingly represented in story form. I began to think about this study with a different lens. As story became central to my own analysis, I made the decision to write this thesis as a narrative inquiry.

Listening to David's conversation enabled me to construct a new lens through which to evaluate my data. With this lens I sensed that any transformation of the local science education culture would have to involve some change or modification or addition to those potent categories, the myths. The actions of the members of the culture would then alter to reflect the new understandings. In particular, in the science teacher culture, where new referents became part of each member's understanding of science knowledge, school science, teaching and learning, the practice of school science would also change. Inevitably, this variation in underpinning referents would not be recognisable as cataclysmic and immediate. Instead, such change might evolve over some time as the members of the group came to a collective community acceptance of the new understandings.

How then, was this culture able to access new understandings? How did this happen in such a seemingly acquiescent manner? Already, several of my informants had specifically alluded to influential persons who had promoted and progressed State-wide changes in science curriculum within our Education Department from the late 1950s until the 1970s. It remained for me to return to these informants as well as others; this time to ask about the beliefs and actions of particular individuals from the science education community.

Two unique personalities were identified as primarily responsible for the promotion and the implementation of the two State-wide changes to the school science curriculum in the Education Department. I have characterised each of these influential individuals as a "Hero" because each brought new myths to their existing culture (Campbell, 1949). Further, in reviewing the extended career of each Hero it is possible to draw strong parallels with particular mythical Greek heroes. I found this link as being even more appropriate when recognising the ancient Greek philosopher Aristotle as the forefather of modern scientific methodology.

In this study I have represented these modern Heroes as Perseus and Theseus. Their metaphorical stories follow in Chapters Three and Four. I begin each chapter by revisiting the original Hellenic hero myth and then follow with a short narrative in the voice of the modern day Hero. These stories are drawn directly from my conversations with each Hero and helped me to identify the understandings of each. As a part of our dialogue, I had asked each to clarify the way in which he viewed science, school science and the teaching and learning of science. My own voice then continues with a narrative analysis (Polkinghorne, 1995). From their stories and those of others, I endeavour to clarify the referents I associate with each Hero, since these understandings underpinned the curriculum directions each communicated to his science education community. I then examine the means by which new or modified referents and curriculum practices were discussed and presented to the wider community. I conclude each chapter by reviewing the processes by which each Hero implemented a changed curriculum.

In Chapter Five I revisit my decision to refer to these influential individuals as Heroes, using the framework of the Hero Monomyth as described by Campbell (1949). In this chapter, I also compare the stories of each modern-day Hero with the Hellenic Heroes and examine the validity of the metaphor used.

Drawing from the stories of the preceding pages and the combined understandings of a many long-standing participants in our culture, Chapter Six becomes my analysis of the narratives (Polkinghorne, 1995). It represents my attempt to interweave the common threads of the stories of Perseus and Theseus. In particular, I reframe my understanding of their beliefs and actions to explain the process of changing the culture of our science education community. For me, the value of this study is not solely in re-visiting the stories of each Hero, but in clarifying the common components which together enabled successful change to proceed.

Of course, the question then becomes, so what? Thirty or so years ago is a long time. What relevance has such understanding for today's leaders and future heroes, or is this all of only academic interest? Perhaps I do this to satisfy only my own curiosity? I am an optimist. I also appreciate that changing the way we do things means changing the minds of individual people, modifying and changing their fundamental beliefs. What might the change process look like in our post-modern world? Chapter Seven then, is the "So What?" chapter. How can the lessons of yesterday be applied to our different tomorrow?

CHAPTER 3

PERSEUS

The Hero Perseus

"Perseus is the Hellenic hero fathered by the god Zeus and a mortal woman. In an impulsive gesture to honour his King's betrothal, Perseus vowed to rid the world of the Gorgon Medusa. This terrible monster Medusa, with locks of serpents turned to stone anyone who dared look upon her visage. Throughout his quest, Perseus was supported by the goddess Athena and messenger god Hermes. Thus Perseus was guided to acquire a pair of flying sandals, a magic wallet and the helmet of invisibility essential for his success. Courageously he then slew the monster and escaped.

Returning from this endeavour, Perseus spied the beautiful Andromeda chained to a rock awaiting her death. He fell in love with her and so killed the threatening sea monster, freed and married Andromeda and returned to his home at Seriphos. Once home, Perseus discovered his mother and guardian being persecuted by the King. At court, Perseus was insulted by the King and his companions, so he held up the bloodied head of Medusa. The King and others looked upon the face of Medusa and turned to stone.

Perseus then returned the sandals, wallet and helmet to the Stygian nymphs through Hermes, and rewarded Athena for her support by giving her the Gorgon head to wear on her breastplate. Taking his wife and mother to his Grandfather's kingdom of Argos, Perseus hoped to reconcile with him. Fate ordained however, that during a discus throwing contest Perseus' discus was diverted by the wind to a group of spectators where it killed an old man. The oracle, predicting that Perseus would one day kill his Grandfather, was thus fulfilled.

Stricken at having killed a member of his family, Perseus did not wish to succeed his Grandfather's throne and so exchanged kingdoms with an uncle. As King of Tiryns and Mycenae, he recaptured territories and fortified his city, becoming a well loved leader. With Andromeda he fathered a number of sons and founded the family of the Perseids, of which Heracles was to become a glorious descendent."

Renown in Greek mythology as a monster killer, Perseus shared several characteristics in common with other heroes. Firstly he was blessed by the gods to perform one great deed and in doing so was guided by an almighty "mentor" god. Athena and her messenger god Hermes ensured that Perseus was properly equipped and guided to achieve success in his venture. In effect their strengths helped to overcome his own shortcomings. Secondly, as a hero Perseus exhibits particular personal characteristics. As in other Greek hero myths, the hero pledges that he will accomplish an incredible deed. Having impulsively made this commitment, he is then honour bound to achieve this end. The honouring of an obligation, and the personal pride which comes with this, becomes the driving force behind the heroes' actions. For some heroes, this pride in maintaining honour can lead to almost criminal acts (see the myths of the hero Heracles). The elegant and loyal hero Perseus however, performs his one great deed honourably. He is recognised as a courageous and constant friend who then retires to a long life of effective and fair governance whilst creating progeny who will further embroider the hero mythology of the Hellenes.

Perseus In Post-World War II Science Education

In His Own Words

As an influential science educator the latter day Perseus became the voice for school science in the context of post-World War II education. This time of unprecedented population growth created new pressures for the State Education Department.

Perseus' understandings of science and school science were critical to changes in science curriculum in the late 1950s and early 1960s. This is Perseus' story.

Early Days

We came out of Teachers' College in the depths of the Depression when there were no permanent jobs. I was one of the fortunate ones in that I could get a bit here, then a month somewhere else, until I was sent to a school for the year. You couldn't afford to study full-time during the Depression, so I did it part-time and the Department very generously gave us six hours off a week. Six hours to go to the University and that had to include travelling time so I used to do about two subjects a year fitting in where ever the lectures were. I could do lectures later in the afternoon so I studied chemistry and agriculture and physics. We used to go to the Technical College often because their lectures were available mainly of a night time. At one stage I was going there every night of the week. Of course, we sat for the same University examinations. That was the way I finished my science degree studies. It was a bit different in the old days.

Science Knowledge and School Science

I found science a very satisfying discipline. It made sense and you knew you had a correct solution. I could just lay it out for my students. It was straight forward and rational.

I understood one of the strengths of scientific training was in its methods, it was so structured and organised. I suppose that was one of the major things that there was with the University courses. They were very rigid and rigorous. It was an attitude you observed. You couldn't help but become methodical. I tried to make sure my students had that training.

In those early days when I was teaching, only the best students stayed on at high school. They were top calibre people. Whenever someone had a problem I could say, "Let's go back to the beginning." With science you could lay it all out in order and although it might be long winded for some, we could go through each alternative until we found the right answer.

My class notes were excellent. I took great care with them, always in the right sequence and thorough so that I had no problem sharing them with younger teachers who needed extra help. Once they could see the way you needed to organise the material, they would follow my structures and go on to be good teachers.

In class we did quite a deal of experimental work. I understood that one of the strengths of scientific training was in its methods, you had to be organised and practical to follow through properly. I tried to make sure that my students had the kind of training I had with the University courses. The only drawback was with the glassware and equipment. Everything needed its own shelf with its own label. It did take quite a lot of time. Once again you had to be organised as you worked. I was able to train student monitors to help on that side of things. "A place for everything and everything in its place" became one of my rules.

Teachers and Science Teachers

It is an observation that I made at this time that people who studied in a particular field to a considerable depth were absolutely different individuals from those who studied in a different field. Their background, the nature of the person, their method of thinking and so on was quite different. For instance, and I'm biased towards maths and science people, they were people you could rely on for sound solid work. They were not taught to be contentious. I can remember later on being in a school where

another Superintendent¹ wanted to drop a teacher's mark. So this bloke said, "But look, its only your opinion of me." And Owen, the Superintendent, just looked at him and said, "Yes, but there's one important thing for you to remember. Mine is a very important opinion." Science people just weren't like that. I could go along to one of our people and say, "What do you think we should be doing here?" and you could guarantee he would be right. I couldn't help but feel that good heads were going to come out of certain fields. I suppose it might have been because they had a similar outlook to me and I thought like them too.

Our science teachers in the schools were tremendous, well qualified people who knew their subject and because they knew their subject and had the experience they knew what to do. In those days (1950s) we Superintendents knew every teacher in the secondary division. We not only knew them as teachers but when we went to the country they always took us to their places. We knew their families and their circumstances and when they were sick and when they needed help. I pride myself on the fact that I had some teachers who had come to see me when they were in more or less distress conditions and I knew I could say to these people, "Well, would you like a transfer to the city?" or whatever else, and they never forgot your support.

I had a terrific working relationship with the Heads of Department. I used to talk about the syllabus and students and our teachers with them. We fostered this consultation because we showed these people that you worked by discussion and that was their job as Heads of Department. I knew that some didn't, but from what I've told you, you can imagine the outstanding Heads of Department with their young teachers around them all of the time. Our annual Heads of Department meeting became a terrific forum to promote this exchange.

¹Superintendents were appointed by the Director General of Education to overview and coordinate the operation of schools. From 1956 subject superintendents were appointed to take responsibility for the physical and human resourcing of specific subject areas in all schools throughout the State.

I knew that science courses culminating in the external Junior Certificate examination weren't working because all of my teachers told me. The problem of "the great unwashed" they used to say. But the system had served us all well. Now, we needed to fix it, but not by smashing it all down and rebuilding it. I'd say to myself, "What is wrong with these courses? Let's list the things and put them in order."
(Perseus, interviewed in April 1991)

Perseus: His Position

Long standing teachers perceived that Perseus, upon his elevation to the position of the first Superintendent of Science, Mathematics and Agriculture in 1956, became the single most influential science educator in the State. His appointment signalled to science teachers that the Education Department recognised the need for a person with specialist knowledge and integrity to guide the directions of a discipline specific curriculum across the expanding secondary schooling system. Perseus was an experienced science and mathematics teacher who had moved through the promotional ranks of Head of Department, Deputy Principal, and Principal. This new position had amalgamated into one person, someone with legal administrative authority as well as credibility in the science teaching community.

The appointment of Perseus heralded a new Education Department policy. In future secondary education Superintendents would be given responsibility and control over the curriculum, instruction, teacher placement and resourcing of their own discipline throughout the system. In effect, Head Office structures would mirror, and consequently reinforce and strengthen the organisation of secondary schools and their curriculum and teachers into discipline-based departments.

As the most powerful individual in this small science education community, the beliefs and referents expressed by Perseus with respect to science knowledge and school science curriculum practice, influenced the whole group. In articulating his own

understandings, frequently through the use of stories, rituals and artefacts, Perseus was able to reinforce existing referents and to construct new ones to promulgate amongst the community. As a member of the existing group, many of his beliefs were founded amongst his own experiences as a student at school, a trainee teacher, university student and practising teacher. The commonality of these encounters ensured that his referents were already shared by many within the community. Concurrently, many younger teachers had recently begun to participate in the culture as the school system expanded. As one teacher remembered:

We learnt from the people around us, the senior teachers and the Heads of Department. There was a mystique about superintendents too, in that they came from Head Office and carried authority. (Prometheus, a beginning science teacher in the late 1960s, interviewed in 1991)

Within such a small coherent group, it was understandable that the beliefs of the one person with outstanding power, authority and credibility would become fundamental to that of the whole culture.

Perseus and His Referents

A conservative and highly energetic man renowned for his excellent organisational skills, Perseus espoused a number of beliefs about science, science teaching and learning in school and science teachers, which were critical to the imprint he was to make on school science. These beliefs underpinned the stories he told as he spoke with fellow members of the science education community.

Constructed through his own life experiences, many of these beliefs were so profoundly based and unquestioned that they may be represented as referents or myths. These referents are the deeply held beliefs by which Perseus explained his

world of science teaching and learning, justifying the practices and institutions he supported and harmonising the science education community with himself. Such unconscious and unchallenged understandings created the foundation upon which Perseus organised curriculum directions and practice.

Science As Rigorous, Rational Knowledge

Essential to his valuing of science was Perseus' referent for scientific knowledge as rigorous, rational knowledge. As a student Perseus perceived that the study of science trained students into a particular discipline of thinking. This point of view was commonly held amongst professional scientists and science educators of the day. It was succinctly stated to a meeting of science teachers by the Professor of Physics at the local University and a confidant and adviser to Perseus.

Science can command respect for truth, develop clearness in reasoning and eliminate prejudice and personal bias. Through the scientific method students may follow the progress of scientific discovery with its training in accuracy of fact and precision of results and logical and inductive thinking.

By following the progress of scientific discovery with training in logical and inductive thinking through the scientific method, students will learn to eliminate prejudice and personal bias, effect precision of results, clearness in reasoning and clear and logical thought. (Aegis, 1944)

Like the scientists of this time, Perseus was comfortable in the irrefutable objectivity of scientific method, its meticulous observation, causal inter-relationships and logical interpretations. Studies of the science disciplines were scrupulously authentic, they were rigorous.

At secondary school, the elite students of the day engaged in school science activities which mirrored the university experiences of their teachers. As was the practice of the day even the organisation of school subjects reflected the departmentalisation of university science courses into physics, chemistry, biology and geology. The rigour of the scientific method was integral to all science courses. Translated into school classrooms, the standardised experimental report with its aim, apparatus, method, results and conclusion was neatly produced as students practiced the experiment previously demonstrated by their teacher. Students were left in no doubt that science was rigorous. It was rigorous as a result of the extensive experimentation with its rechecking of observations and measurements, controlling of variables, clear cause and effect relationships and indisputable interpretation. This was the sequentially ordered, straight forward and rigid science knowledge experienced by Perseus and his colleagues as they had studied science. At the end of the process it made sense and participants knew they were correct.

The training in observation and experiment, the marshalling of facts, making deductions (and perhaps intuitive thought). These are the vital contributions that science can make to a sound education. (Epaphus, Presidential address to the Science Teachers' Association Annual Conference, in 1958)

As a longstanding and influential science educator, Perseus represented his own and the views of his whole science education community when he espoused the value of science knowledge as being rational and rigorous. This technical knowledge already had profound implications for the quality of argument and thinking in future generations.

Science Knowledge For All School Students

In the context of post-World War II Australian society, science knowledge was eminent. Science had won the war! The technology created through the applications of science knowledge became visible at every corner, in household appliances, antibiotics, transport and agriculture. Throughout Australia, communities expected that science would become the avenue through which the problems of the world would be solved.

This new public perception had implications for the secondary school curriculum. Even immediately after the war, professional scientists were only just coming to terms with this understanding although some more forward thinking scientists had foreseen the shift in public perceptions.

The day has surely passed when school prospectuses may contain the statement "For those boys having no aptitude for the classics or modern studies, a science course is provided." (Aegis, 1944)

Perseus had no reservations. He saw power in the logical and causal explanations associated with scientific understandings and recognised the structures and organisation of its methods as central to the education of all children. Consequently, he believed that into the future all children would have access to the central logic of scientific methodology as it became a compulsory component of the secondary curriculum.

I think this is the first time I heard what have become cliches, such as "Science for all" and "Science for Citizenship".

(Minos, a teacher in the 1950s, interviewed in 1992)

This referent of "science for all school students" while fundamental to his own notions of value, was relatively new and not yet widely supported by the 1950s science teaching community. However, Perseus was pledged to future school students. His understanding of the value of scientific thought was immutable. He began to tell stories about the value of science education and about his own successful science students of the past. He would honour the obligation arising from this belief.

Science Teaching As Transmission

You see then we didn't think it was very important as to how you delivered a lesson. It was more important to analyse your teaching programs in depth and make sure you got the proper sequence. It didn't matter how you actually taught, what mattered was your knowledge organised in the right order.

(Laomedon, teacher in the 1950s, interviewed in 1994)

Descriptive, rote and validation. Descriptive rote theory lessons together with validation demonstrations. You'd go into a group and be told what to do and you did it knowing the answer before you got there. It was comfortable and it was very structured. The questions were closed.

"Here's the notes, take them down" and "Here I can show you how it works so the notes are right so take them down and learn." (Jason, a student of the 1950s, interviewed in 1993)

Perseus, like the school science teachers of his time, was untroubled by questions of how best to teach. In concert with the majority of science educators in his community, he believed that his role as a teacher consisted of laying the information out in a logical sequence. This had been his experience at school and at university. As students with limited understandings of scientific concepts, he and others had listened to teachers

and lecturers, copied notes, then learned the knowledge required for the examinations. In effect, this new knowledge and understanding was acquired from accurate descriptions of concepts, relationships and theories.

The best teachers made scientific knowledge available in the most organised, methodical manner. Effective science teachers were those who transmitted more of the subject matter to their students. In common with educators world-wide, Perseus understood that knowledge was transmitted to students by teachers. The attributes of good teaching were fulfilled when teachers knew the knowledge to be acquired by their students and programmed instruction in a suitable order. Perseus worked hard to support his own science teachers. Discussions with colleagues and subordinates centred on sharing programs, teachers' notes, organising materials and structures.

He wasn't inspirational. There were bells and kids running after you asking questions and he would lecture you about the untidiness of your storeroom. He was strong on organisation. His courses had to be very well organised with every bit in place and everything sequential. That was his forte. (Laomedon, as a teacher being inspected by Perseus in the 1950s, interviewed in 1994).

Perseus believed that teachers who followed his advice would go on to become good teachers, good transmitters of scientific knowledge.

Science Teachers As Experts

Perseus had enormous faith in the ability of *his* teachers to do things the *right way*. Throughout the community he talked about the wonderful teachers in the school system. He named names and gave kudos to those with excellent skills, both in

content knowledge and in establishing sound relationships with their students. He always promoted their knowledge, expertise and creativity and was never denigrating.

Can you imagine, those students were spellbound listening to every word! I could have heard a pin drop. And after the demonstration, he asked that anyone who wanted to play hockey with him that afternoon should meet at the science room. You know, every one of those boys turned up!
(Perseus, recounting a science lesson he had observed, interviewed in 1991)

Across the State, teachers understood Perseus' support and internalised the underlying message about the high quality of their expertise. When teachers of the 1960s cried out for improved resourcing, it was always with teachers' own acknowledgment that they had expert control of their professional knowledge of teaching and learning. Teachers in other states of Australia requested university educators or consultants or other outsiders to visit schools and provide support for their science teachers. However, science teachers from this State placed greatest value on input from their own. In this community, science teachers were the experts!

Perseus and the New Science: 1960 Science A and Science B

Late 1950s: A Time Of Anxiety

It was no accident that the central bureaucracy should create the position of Superintendent of Science, Mathematics and Agriculture in 1956. The State education system was growing exponentially and a different basis for administrative management had become paramount. An individual with a talent for organisation had to be found to clarify future curriculum directions as well as coordinate the human and physical resourcing of schools. In a visibly youthful system, Perseus was one of the

very few individuals with sufficient experience, knowledge and skill to be able to accomplish such diverse tasks.

The late 1950s was a time of anxiety for science teachers. Prior to that time, the majority of young people completed their schooling in their fourteenth year. Only the few elite students progressed through years nine and ten in secondary school. The 1950s saw a burgeoning in the number of the students of any one age group. Compounding this population explosion was an increasing number of students expecting to access secondary education until the end of their fifteenth year. The existing science curriculum made up of the traditional academic disciplines was seen to be inadequate to such a challenge.

The earlier science courses were only for the few who were academic and going to proceed through high school and then to University — about 8% of the population. (Proteus, a teacher in the 1950s, interviewed in 1992)

Schools and teachers searched for solutions. In some schools selected students studied physics and chemistry, others were taught physiology and hygiene or biology, and others did not study any science. Traditional boys schools offered only physics and chemistry and no biological sciences while some girls schools were only provided tuition in the biological sciences. In some city schools, a female student who wished to study physics would walk from her school to the local boys school for these classes (from interview with Laomedon, in 1994). Perseus found such practices unacceptable.

The curriculum committee of the State School Teachers' Union had reviewed the traditional curriculum in 1937. The outcome of this process was that several members supported the adoption of a general science curriculum for thirteen to fifteen year olds, similar to that developed in other states of Australia and in the United Kingdom. This

curriculum was accepted (alongside other specialist science subjects) as a Junior Certificate course by the local Public Examinations Board in 1941. Initially it was not widely taught as teachers reported that they found it difficult to translate the thematically-based syllabus statements into practice.

Searching For The Solution

Upon his move to Head Office, Perseus was in contact with the President of the local Science Teachers' Association. As the Chief Examiner for General Science, lecturer in General Science at the University and the author of two text books on General Science he too was keen to support reform of the existing science curricula.

However, the Executive of the Science Teachers' Association also recognised that a major inadequacy of the General Science course lay in teachers' perception of its qualitative nature. Their President proposed several alternatives, including the retention of the existing Junior Physics course with General Science, or the institution of another new course dealing quantitatively with the physical sciences alongside the General Science course.

Such suggestions were exciting, but for a conservative such as Perseus, not yet ideal:

I consider that the retention of the present Junior Physics course which is to be studied concurrently with a General Science course is not satisfactory as a solution for it places undue emphasis on physics as the basis for further training. (Perseus, in a letter to the Director General of Education in 1957)

Perseus talked with his teachers at schools, at meetings and with work colleagues in Head Office. Additional committees were established, most particularly the 1957/58

Secondary Schools' Curriculum Committee and his own science sub-committee. Extended discussions flowed and gradually Perseus' own ideas cemented.

Well, it hit me! I can remember thinking so clearly now, that every student in the school should have science, regardless of whether he was the top notch school student or whether he was the poor little Italian migrant who couldn't think so well. So that it should be taught to everybody. But, when we think of it, the boy that was at Modern School with the super IQ needed a different science from this other little boy who wasn't so interested in science. Everybody should have science but those who had ambitions to go ahead with it and had the ability did a different science. So we needed two sciences which for no other reasons I called Science A and Science B. Science A was the broad one which everyone should have, for citizenship. Science B was the one that prepared people for University work. (Perseus, recounting his solution to the curriculum problems of the late 1950s, interviewed in 1991)

This solution created a compromise which rationalised many of the concerns of the established community. The new curriculum was clearly not general science.

Traditional science teachers were reassured. Science A was mostly qualitative but seen to be primarily directed to less interested science students. Sections or chapters of the Science A course were given traditional discipline-related titles — chemistry, geology, vertebrates, mechanics — rather than thematic titles. For experienced teachers, there was further familiarity when many aspects of the new courses were found to be very similar to parts of the pre-existing discipline organised courses. For instance, the pre-existing chemistry course was split with the qualitative aspects moving into Science A and quantitative and conceptual knowledge assigned to Science B. In keeping with Perseus' conservative beliefs and referents, the new science curriculum owed much to tradition.

It didn't seem very different from what was going on when I was at school in terms of the way it was taught. There was a change in the structure of content which was really saying, "science is for everyone not just the academic few" as it was for physics and chemistry. (Chiron, a new teacher in the early 1960s, interviewed in 1993).

Implementing the Science A and Science B Curriculum: The Process

Since many aspects of the knowledge and understandings incorporated in the new science curriculum remained recognisable, this curriculum acted to reinforce the already accepted referents of *science as rigorous, rational knowledge*, and *science teaching as transmission*. The new referent of *science for all* served to add to the status of scientific knowledge in the education system. Alongside English language studies and mathematics, science was now accepted as a compulsory component of secondary school education.

Science for all was a powerfully persuasive argument towards social equality as well as upgrading the perceived importance of science. (Minos, a teacher who commenced his career in the late 1950s, interviewed in 1992).

However, not all science teachers wished to teach the new curriculum. Everyone was required to teach Science A to all students. Thus, all science teachers would teach at least a little of the physical sciences, biological sciences and earth sciences. Some physical science teachers saw teaching the biological sciences as reducing their own status. Some biological science teachers were concerned about the strength of their knowledge base in the physical sciences. For a proportion of science teachers, these new courses created real discomfort.

Opposition arose from the biology component for all students. Physical science teachers in particular, didn't want to do the biology part. Teacher status, teacher background, teacher confidence and teacher familiarity with the content, all combined to fuel initial resistance. (Proteus, experienced teacher during the late 1950s, interviewed in 1992)

Perseus drew upon his referent of science teachers as experts to establish new symbolic structures in stories, ritual, ceremony and artefacts to bridge old practice with new.

Maintaining and Modifying the Myths With Rituals

Individuals tend to create structures to provide a framework for their beliefs. As the most powerful and influential member of the science education community, Perseus established and participated in a number of organisational rituals designed to revisit, clarify, modify and make homogeneous the understandings underpinning the practices of his group. At the administrative centre of school science education, he needed to ensure the appropriate intersection of enduring teacher referents, their classroom action and science curriculum policy and structures. To do so he recognised the value of quality communication between himself at the centre and science teachers in schools. Through the rituals he established, Perseus was able to monitor and also to effectively control the understandings which informed the practice of the majority of the members of the science education community.

Heads of Science Department Meetings

The annual ritual of Heads of Science Department meetings became obligatory and valued. Every science Head of Department from around the State converged to Head

Office, a suburban school site, or the University to meet with the science Superintendent and other senior Department officers.

I just kept on talking to the teachers. Heads of Department meetings were important. They were a strong group of people. We fostered meetings with them as a group because we were able to show these people that you worked by discussion and that was their job as Heads of Department - to work with people. (Perseus, remembering these Heads of Department meetings, interviewed in 1991)

The ritual of these meetings modelled a form of communication which the Director General of Education had established at the Head Office of the Education Department. He routinely gathered together his Directors² and Superintendents to discuss concerns and listen for solutions. At Head Office, participants understood that the effective implementation of ideas came through consensus and negotiation, with a well informed exchange of ideas.

As part of this culture, Perseus recognised that the opportunity to be part of the decision-making process ensured that participants felt ownership for decisions. In creating Heads of Department meetings which mirrored his own experiences in Head Office, he located a different level of participation in decision-making with the appropriate practitioners. In his unique position as an integral member and leader of the science education community, Perseus worked to develop a respect for and an expectation of collegiality, consensus making and discussion amongst his group.

Bringing together the most senior school science educators in the State created enormous opportunities for the Superintendent as well as teachers. Perseus was able to formally update the group as to the latest directions in science curriculum as well as

² Directors were Head Office promotional positions senior to that of Superintendents.

support the new and acceptable practices of creative and exemplary teachers. In the formal seminars and discussions, selected Heads of Department made presentations to their peers about their understandings and the practice of science education.

In this sense, at conferences I began to get messages, or at least come to an understanding about some of the things the Superintendents were saying. (Prometheus, Head of Department in the 1970s, interviewed in 1991)

Always in control of the formal conference agenda, Perseus was able to reward and reaffirm to the community what was admissible as good practice. At these meetings Perseus reiterated his message of science for all. He expounded upon the knowledge and expertise of those who worked on committees with him, of their valuable contributions and of the positive commitment from science professionals at the University for the new science curriculum. He provided opportunities for disparate ideas to be debated in the more intimate forums over which he was able to preside. As solutions clarified, members were kept well informed and most were able to support and validate the new directions.

Informally, this was also the venue for introducing new members to the community, listening to the problems of school-based science educators, and finding solutions through group discussions. School resource issues were raised. Heads of Department debated the effectiveness of the local curriculum as well as overseas curriculum directions. Perseus continued to measure support for his new initiatives and discuss possible shortcomings. The opportunity to suggest alternatives and participate in developing policy directions in an informal environment reaffirmed the membership of the community to all participants.

As you went on through your career, became a Head of Department, saw them at conferences and on committees and so forth, you realised that the Superintendent was a human being. They consulted with you over issues in which you had a mutual interest, like funding for the school, buying materials, staffing levels and so on. (Prometheus, remembering Head of Department meetings in the 1980s, interviewed in 1991)

The ritualistic once-a-year conference ensured homogeneity of the culture. Heads of Department arrived with local issues and interests, mixed with the whole group, discussed ideas broadly and returned, as would the warriors of old, to their far flung school empires to spread the official word — the apparent consensus voiced by the group. The propagation of key understandings diffused throughout the science education community through both the formal and informal components of the Heads of Department meetings. Each local science teacher was thus able to maintain his/her membership of the culture. This particular ritual ensured the sharing of beliefs about teaching and learning and exemplary practice. It presented Perseus with an ideal forum from which to modify curriculum across the State.

Regular School Visits

The second of Perseus' ritualistic responsibilities was to visit every science teacher in the State at least once a year. Until the end of 1968, all State Education Department teachers were given a teaching mark. The mark — reflecting a teachers' expertise and seniority — was critical in determining the future promotional opportunities for each teacher. It was the subject Superintendent's role to raise or lower the mark according to the teacher's demonstrated efficiency and proficiency. Perseus had a legitimate administrative role which required him to spend time in classrooms, talk with individual teachers, Heads of Department and Principals.

The formal school visit was a source of teacher anticipation, anxiety and intense interest. For a short time every teacher had the Superintendent's ear. At the same time, Perseus had individual access to every teacher. A reserved, older man, he was most at ease with his younger subordinates when discussing the teaching and learning of science. He was not comfortable with social small talk but within the defined purpose and expectations of school visits he was able to establish personalised professional links with individual teachers. Inevitably this interaction gave some individuals the confidence to request support later on when needed. Perseus' own positive responses to such pleas added further to the credibility he received from science teachers. He became their trusted mentor.

We not only knew them as teachers but when we were in the country they always took us to their places. We knew their families and their circumstances and when they were sick and when they needed help.

(Perseus, reminiscing about his relationship with teachers, interviewed in 1991)

He didn't drink. We thought none the less of him. But it is difficult to warm to people who won't lower their guard a bit and tell you what's in their heart. He was always so deadly serious and yet he was unquestionably a good man. (Laomedon, recalling socialising with Perseus, interviewed in 1994)

The comments were that it was nice to have someone in Head Office who was looking after your future around the State.

(Helios, commenting on teachers' perceptions of the superintendency, interviewed in 1992)

With Perseus' appointment, the Heads of Science Departments became directly answerable to the science Superintendent in Head Office for the quality of their science curriculum and instruction. In turn, Perseus was responsible for the effective provision of resources (material and human) for all school science departments. This line of management had the potential to create conflict between school administration and the Superintendent. Perseus ensured that his own communication with school Principals remained open and valued. Thus the initial meetings at schools with Principals were an important vehicle for communication, as was the careful debriefing prior to departure.

At different schools, distinct rituals signalled the arrival of the Superintendent. Inevitably he would be greeted by the Principal, who then met for a private chat — another opportunity to foster strong links between Head Office and school sites. A brief meeting with the Deputy Principals would follow before the walk to the Head of Department's door. Together with the Head of Department Perseus would plan his movements for the day, discuss teacher strengths and interests, equipment needs for the school science laboratories, room availability and generally reach an understanding of what was happening in the school's science department.

Teachers found the older man (this was a rapidly expanding system and many of the post-war science teachers had been taught by Perseus when students themselves), clear thinking and organisationally-minded. He particularly valued consistency, organisation and logical and analytic thought. He rarely discussed pedagogy with his teachers.

It is my belief that the good science teachers knew their subject and they knew what to do. (Perseus, commenting on teaching practice, interviewed in 1991)

Good science teachers *knew* what to do. In Perseus' eyes, it was the science knowledge and methodology which were basic to school education. If the science teacher displayed a sound grasp of these understandings, then effective teaching and learning would follow. With annual visits, young teachers gradually recognised what was valued in the science education field. Perseus helped them with their laboratory organisation, placement of materials in the classroom, structure of practical classes and ensured they developed concise, sequential teaching notes. These organisational skills were important. This constant reaffirmation ensured that the referent of teaching as transmission remained solidly entrenched into the community. As science teachers, the group understood that they were the experts in *how to do it* in the classroom, and their organisational skills were highly valued.

These visits provided Perseus with the ideal private forum in which to discuss specifics, assess reactions and garner support for the new science curriculum. When teachers were less than enthusiastic about the new curriculum, Perseus was able to counter private fears with logical argument.

Teacher Advisory Committees

Throughout his superintendency, Perseus continued to draw upon rituals to enable him to access and involve the understandings of school science educators in curriculum decision making. Some of these rituals involved creating new structures. In order to encourage experienced science teachers to participate in the review and development of school science curriculum, Perseus established school science curriculum advisory committees. Recognising the need to maintain the credibility of school subjects with state school teachers, Perseus also included University professionals and independent school science teachers on his committees.

Perseus employed the advisory committee structure to ensure that disparate members of the greater science community were able to debate, discuss and clarify curriculum issues. Although not a charismatic person, Perseus as the senior authority was persistent and thorough with his arguments. As one of his colleagues explained:

He would lay out all the facts, then go over the alternatives one by one sometimes boring you to death because you could see way before he finished that there was only one sensible way to go — his way!
(Laomedon, as a member of a science advisory committee, interviewed in 1994).

As solutions and directions were cemented, members gave justification and support. As publicly acclaimed by one President of the State Science Teachers' Association:

Let me record my appreciation of the recognition by the Secondary Schools' Curriculum Committee and the Education Department in its planning that science is an essential part of the curriculum for ALL students. (Epaphis, 1958).

Creating Artefacts For Science A and B

As the most authoritative person amongst science teachers in the State, Perseus was fixed in his understanding of the excellence of his teachers and the certainty that they knew what to do. However, in implementing the new curriculum he wanted to ensure that all teachers accessed uniform science understandings. If teachers were presented with science texts where knowledge was organised in an appropriate sequence, then the Science A and Science B he envisaged would be well accepted. It was consistent with his referents that in developing new artefacts to consolidate the new school science curriculum, Perseus again drew upon the skills of classroom teachers.

Texts, Teaching Notes and Programs

Very early in his superintendency, Perseus recognised the teaching inexperience of his young, well qualified teachers. In a school system where the secondary school population had doubled within a ten-year period, new teachers were a precious commodity to be introduced to and supported by the existing science education community.

Perseus knew what would work in a classroom — he was a teacher too. His referent of teachers as experts and his belief that good teaching was transmitted through the excellence of the materials employed by the teachers, led Perseus to formalise a long-standing practice. For some time, all teachers had been able to access the quality teaching notes and exemplary teaching programs of their senior colleagues. Perseus made the dissemination of such artefacts a part of his role. While visiting school sites, at Heads of Department meetings and through the Education Department circulars, he asked experienced, credible teachers to share their knowledge and materials with others.

I'd prepared a set of teaching notes for the staff to use at Attica and Perseus saw them when on the rounds and said "That's exactly what all teachers need, so I want you to prepare some." (Theseus, recounting a visit from Perseus in the late 1950s, interviewed in 1993)

In building upon the powerful science teacher as expert referent, Perseus established an additional ritual designed to draw classroom teachers into developing artefacts for the new curriculum. Teachers would become the drivers for the new arrangements. Perseus arranged for teachers to participate in the production of texts, programs and teaching notes as artefacts to support the new Science A and B courses.

The senior teachers did all the writing because they knew what would work with their teachers and their students. Once everything had gone through our editor (a highly respected Head of Department) we took them to another group of outstanding Heads of Department. We didn't do Teachers' Guides. I honestly believe the booklets spoke for themselves. The Department provided teachers with programs to see links between sections. Again we relied on the senior science teachers to help us do that. Whenever we needed a senior science teacher to write for us, we had only to ask.

They were written by us and for us. What better way to do it?

(Perseus, recounting the process whereby text materials were produced, interviewed in 1991)

It was testament to Perseus' powers of persuasion and organisation that he was able to create this new pattern for implementing the new science curriculum. Classroom science teachers received information about the new courses via their own colleagues. Teacher support and materials were seen to emanate from people who knew, who were in the same culture. In this production of new artefacts, Perseus gave further credence to the referent of science teacher as expert.

Science Laboratories and Equipment

The classrooms in which science teaching and learning takes place are artefacts which reflect the beliefs of the person who designed the rooms and those of the occupying teacher who creates his/her own imprint. The Superintendent of science was responsible for the resourcing of schools and for the teaching and learning of science. Thus, the annual re-stocking of science departments in all schools, as well as the

design brief for the building and provision of science rooms in new schools, was his responsibility.

In the early 1960s the State Education Department was building ten new schools per year and using Commonwealth government money to build specialist science laboratories. Again Perseus collaborated with Heads of Department.

I just rounded up six of the Heads of Department and put it to them, "I'm going to fix it with your Principals that you don't teach for the rest of this week." We sat down and listed all of the things we thought should be in laboratories and the kinds of courses. Straight away we came up with two kinds of laboratories. It's utter nonsense for the little person who's just interested in science in having all of the intricate apparatus. So we came up with two kinds of science laboratories. Science B was the conventional laboratory with all its facilities and Science A which didn't need all of those because you would demonstrate mainly to those people. (Perseus, recounting his views on science classrooms, interviewed in 1991)

In keeping with Perseus' view of the special nature of science method and thought, Science B classes were to be taught in science laboratories. Perseus maintained the traditional well-equipped science laboratory as the model room in which quantitative science should be taught. Here benches and stools of heights appropriate for standing and experimenting were fixed to the floor. Cupboards for equipment and material storage were placed at each end of each bench. Around the room, balances and glass bottles of chemicals were on display. The adjoining preparation room was filled with university quality chemicals and equipment. In the room, the teachers' bench was raised on a dais at the front and centre of the room. These rooms were built and provided for along the lines of good university science laboratories. These artefacts

were consistent with the recurring myths. Good science is methodologically rigorous, rational, organised and structured. The good science teacher is the expert at the centre of learning. Science has value — its own specialised structures, equipment and rooms.

Whenever possible, Perseus would be seen to refer to his teachers for advice. Frequently, the result mirrored his own firmly held beliefs. In view of Perseus' meticulous knowledge and exhaustive discussion of possibilities, it is not surprising that the solutions proposed from Heads of Department matched his own preferences. In fostering change in the science curriculum, this grass roots link and the recognisable support of the science teaching community provided Perseus with the credibility as well as authority to influence science teaching practice.

Perseus' Mechanisms for Change: Collaboration or Control?

Were these rituals and artefacts created solely to model and perpetuate an ethos of collaboration and sharing of decision-making? Or rather, were they means by which Perseus ensured that his own control of the science curriculum agenda remained unquestioned? Participants of the culture have different perceptions of the extent to which Perseus consulted or directed.

Teachers who were younger in the system and perhaps eager for the support of experience, were accepting of the Superintendent's structures.

Then there were the outside influences like the Superintendents. I respected all of them and each one remembered you. They really had the influence, school visits and the curriculum materials and so on.

(Deucalion, recalling teacher links with superintendents, interviewed in 1991)

Others who were already Heads of Department when subject superintendents were appointed into Head Office, were more circumspect.

The science Superintendent drove curriculum initiatives. He was the one person who was able to bring together a group of people who were committed to a particular direction.

(Theseus, his perception of the superintendency, interviewed in 1994)

However, the paradox confronted by the first science Superintendent remained a contradiction for all who followed. Control or collaboration? Power or participative decision-making? It is most clearly explicated by a science Superintendent from another more recent time.

Teachers were always persuaded or encouraged to adopt new directions by coercion. You can call it supervision or evaluation or rewarding, modelling or pushing a line, flogging or brainwashing. Basically you're charged with a job of taking some leadership and there is a group that believe in certain things and you want the group to move, you want change to occur. Do you sit back and wait until the group of its own accord logically thinks through it all and values it to make the change or do you have to coerce, push, model? Do you have to push them along even if its not going to make everybody happy? I'm realistic enough to feel that if you wait around for some people to do things you wait 'til hell freezes over. For the organisation to move forward we need to empower some people to pull us along and we need to force the people who don't want to move to come along. Call it coercion or influence or leadership or whatever. I think it's part of the progress or development of any Club, be

it the science teaching culture or whatever. (Jason, superintendent in the 1980s and 1990s, interviewed in 1993)

This particular paradox challenged Perseus as the first science Superintendent. Preferably through collaboration and the sharing of understandings, he wanted to maintain coherence and homogeneity in the beliefs and practices of the science education community. However, this was balanced by the recognition that he would sometimes have to use his power to ensure that some members of the community conformed. In the final analysis, he could and did use the power authorised by his position. As expressed in his own words:

I admit I did use a little bit of influence here and there to make sure that the right people were appointed to the right jobs. We did it very quietly so that they became Heads of Department. I am thoroughly convinced that its no good trying to do something unless you've got the right people there. We had some of the very best kinds of science teachers and they were the ones who made school science work. (Perseus, reflecting on his persuasive powers, interviewed in 1991)

While Perseus extolled the virtues of his collective group of science teachers, he also retained and made use of the authority and power of his position of Superintendent. His well structured collaborative rituals and their resultant artefacts contributed to the positive response received by Science A and B from the science education community. Control ensured that any persistently disparate voices were unable to access the appropriate debates and were thus effectively silenced.

CHAPTER 4

THESEUS

The Hero Theseus

"Theseus was another great Hellenic hero, renown for his outstanding monster killing adventures. The son of Aethra, his mortal paternity is accepted as Aegeus, King of Athens, although many stories claim that Poseidon also slept with Aethra on that night.

After a childhood spent with his mother, Theseus set forth for Athens with the sandals and sword left for him by Aegeus. Distaining the ship by which he could safely sail from Troezen to Athens, Theseus determined to take the overland path renown for the danger presented by bandits. For this journey, he resolved firstly that he would not be the first to attack others, and secondly to inflict punishment appropriate to the crime.

His adventures along this path were many. He killed Periphetes (Clubman) with his own club, which Theseus then retained. He met Sinis, called the Pine Bender because he killed his victims by tying them between the tops of two pine trees bent to the ground, then releasing the trees. Theseus inflicted the same torture on Sinis. Further along the trail, Theseus dashed Sciron against a boulder. Sciron had made travellers wash his feet, then kicked them over a cliff. Later, Theseus killed Procrustes who had forced all visitors to lie on his bed and had then cut off their overlapping limbs or stretched them to fit. Theseus also destroyed him by his own method. Throughout this journey, Theseus met and conquered numerous robbers, clearing the way to Athens for safe travel in the future.

Even on his arrival in Athens, Theseus was almost poisoned when his father's wife Medea persuaded Aegeus that Theseus was an enemy. Fortunately Theseus drew his sword and Aegeus recognised it as that of his son. Medea and her children fled as Theseus was declared heir to the throne.

Theseus then worked to maintain his father's authority. He crushed a conspiracy amongst the Pallantids who had hoped to succeed the childless king. Theseus tracked, captured and brought to Athens the fire breathing bull of Marathon which had terrorised the people of Attica. At Athens the bull was sacrificed to Apollo Delphinus.

Next, Theseus embarked upon the deed for which he is most remembered. For three years, Athens had paid tribute of seven virgins and seven young men to Crete. Once in Crete, the youths became food for a monster called the Minotaur which lived in an incredibly complex maze called the Labyrinth. Theseus joined the party with the aim of destroying the monster.

Ariadne, the daughter of Minos the King of Crete, fell in love with Theseus and helped him by obtaining from Daedalus, who had constructed the Labyrinth, a ball of silken thread. After killing the beast, Theseus was able to guide himself and his companions out of the Labyrinth. He then sailed for Athens with both Ariadne and her sister Phaedra. However, he deserted Ariadne on the island of Naxos. Arriving in Athens, Theseus forgot to replace the black sail with a white one, and Aegeus, despairing, threw himself into the sea (henceforth called the Aegean).

Theseus now became King of Attica. He proved to be a wise ruler, guiding the people towards a democracy with popular vote and a town council. Believing that liberty enabled people to be more responsible and wealthy, he supported them in attaining self government while he retained a position equivalent to Commander in Chief. During

this time he consolidated the Attic communities into one state, and extended Attica to include the isthmus of Corinth.

As the community became less in need of direct rule, Theseus became more restless. Essentially his interests lay in adventure and the excitement of heroic deeds. With Heracles he sailed against the Amazons and also with the argonauts. He captured the Amazon princess Hippolyta, with whom he had a son Hippolytus. When the Amazons attacked Attica she died fighting on the side of Theseus.

Throughout his later adventures, Theseus was accompanied by his friend Peirithous. Together they abducted the child Helen from Sparta, then went to the Underworld to seize Persephone. Once into the Underworld they could not escape until four years later when Heracles was able to rescue only Theseus.

Back in Athens, Theseus found little peace. Tension between his wife Phaedra and son Hippolytus eventuated in the death of his son. That he was partly responsible caused Theseus enormous grief. At the same time, his subjects became increasingly argumentative. Theseus left Athens to retire to Scyros to the home of King Lycomedes. Jealous of his guest's fame and disputing ownership of territory, Lycomedes pushed Theseus from a cliff."

A great hero renown for his prowess as a warrior and monster killer, Theseus demonstrated outstanding heroic attributes early in his lifetime, but endured a tragic middle life. Theseus' early exploits revolved about the defence of those weaker than himself — making the road from Troezen to Athens safe, removing the obligation of human sacrifice from Athens to Crete and guiding his own subjects towards democratic self government. Blessed by the Gods as a warrior hero able to protect the weak, Theseus was helped in his exploits by Poseidon. He was intelligent, strong and courageous. However, Theseus did display a restless, rash dimension to his

persona and it was this flaw which led him to his miserable middle life and end. While many of Theseus' adventures provide worthy models for ordinary people, the consequence of such imperfections of character are made equally clear.

Theseus In Post-World War II Science Education

In His Own Words

The modern-day Theseus was renowned as the principal voice for science education throughout the State during the 1960s and 1970s. Theseus was a descendent of Perseus and had been one of his warriors (an outstanding Head of Department) in the 1950s. He rose through school promotional ranks to Deputy Principal and Principal to become a Superintendent of Science and Agriculture. As did Perseus before him, Theseus maintained definitive understandings of science and science education as well as memories of its practice in secondary schools while he was Superintendent. This is Theseus' story.

Early Schooling

Primary school science when I was a student was virtually non-existent, although I recall some nature study and Gould League. High school science was the committing to memory of a huge number of somewhat isolated facts. Chemistry was dominated by what was called qualitative analysis. We had enormous volumes of hydrogen sulphide, potassium cyanide and potassium thiocyanide. Of course I only studied physics and chemistry.

I do remember a teacher who took offence to a question I asked late in Year 12. It was about a problem I'd seen in a library book. He stopped the class. "There is to be none of this." Essentially he went on to say that the job of the class was "to turn the

handle and general exhibition awards would come out at the far end like sausage machines." In fact the last four months of Year 12 was spent preparing for the final Leaving Certificate examinations. We "did solutions." Basically that involved getting four sheets of carbon and making an original and four copies of the solutions to the Leaving Certificate examination papers back over the last twenty years. You worked in a syndicate and you passed your carbon copies around. You didn't even solve the questions, you were given the solutions which you then copied. I was so bored that I determined then that I would teach so that people understood!

Science

I see science as three parts really. One is clearly understood as a body of knowledge around a number of reasonably understood areas. This includes the interpretation of the physical world and the rules that determine the behaviour of animate and inanimate objects. Secondly, science is also a process. It is an approach to knowledge that looks for testing and empirical data and hypotheses and all of those generally accepted processes of science. Thirdly I think, it is an approach to the organisation of knowledge which is rather different from that which applies in most other fields. The whole approach to science is a logical taxonomy of information. It is a search for simplicity that is contrived to take in a huge number of observations and find what is the common driving principle to that body of information and then even to take a bundle of principles and see if there is a common driving law to that and, .. get science down to a religion finally!

School Science and Teachers

School science? Schools are to some extent society's method of taking out people from the age of 6 to 17 almost en masse and keeping them under control in some sort

of ordered environment. Science in schools then, has to suffer, has to flourish and function within that custodial role.

There are physical limitations to free enquiry. You've got a bunch of 35 youngsters in limited and confined spaces and schools, by definition really, have to follow accepted rules of procedure or end up in anarchy. That and the particular role of school is competing more and more with the growing maturity of the youngsters. It really wasn't terribly hard in the days when I started teaching because only about 7% of the population, highly selected, highly motivated and interested, went onto Years 11 and 12. Today secondary schools have assumed an "economic carpark" role.

Consequently, school science becomes different things in the hands of every teacher. Some teachers keep it remarkably alive while others change it to as boring a list of daily regimes that you could possibly imagine. The individual teacher is crucial, but even the very best of teachers have to put a fair number of physical constraints around what can and can't be done.

Certainly some of the most effective teaching I have seen was with students of lower academic ability, where a teacher has taken them on board as his or her own special responsibility and developed a very strong relationship with the students and developed in them a sense of self worth.

Learning School Science

Interestingly, from the point of cognitive development, we have always had science somewhat upside down. It is upside down out of a question of economics and logistics. The younger the child is, the more they need to learn by experience and having hands-on activities. Younger children learn by internalising from their own experiences. They are less capable of learning from generalisations and words and

descriptions. The older they get the more they are able to handle concepts. But in science at primary school level the children almost only hear about science, they very occasionally do some. Yet early in secondary school they see quite a lot of science done, there's a fair number of demonstrations, but with the logistics of the big classes, costly resources, there are limits on the amount of doing and it is bedlam trying to have them do it, as you well know. It is not until you are in graduate school that you really are elbows down in the laboratory, in quite a different way. So schools do impinge on the nature of science as understood by their students.

In the late 1950s, the recognition that the body of scientific knowledge was doubling and trebling every decade meant that any suggestion that students and teachers could keep up to date with the total body of information, or could impart significant portions of it, were less and less realistic. There was also a resiling away from the rote learning which had been associated with school science. A more laboratory centred, hands-on school science which presented science as a voyage of discovery was more appropriate to help students understand their science. Of course, this affected the style and quality of science instruction, from didactic to enquiry.

I think it became everybody's experience that you can only internalise and generalise and theorise if you have a significant data base to tie together. For instance, the presentation of chemistry as a set of broad principles without enough sleeves rolled up and dirtying of the arms, just didn't give the students that sort of data base. I watched the students with great interest. Some could handle the abstractions and concepts and grasp what were the underlying bases, but others could do nothing and rote learned the concepts just as I had learned when I was at school. They could no more interpret the world than fly!

Curriculum Change

The secondary Superintendents drove curriculum and curriculum change whether it was science or mathematics or whatever. They were the group who were committed to its directions and were able to bring together a group of people who were committed to it. I have no doubt that the superintendents were the engine for curriculum directions.

I also have no doubt that the group of people in Curriculum Branch were really very influential in putting together the substance of the curriculum directions. There were a fair number of advisory committees of one sort or another and a lot of discussions held through regular meetings of Heads of Department and the like. Overall there was quite a reasonable flow of information from schools to Head Office.

Theseus: His Position

The elevation of Theseus to superintendent was accepted by the science teaching community. He had served his apprenticeship during the time when Perseus' stories, symbolic images, rituals and artefacts became established in the culture. As one of Perseus' warriors, a Head of Department of the 1950s and a writer of much of the Year 8 Science A text materials, Theseus had already shared in the propagation of some of these understandings. His own prowess as a teacher and thinker made him the subject of some of the stories and legends. His academic record had been outstanding and his classroom teaching was recognised by his peers as being excellent. He was charismatic and could dominate a room of people. As a public speaker, he was able to articulate concepts clearly with enormous persuasion.

As an influential member of the existing culture, Theseus already accepted many of the referents which Perseus had so effectively disseminated throughout the community. A

successful science student and teacher within the State secondary and tertiary system, Theseus did not question the established referent of *science being an empirical, rational body of knowledge*. In the same way, his own life experiences and understanding of the way we do things around here ensured that he understood that *science for all school students* made sense. He had been a participant and compelling supporter of the 1960s shift towards ensuring that all students studied some secondary school science. For Theseus, the *teaching of science as transmission* was common sense. Having progressed through the school system as a teacher and administrator, he also recognised *teachers as experts*. As an eminent and credible spokesperson for the science education community, his background of coming from that culture ensured that his values and beliefs were consistent with those of the community he would represent.

Theseus And His Referents

By the time Theseus ascended to the position of Superintendent of Science, schools were already different from those of Perseus' time. It is quite appropriate then, to recognise that Theseus held fast to some modified and some additional referents which he valued as being important to the science community and its work. It was these beliefs that were to identify the imprint which Theseus was to make on the culture of school science educators.

Science As Rigorous Knowledge And As A Process

A traditional, and continuing justification put forward by science educators for the inclusion of science as a compulsory school subject was its perceived ability to train students into a particular discipline of thinking. Rigorous, logical and rational thought, linking content cause with effect, was seen as representative of the way a scientist worked. Perseus and his science education community recognised this

knowledge as invaluable components in school education. It was thought that scientific knowledge had won World War II, through the actions of individuals well versed in its content and rationality.

As a member of Perseus' science education community, Theseus was committed to this belief. He accepted science as a study based in logic, clarifying cause and effect relationships. However, his own understanding of scientific knowledge also ranked highly the process of testing empirical data through hypothesis generation and the increasingly accepted and formalised scientific methodology. He included as science knowledge, the search for explanations and overarching rules and laws governing the behaviour of the world around us. In expanding the concept of scientific knowledge to include its processes and taxonomy, Theseus' referent reflected the burgeoning of the body of scientific information and its management.

Theseus understood that it was no longer possible to learn it all in school science. He began to tell stories throughout the science education community. While the body of knowledge was important, another value of science lay in understanding the nature of scientific enquiry. Increasingly, science educators found they were of the same understanding.

It was interesting. Initially I saw science as just a bunch of facts. Even going through school science and physics and chemistry I still hadn't realised that it was a process too, until I began to teach and saw that bigger picture. Using the teaching materials and teaching with peers taught me more about the nature of science than my own academic learning.

(Deucalion, reflecting on the effect of his teaching practice in the 1970s, interviewed in 1991)

In concert with science educators around the world, the community modified its understanding of science knowledge. The empirical nature of science as well as the testing of hypotheses, precise observation, the collection of objectified data and its interpretation became highly valued alongside the content knowledge previously exemplifying school science. Inevitably, this amplification of science knowledge would impinge on the traditional practice of teaching and learning science in schools.

Science Pedagogy As Laboratory Centred And Hands-On

Theseus was not content to merely modify his community's perception of what constituted scientific knowledge. He remained committed to his youthful promise to promote teaching and learning for understanding. Fortuitously, he rose to his elevated position of authority as a worldwide interest in cognition developed. Theseus read the research findings of Piaget. Just prior to his appointment as Superintendent he had completed his Doctorate in Science Education at Florida State University developing and evaluating new school science curriculum. There he worked with Burkman and Gagne. To his own community he now brought new understandings related to cognitive theories about how children learn and the value of specific teaching strategies in promoting that learning.

In particular, Theseus related the value of school science instruction as being laboratory centred and hands-on. He clearly supported a move away from rote learning, but not a move away from knowledge.

The relative focus of process versus the need for factual information is important. Whether we like it or not, there is still a demand for knowledge. (Deucalion, reiterating his belief about the balance between knowledge and process, interviewed in 1991).

The type of activities included meant that the kids experienced the content rather than just learning about it. You can memorise things but it's just words and it doesn't necessarily mean that you can apply it anywhere else. If you've experienced say electricity, you've found out what a series or parallel connection is, then you can apply that knowledge better to a new situation. It was really to experience the content and the concepts so that there's a better understanding of them. (Chiron, explaining his support for laboratory centred, hands-on teaching, interviewed in 1993)

Students needed a knowledge base upon which to build concepts. Practising science teachers already understood this belief and their confidence in their own skills was reinforced. Moreover, this referent did not undermine that of *teaching as transmission*, but merely provided teachers with an extended repertoire of classroom activities which might improve student learning. Theseus' new referent was carefully communicated. Science teachers remained confident of their own competence and that of their Superintendent.

School Science Assessment As Comparable

Theseus very clearly understood the power of school assessment.

He realised that the way you changed teachers' methods was that you changed the way they assessed the course. (Chiron, commenting on Theseus' perceptions, interviewed in 1993)

Traditionally, the culmination of school science in Years 8 to 10 had been assessed at the end of Year 10 through an external Junior Examination set by either University or other esteemed science educators. In some years, the science Superintendent had taken on this responsibility. This examination had been viewed by Perseus and the

community as a fair and objective means of measuring the merit of secondary school science students. Science teachers ensured that their students had frequent tests and examinations as preparation for the Junior Examination. The wider community, employers, parents and Universities were comfortable in the assurance that academic standards were being maintained.

Coming from within the same culture, Theseus too saw the external examination as fair and objective. However, he also saw the Junior Examination as constraining teachers' classroom practice when they sought to improve the science understandings of their students. This concern became particularly apparent with the diversity of interest and achievement of the increasingly large student cohort. Science curriculum and its assessment had to be reshaped if it was to become more inclusive of these students. Consequently, Theseus supported the replacement of the external examination with a system of cumulative assessment and certification.

However, Theseus understood that a school science grade given at one school should reflect the same achievement as the same grade given at another school. This had been the perceived advantage and credibility of the examination. Thus he viewed as critical the need for school science assessment to be comparable from one school to another. As Theseus talked with his science education community, he consistently restated his belief in the value of comparability of assessment from school to school. Of course, comparability of assessment would also ensure that secondary school science classes across the State studied similar knowledge and processes, probably with similar centrally-produced materials. In the transition to a new State certification system, many science teachers found security in the assumption that their own school-based assessment was comparable to that in other schools.

Within this climate of change, secondary school teachers were uneasy. The majority welcomed the demise of the examination system, but were unsure of the mechanics and eventual consequences to their practice. However, initially only a rearrangement of the existing curriculum was required.

The Achievement Certificate didn't necessarily involve a change in content, just in assessment. There was also some change in the structure of the content from the original Science A and B into an amalgamation of the two and their re-arrangement into the levels advanced, intermediate and basic. (Chiron, viewing possible changes late in the 1960s, interviewed in 1993)

Members of the science education community remained anxious. Although the study of science would retain its status as *core* or mandatory for students in their compulsory years of schooling, it became clear that capable students would be given less science class time in which to achieve the standards traditionally expected of students progressing into the non-compulsory years of school science. Specific curriculum requirements to meet the new cumulative assessment procedures were still unclear. Theseus had only recently returned from an extended time studying in the United States. However, it was towards Theseus as the science Superintendent, that the community turned for guidance.

Theseus' Solution: Change in Assessment and Also Curriculum Organisation and Pedagogy

As the representative of science teachers in the central bureaucracy, Theseus had the authority to act for their interests. Such was Theseus' credibility that the science education community trusted him to clarify appropriate directions for secondary school science education.

When Theseus arrived back from the US, he said to me that when he went from school to school he always saw the same thing. The teacher would be standing out the front of the room, chalking and talking, dictating notes to the students with very few demonstrations or laboratory periods. He was appalled by this sort of thing, but with the exam, teachers could do little else. It was on this basis that Theseus suggested that the new Achievement Certificate science course should stress a laboratory centred approach to teaching science. It was really that if students were to experience the content and the concepts then there would be better understanding of them. (Chiron, recalling Theseus' comments late in the 1960s, interviewed in 1993)

The extensive changes in the certification of compulsory education required a restructuring of science curriculum content. This reorganisation provided an opportunity for Theseus to add his preferred pedagogy. Rather than simplifying the change process for science educators, Theseus added his own nuances.

In a sense we were a bit ambitious about the Achievement Certificate because we tried to do three things simultaneously. Perhaps one at a time would have been better. The first was to abolish external examinations and replace them with a cumulative assessment, and there were many problems with that associated with comparability and maintaining standards. It was a big exercise to get it right so that employers would trust it and students could be sure that they were getting a fair shake.

But simultaneously we also went to the core-option structure and the multiple cross-setting in timetables so that students could be in say, the top level mathematics class or whatever, and perhaps a lower level class of another subject. That involved a lot of structural change and also resulted

in an able science student losing a significant number of hours of instruction.

And the third thing that the Achievement Certificate tried to do was to change the process of teaching. We wanted to change the model of instruction in schools from didactic to enquiry, hands-on science.

(Theseus, thoughts on Achievement Certificate changes, interviewed in 1992).

As a member of the established culture, Theseus was not about to change the powerful teacher beliefs already in existence. These beliefs were also part of his own understanding. However, he did seek to add referents to the beliefs of the science teaching community. In accepting the rationality and empiricism of Perseus' science, Theseus sought to highlight the processes associated with advancement of science knowledge. Thus, science was knowledge and processes. While accepting that teachers' subject knowledge was valuable and extensive, Theseus wished to further their knowledge of pedagogy to encompass laboratory centred and hands-on instruction science. Along with the multitude of structural changes accompanying the system-wide move to the Achievement Certificate, Theseus welcomed the challenge to introduce the new generation of science teachers and students to these referents.

Implementing Achievement Certificate Science: The Process

Maintaining The Myths With Rituals

Fortunately for Theseus, the rituals established by Perseus remained entrenched in the science teacher community. The Superintendent visits to schools, the Heads of Department conferences, and various science curriculum committees were rituals which provided opportunities for the beliefs of the community to be tested in-house,

then presented as the homogeneous understandings of the larger group. Inevitably, Theseus added new rituals in ensuring that his new referents were effectively disseminated throughout the community. In particular, the steadily increasing status of the Curriculum Branch and the associated travelling road show of teacher advisors improved the channels of communication between the Head Office and science teachers.

Superintendent Visits to Schools

The visit from the superintendents remained an enormously important event.

Certainly there was a mystique about superintendents. A visit from the superintendent was an important event. It wasn't so much that we thought that they were going to pop in on us and check at any time, but rather they carried authority and came from the centre. I think that what we were buying was the package of curriculum, staffing, professional development, inspection, money, maintenance, extra allowance. It was like a package and you didn't just buy parts of the package, you bought the whole thing. It followed that you taught the syllabus as it was too.
(Prometheus, reflecting on the superintendency, interviewed in 1991)

The Education Department had by now, ceased inspecting teachers to award teaching marks. The teaching of one's subject and the support one received from the centre became a major focus of superintendent visits. During these visits, Theseus could gather small groups of science teachers together and explain the rationale behind the existing and changing science curriculum. Stories of his own experiences gave added authenticity to these accounts. Doubts could be eased quickly amongst the small number of members of the school science department, where each individual could voice concerns and contribute to the discussion of solutions. Theseus was

comfortable in these venues and his persuasive discussion engendered confidence in the community.

Heads of Department Conferences

The Heads of Department Conferences continued to be another important homogenising ritual. In keeping with the established myth of teacher as expert, Theseus worked hard to maintain the cohesion and support of the Heads of Department.

If you talk to those who are a little older, like AJ, TG, LR and OI and those guys, they hold Theseus in great reverence. He used to plan the Heads of Department conferences by getting a group of them in and saying, "What do you want to do?" I mean, it was really involvement of the people at that sort of decision making level. Also, he listened to them and did what they wanted. His sincerity counted. (Deucalion, recounting the observations of colleagues, interviewed in 1991)

The perceptions of the teachers of the day confirm the positive support for the community that Theseus was seen to engender. He saw teachers' concerns as being valid, and valued opportunities to develop whole group strategies to alleviate problems. Theseus had sufficient confidence in his own standing in the community to concentrate his efforts on supporting the hierarchy of the science teaching community in their own networking.

At these conferences, Theseus found time to call attention to some of the successful exponents of the new curriculum. These were always respected teachers from within the community.

There was a very powerful effort by people like KB and GT, one of the best exponents of getting students involved. G was an extremely interesting case study because he had taken on board the new science course as a laboratory approach in a way no one else had. He frequently did in-service work and "show and tell" for us. I can remember them asking him questions about time and so on. He didn't have a lab assistant, and said "I arrive half an hour before school and that's all I need to get it organised." He was quite influential because it was impossible to see what he was doing and then say it could not be done. (Theseus, remembering the work of two talented teachers in the early 1970s, interviewed in 1993)

Through discussing and examining models of exemplary instruction, Heads of Department came to relatively consistent, shared understandings of the new curriculum. Returning to their own schools, they told stories of other teachers and their feats. Rather than simply transmitting directions from the Superintendent, Heads of Department spoke of other members of their community and their wonderful classroom practice. Community members became inquisitive and enthused, and began to review their own practice.

The Curriculum Branch

Perseus added to the status of his outstanding teachers by disseminating their teaching materials as artefacts to support his referents. Since that time, the Head Office of the Education Department had formalised such arrangements by establishing a Curriculum Branch. Here, experienced and outstanding teachers from all traditional discipline areas were seconded to produce curriculum support materials for teachers across the State.

Theseus recognised that these people were able to exert enormous influence on the quality of curriculum and its instruction in schools. He became involved in this process and in the direction of the work done by the group of science teachers in Curriculum Branch.

When I went into Curriculum Branch it was run fairly much as it had been for twenty years or so. When we all gathered around the table there were at least a dozen people — quite a kingdom really. The Superintendents used to run it as their own domain, and there was no question about that. If you were in it, you were there because you were chosen. (Prometheus, member of Curriculum Branch in the late 1980s, interviewed in 1991)

Of all science teachers in the Department, this group had the time, the interest, the access and the expectation that they would seek out excellence in curriculum methods and materials from across the world. In addition, as members of the culture, their work was seen to be produced for local schools and teachers. The credibility of Curriculum Branch personnel was exceptional. Theseus was responsible for the selection of outstanding teachers to enter the Curriculum Branch and for their direction and supervision. Theseus then, overviewed a powerful, cultural, homogenising agent.

Travelling Road Show - Professional Development

Theseus wanted to ensure that the science education community received consistent messages. He introduced an additional ritual which would lead directly to the ordinary classroom science teacher.

We got a travelling road show set up. We built the apparatus for some experiments and took the teachers guides and went out to all of the pilot

schools in the metropolitan area. We prepared a plastic bag which had in it colourful sheets of resource materials and things which we could give out, which was new in those days. Now you go to an in-service course and get your folder of all these things, but in 1969 it was new for teachers to get their own plastic bags. We put on this show for teachers who were involved and showed the equipment and spoke about it. Generally it went down rather well. (Chiron, member of Curriculum Branch in the early 1970s, interviewed in 1993)

In developing another ritual through which his messengers could visit teachers in their own schools, Theseus provided teachers with a very visible means of support. These messengers spoke freely, gave demonstrations, and carried stories from other schools. The messengers were credible teachers in their own right. They were supportive of the new curriculum, enthusiastic and confident. Their zeal was infectious. The messengers reported back to Theseus so that he remained well informed about local difficulties and successes. The message was the same at every place, the discussions varied from locality to locality and the outcomes became increasingly similar. The community shared similar understandings. As stated by one of the messengers:

My impression was that teachers accepted these changes. People operated in the classroom giving greater emphasis to student centred laboratory work. (Chiron, Curriculum Branch member and travelling road show person, interviewed in 1993)

Written Support Materials

In seeking to provide effective support for teachers as they developed and modified their practice. Theseus drew upon his own experiences. Throughout his own years in schools and work with Perseus as his hero, he recognised the value of locally produced teacher materials. These materials had credibility and acceptance from within the culture. Science educators from within the community tended to retain much of the traditional content in the materials they produced. Theseus too was at ease with this knowledge. His goal was not to invalidate the content knowledge but to add understanding and practice of the process of science.

To this end, Theseus learned from his own involvement in curriculum development while overseas. While in the United States he had overviewed a major curriculum development project (the National Science Foundation funded Intermediate Science Curriculum Study). This experience had provided him with enormous insight into the varieties of materials which American teachers were able to access. In creating artefacts for local science educators, Theseus borrowed from his overseas practice. He arranged for the science teachers in Curriculum Branch to produce teachers' guides, programs and sample tests.

Theseus suggested that the new Achievement Certificate science course should be prepared with teachers guides so that it stressed a laboratory centred approach to teaching science. He wanted to get teachers away from summarising the text book and dictating. He also suggested we write basic level workbooks and some resource materials and tests. The tests fitted the teachers guides which stressed certain activities. They were so highly linked that you would actually see the same apparatus with the

same diagram as the teachers guides. Teachers, if they were going to use the tests, had to have used the teachers guide and had to have used the activities that were there to teach the content. That way the kids got to experience the knowledge rather than just hear about it. (Chiron, Curriculum Branch member in the early 1970s, interviewed in 1993)

The informal writing groups initiated by Perseus and formalised into the Curriculum Branch now swelled in number. Unlike Perseus, Theseus had practiced his own teaching when almost all students remained in school until the completion of their compulsory education. He recognised the range of interests, abilities and aspirations students brought with them to the classroom. The science teachers he worked with were the classroom experts, but the teaching and learning of science knowledge and process skills was not all that would occur in the classroom.

School science becomes different things in the hands of every teacher. Some can manage to keep it remarkably alive while others change it into a boring list of daily regimes. The individual teacher is crucial, but even the best have to implement a number of physical constraints in the classroom. (Theseus, reflecting on the role of teachers in the 1970s, interviewed in 1993)

Consequently, where Perseus had relied on his teachers to know what was right, Theseus exerted great control over the final written products. He knew what he wanted to appear in these curriculum materials. Unlike Perseus, he wasn't sure that all teachers would know what to do. He was sure that many didn't. Although the writing team was hand picked and clearly in sympathy with his desired outcomes Theseus ensured that nothing was left to chance.

Provision of Qualified Laboratory Assistants

Perseus decided that school science classes should have access to university style science laboratories as well as university quality chemicals and equipment. Science educators were reassured of the special value of science instruction with its own specialised structures, equipment and rooms.

Theseus argued strongly for additional teacher support in the form of the employment of qualified laboratory assistants to work with science teachers.

That step made much more possible the involvement of significant numbers of youngsters in hands-on laboratory experience, because there were people who could lay out equipment, take it away and clean up afterwards. The schools that were very well organised in this regard really made a quantum leap forward, others just went along as they always had.

(Theseus, on the need for technical support for teachers, interviewed in 1994)

By removing this perceived obstacle to greater student activity and interaction in the classroom, Theseus demonstrated his commitment to the new strategies. Theseus made hands-on, laboratory centred classroom practice more attainable for his community. For him, such change would effectively support the teaching and learning of science for understanding.

Theseus' Mechanism for Change: Collaboration or Control?

By the time Theseus ascended to the role of Superintendent, the science education community had a clear understanding of how he should operate in the position.

Expectations established by Perseus had been cemented by the several individuals who followed in his path. Communication lines, both personal and hierarchal, were defined and effective. The rituals first put in place by Perseus remained entrenched. "The package" represented by the Superintendent was accepted by science teachers as an appropriate means of maintaining effective communicative links between Head Office and schools. If individual teachers and Heads of Department in schools did the right things the Superintendent would look after them. There was security (and a good degree of paternalism) in understanding that one was known and supported by a trusted and superordinate person in Head Office. Together, there was an assurance that students studied the right sort of science. This made sense.

Theseus was promoted into this relatively new tradition of a subject Superintendency. As an integral part of the culture, he understood the value of the Superintendency. Consequently, he had actively sought what was to him a very special and powerful promotion. The Superintendency endowed in him responsibility for science curriculum and its resourcing throughout the State. In the eyes of many science teachers, he was also responsible for their own professional and personal well being.

Collaboration Or Control?

Theseus was very clear about the directions he wanted school science to take. In introducing his new referents, and modifying older ones, Theseus communicated his vision via traditional as well as new rituals and artefacts. Theseus was comfortable with rituals which involved discussion and negotiation. He was especially confident of his own ability to sway argument. A man with an incredibly sharp mind as well as persuasive wit, Theseus was able to turn conversations and debate to his end. His colleagues of the day report leaving meetings believing that each had been able to draw together evidence leading to decisions to undertake new initiatives. On further reflection, each acknowledged that the timely intervention of Theseus had been critical.

Theseus worked with logical, rational debate. It was difficult for educators with scientific training to disagree with his interpretations. During this time his reputation for collaboration remained untarnished. He was totally in control in his role as a spokesperson for science education.

With respect to a number of the community rituals, Theseus was able to retain the community perception of democratic conduct. The committee structures begun by Perseus remained, with responsibility delegated to individuals from each group. School science educators placed great value on these meetings since many dealt with the intricacies of the resourcing of school science departments. This sharing of ownership for the points of discussion and their consequences earned Theseus inestimable respect. In particular, this respect came from the experienced members of the community, especially the Heads of Department, who relayed their valuing of the Superintendent to classroom teachers in their school.

However, in some areas of his responsibility, Theseus was not prepared to act democratically. He was very ready to collaborate, explain and persuade, but final decisions were clearly his own. In the Curriculum Branch, after the meetings and negotiations had been concluded, it was always Theseus who determined the next step. He decided that teachers guides would be written and he also decided that there would be no text book. He hoped that the lack of a text would force teachers away from summaries and dictation. It was his recognition of the link between assessment and teaching practice which resulted in tests of a particular style. Teachers were inundated with new materials to support their transition to activity oriented, laboratory based, hands-on teaching strategies.

For some in the community, the quantity of support threatened to change the image of science teacher experts into science teacher technicians. Theseus was made aware of such concerns.

To support the teachers, we wanted to provide workbooks and teachers guides. That way a social science teacher in the far North of the State with very little idea of what science teaching was about, could follow these ideas. In all probability we erred on the side of too much support and too much information. I can remember walking into a District High School one day to find a stack of teachers guides barricading the door to the science office!

Too much teacher support became a little like strychnine — a little is therapeutic, whereas a lot is lethal! (Theseus, reflecting on the quantity of curriculum support in the 1970s, interviewed in 1993)

Theseus filled Curriculum Branch positions with science teachers sympathetic to his message. Consequently, the messages from the centre to schools and individual teachers were always consistent. In the meetings and discussions within the Branch, there were some differences of opinion. Invariably, Theseus had the answer and determined the final outcome. Frequently his subordinates were awed by his consistent orientation towards hands-on learning.

There were a number of advisory committees of one sort or another and a lot of discussions held through regular meetings of Heads of Department of science and the like. We all met on a most regular basis, maybe once a week about a lot of joint planning and broad shape, then people would go away and write and back it would come for critique. (Theseus, on the curriculum development process, interviewed in 1994)

While Theseus was the Superintendent there was a perception and articulation of the sharing of decision-making amongst the science teacher community. However, when decisions were about the future directions of school science curriculum, these perceptions altered. In the words of two science teachers of the day:

I think there was a tendency to see it as authoritative because it came from the centre, so there was that pressure. Your superintendent says ..

(Cronus, teacher from the 1960s and on, interviewed in 1993)

The new directions had come from the Superintendent so we had to pay particular attention to it — like tablets handed down in stone. In general we tried to bring more student activity into classes, even more when the Super visited! (Prometheus, teacher in the 1970s, interviewed in 1991).

Clearly, Theseus used his power. He was expected to do so. Such was his stature amongst members of the community, and so gifted was his oratory, that many science educators found it impossible to sustain longstanding disagreement with his directions. Quite the contrary, his silver tongue persuaded many of the rationality of the new teaching strategies. Inevitably, Theseus had his way with school science curriculum with very limited overt opposition.

CHAPTER 5

HEROES

From the late 1950s until the 1970s, modification of the State science curriculum led to changes in the practice of science teachers. What seems to distinguish this period of reform activity is the presence of particularly influential men recognised by their own science education community members as its "Heroes." These individuals are still perceived by those who were members of the culture at the time to have moderated the previous practices and customs of teachers.

Heroes and Their Referents

In the world of education, myths stand as the deeply held, unquestioned referents which provide the bases by which knowledge and action are justified (Tobin, Kahle and Fraser, 1990). They are the framework within which each of us act and underpin our epistemology, actions, practice and policies.

In identifying the Heroes of a culture and explicating the myths and referents associated with each, one can better clarify their beliefs about the practice of teaching and learning. Within the small science education community in my State, where members attended local schools, the one State University and participated in similar activities and practice, the group beliefs and referents about science education became entrenched through the shared context of experience and practice. In consolidating some myths and establishing and propagating new myths, rituals and artefacts, these Heroes are perceived by their own community to have changed "the way we do things around here" (the definition of a culture given by Bower in 1966). These Heroes are acknowledged to have been critical in the process through which effective and consensual cultural change was promoted and implemented.

The Traditional Hero Mythology

Joseph Campbell (1949) perceives hero myths as "infinite in their revelation" whether they are being interpreted in the physical (outward) or spiritual (inward) metaphorical sense.

Anybody going on a journey, inward or outward, to find values, will be on a journey that has been described many times in the myths of mankind (quoted in Kisly, 1976, p. 79).

Hero myths are stories about a person who has achieved something exceptional to be shared with others. When others share in the newfound understanding, they attain enlightenment in the form of that knowledge.

Furthermore, we have not even to risk the adventure alone, for the heroes of all time have gone before us. The labyrinth is thoroughly known. We have only to follow the thread of the hero path. (Campbell, 1988, p. 123).

The importance of the modern Perseus and Theseus to each of their communities may be evaluated by reviewing the myths associated with their journeys and achievements in the contemporary cultural context.

The Monomyth

Campbell (1949) argues that all cultures possess hero myths, and that these myths are modelled on the same pattern which he refers to as the "monomyth."

The standard path of the mythological adventure of the hero is the magnification of the formula represented in the rites of passage: separation-initiation-return. A hero ventures forth from the world of common day into a region of supernatural wonder: fabulous forces are there encountered and a decisive victory won: the hero comes back from this mysterious adventure with the power to bestow boons on his fellow man. (Campbell, 1949, p. 30).

The heroic myths of the Hellenic Perseus and Theseus clearly follow this sequence. Each enjoys an early life as part of his community (although performing a few remarkable feats) followed by some amazing adventures and heroic deeds which lead to the creation of a beneficial effect for both the hero and his home culture.

The Hero's Early Life

Although the details differ, the initial journeys of these modern Heroes are very similar to each other. Effectively, two young men, separated by over a decade in time, arrived at their vocations via a journey similar to that travelled by most of their peers. As part of the community, stories about the expertise of each became part of the community's store of tales. Stories were told of Perseus' organisational skills as a young science and mathematics teacher, of his toughness and mechanistic problem solving. Anecdotes spoke of Theseus' persuasiveness with parents, Principals and Superintendents, the texts he wrote and his incredible breadth of knowledge or wit. Clearly each of these men originated from and were accepted and identifiable as part of their local science education culture.

Separation and Initiation

All hero myths relate a separation of the hero from his home. The hero makes this journey in a conscious search for something not available in, or missing from, his own community. Campbell asserts that there can be no hero without this detachment.

That's the basic motive of the universal hero's journey — leaving one condition and finding the source of life to bring you forth into a richer or mature condition.

(Campbell, 1988, p. 124)

This separation and initiation formed a part of the journeys of both the Hellenic and contemporary Perseus and Theseus. Already a school Principal, the modern Perseus was singled out as the recipient of a Smith Mundt scholarship in 1955. The resultant journey took him to education sites throughout Europe, the United Kingdom and United States. Throughout his tour he conversed at length with science educators from different cultures with similar and different understandings. He participated in the vigorous debate raging in the UK and North America between adherents of general science curriculum and those promoting separate discipline curricula. Away from home he had the time to carefully evaluate the arguments of the local cultures. He was initiated into new knowledge and returned home with new understandings.

A decade later, Theseus was selected into a full-time doctoral study at Florida State University in the United States. This was in the midst of the American golden age of school science curriculum reform. Theseus was exposed to the relatively new academic fields of educational psychology, educational measurement and evaluation, instructional design and curriculum development. Over the time of his separation there were new understandings reinterpreted over and over as he immersed himself in the

different culture. By the time he returned home, Theseus had rearranged and clarified his beliefs to include new understandings.

Return and Bestowing the Boon: Being Heroic

On his return, each hero then makes a choice. Inevitably, the hero even more clearly now recognises that the understandings of his home culture are not complete. Each now has the power to bestow a boon upon his fellow man. Are his new-found understandings sufficiently valuable for him to undertake the difficult task of introducing them to his home culture? Alternatively, should he accept and appreciate the existing culture of his home and find his own justification for his inaction. It is in making the choice to share his new knowledge, that Campbell explains heroism.

A legendary hero is usually the founder of something —the founder of a new age, the founder of a new religion, the founder of a new city, the founder of a new way of life. In order to found something new one has to leave the old and go in quest of the seed idea, a germinal idea that will have the potentiality of bringing forth that new thing.

(Campbell, 1988, p. 136)

In effect, the journey, its initiation and return, is not enough to make a hero. The hero must not only elect to make the journey but also determine to share his new knowledge with his own culture.

For Campbell the mythic hero is a true saviour offering his people the knowledge that gives them salvation.

(Segal, 1987, p. 63)

It is in the achievement of that change in the "way we do things around here," which ensures that the label of hero belongs with an individual.

Within the science education community of their home State, Perseus and Theseus continue to be recognised as Heroes. The new and modified underpinning referents along with the rituals and artefacts each created, are regarded as part of the contemporary culture of the community.

What Is The Function Of The Hero Myth?

Traditionally, the hero myth is recognised as a story (Campbell, 1949; Samuel & Thompson, 1990). Campbell identifies myths as beliefs encompassing several functions. While the myth is able to create a sense of awe and mystery before the world, it also explains the world with symbolic images, maintaining social order through justifying the traditional and changing practices and institutions of the culture. Myths act to harmonise persons with their society and their world. They bridge the past with the present.

In this context, both Perseus and Theseus can be characterised as Heroes of their culture. As demonstrated in Chapters Three and Four, each was able to articulate the desired changes to his community's understanding through the use of stories, rituals and artefacts in order to construct new referents. The acceptance of these new understandings by the science education community provided an underpinning belief with which members of the community could justify their change of science curriculum practice.

Why Perseus?

There are several reasons for selecting the metaphor of Perseus for this modern day science education Hero.

Mentored By The "Gods"

The mythical Perseus was supported and guided in his quest by mentors in the form of the powerful Gods Athena and Hermes. It was through their intercession that Perseus was able to acquire the pair of flying sandals, the magic wallet and the helmet of invisibility so essential for his success. Similarly, the modern day Perseus had an impressive mentor in the Director General of Education of the day. Perseus held enormous admiration and respect for this man

We had a person, [Zeus] who was remarkable as a planner of the future.

A person like [Zeus] foreshadowed the problem and evaluated the solutions with an analytical mind.

(Perseus, interviewed in 1991)

Colleagues of the men maintained their awe of Zeus' ability and vision, but saw his appointment of Perseus in more realistic terms.

[Zeus] was a towering figure, a real statesman of education. It was in his time that Perseus had the most meteoric promotion in the history of the Department. He was singled out by [Zeus] because he needed a methods man to reform science and agricultural education. Perseus had amazing organising power and a tremendous capacity to get on top of detail, his real forte was his methods and his rule for everything.

The organisation and [Zeus] needed him. (Laomedon, teacher and school administrator in the 1950s, interviewed in 1994)

While the organisation profited by Perseus' methods and rationality, he learned from his mentor. In particular Perseus understood the value of developing good interpersonal links within his community. The associated power of perceived shared decision-making became another important tool to enable Perseus to cement his credibility and authority amongst the science education community.

Throughout his Superintendency Perseus consistently remained in control of curriculum policy directions. However, amongst his community, the ritualistic meetings with Heads of Department, visitation and discussion at schools and support for well respected members of the community to write new materials, ensured a perception of shared ownership and power. In addition to his own strengths of logical problem solving and the organisation of structures and people, this ability to allow others to be seen to take ownership of curriculum direction was to become invaluable when curriculum change was mooted.

The Loyal Hero

Stories about the mythical Perseus reiterate his personal qualities. His pride in his own accomplishments was tempered with an honourable demeanour and loyalty to the Gods, family and subjects. The post-World War II Perseus shared these qualities.

I admit I changed everything there (referring to the science curriculum). I had a terrific working relationship with all of the Heads of Department and I used to discuss it with them.

In those days I used to know everyone in the secondary division. I knew their families and their circumstances and when they were sick and when they needed help. I pride myself on the fact that I had some teachers there who came to see me when they were in more or less distress conditions and I knew I could help them. They never forgot your support.

(Perseus, recalling his links with teachers, interviewed in 1991)

In the youthful, centralised system of the day, this paternalistic support from the centre for schools and teachers, was expected and highly valued. While peers recall Perseus as an older, conservative gentleman, his integrity and loyalty to the State Education Department and his colleagues was unquestioned. As one Head Office peer remarked:

What a marvellous deputy Perseus would be, because he is so loyal. He is loyal and hardworking and he has got the marvellous capacity to work things out in detail. (Arcas, a peer of Perseus', interviewed in 1994)

Towards the end of his career, Perseus became the Director General of Education just as the mythical Perseus had become King of his own Kingdom. A colleague remembered the constant support he received from Perseus.

He was really the one Director General we ever had who was helpful to the people who were behind him. The others just exploited them or more often left them to fend for themselves, but he was like a father to me. He would put down what he was doing no matter how important it was and give you an hour if you needed it. You came out with a lot of work to do but the way was clear. He was inherently helpful, but also he'd already done my job and had thought it through years before. He'd done all of the jobs and he had a rule for everything. Everybody likes to do things that they're good at. Perseus was just an exceptional organiser! He'd never

make a mistake. Of course he was so fantastically hard working and helpful and his capacity to reduce organisational things to a set of rules meant that we all did it his way because there wouldn't be any better way for sure. That was why he was so influential. (Laomedon, recalling working with Perseus in the 1970s, interviewed in 1994)

In a similar way to the Greek hero, the modern Perseus rose to the height of achievement in his own domain. Throughout this time he was seen to have maintained his loyalty to colleagues and his rational mind set. While not beloved he was respected. In developing structures which worked for him, then sharing this knowledge with his community members, Perseus' rules and methodology were to remain entrenched in the bureaucracy for years to come. The structures he created for the sharing of ideas, ownership and understandings about science curriculum, had reinforced his own credibility and standing as a leader and authority with respect to science education. Inevitably, future science education leaders would borrow heavily from the structures and methods so successfully employed by Perseus.

The Father Of A New Race

Like the Hellenic Perseus who fathered the Perseids including the hero Heracles, the post-war Perseus also became the ancestral father of a new race of descendants. Future science Superintendents would be measured against the achievements of Perseus.

In his structures he had provided for a lineage of warriors who supported the Superintendent. These were the Heads of Department. From their ranks, already practising the art of sharing community understandings about teaching and learning and decision-making, many future Superintendents would be selected. From these foremost warriors who wrote curriculum, carried messages, practised in ways touted

by their Superintendents as exemplary and preached to their peers and subordinates, would eventually rise the next generation of Superintendents of science.

A conservative man who preferred limited modification to wholesale reform, the modern day Perseus would have been gratified to witness the longevity of the structures he had created. He did not, however, envisage the endurance of his structures, nor the associated referents, rituals and artefacts.

We created our curriculum and there's no doubt that it was the battle of the plan, science for all. But it must change because the people who have to teach and those who have to learn will change, and that is to be expected.
(Perseus, reflecting on curriculum change, interviewed in 1991)

Why Theseus?

When reflecting on the exploits of the modern day Theseus, it is easy to draw parallels between his professional career and that of the Hellenic Theseus. This metaphor provides a vehicle to better appreciate his achievements and disappointments.

Mentored By The "Gods"

The ancient Theseus and his contemporary counterpart were later generation heroes reputed for their slaying many monsters and following in the heroic paths of others. As for all traditional heroes, both men were guided by mentors. The mythical Theseus counted Poseidon as his protector and adviser. For the modern Theseus, Perseus maintained his interest in the welfare of this warrior of earlier days. While Theseus was promoted and worked as Superintendent, Perseus became Deputy Director General of Education and then Director General. Perseus continued to support his disciples in the science community:

I am biased towards maths and science people, they were people you could rely on for sound solid work. I could go along to one of our people and say, "What do you think we should be doing here?" and you could guarantee he would be right. I couldn't help but feel that good heads were going to come out of certain fields. I suppose it might have been because they had a similar outlook to me and I thought like them too. (Perseus, reflecting on science teachers, interviewed in 1991)

Theseus' elevation from the school ranks to Superintendent should not be seen solely as nepotism. He was a highly intelligent, articulate and clear thinking Head of Department, who had already gained kudos within the science education community for several highly visible accomplishments. He was recognised as an exemplary classroom teacher. Included amongst his early deeds was his writing of programs, teachers' notes and eventually text materials for the 1960s science curriculum. There was an expectation and acceptance by science teachers that Theseus would eventually ascend to the position of Superintendent.

A Democratic State?

A sizeable component of Theseus' new role related to the administration of science resources to schools across the State. Science resourcing included the design and review of science buildings, the requisition of chemicals and equipment for every science department as well as provision for curriculum support and teacher placement. While Theseus was a very able administrator, he was not interested in every detail of the equipping of school science laboratories. While he retained an overview of directions, he did not feel the need to make every decision. Gradually, these interests were overviewed by representative Head of Department committees. Just as the Theseus of old guided his subjects towards a democracy, so did the modern Theseus transfer some ownership and decision-making to his own community.

Hero With An Ideal

The Hellenic Theseus viewed his early adventures through a somewhat idealistic lens. In taking up his new position, the modern Theseus continued to work towards his mission to help students to understand science. To this end, as Superintendent, Theseus collaborated with others and coerced and controlled the science education curriculum agenda. He saw his primary challenge in extending old referents and establishing new ones reflecting his quest to improve science teaching and learning. The vast quantity of artefacts produced at Curriculum Branch, the ritualised Heads of Department meetings and school professional development meetings all coordinated by Theseus, together helped create new understandings in the culture.

The Mature Years

After several years in the Superintendency, Theseus searched for new challenges, new monsters to slay. This consistent restless search was to lead to Theseus' disappointing and even tragic middle life.

Theseus became Principal of the Secondary Teachers' College. Here he had access to many teachers in training, of all subject areas and was able to reaffirm his determination that students deserved to understand the curriculum of which they were a part. However, in order to take up this opportunity he moved away from directing the school science education community and out of the science Superintendency. This man was scholarly and the College was seen to be a tertiary institution well suited to his intellect. In addition, it was appropriate that his curriculum expertise and interest in teaching and learning be utilised in the broader sense to support all secondary teachers. The new appointment was also a promotion and the financial rewards were high. In some eyes, Theseus was seen to demonstrate less regard for his science education community than was expected. The trusted, paternalistic voice had chosen

to leave his domain, and subjects, for adventures further afield. For whichever reason, school science educators generally recognised Theseus' new role as further extending his need to meet the old challenge in a new sphere.

As in mythical stories, times change and several years later the State Education Department required a new Director General. Many science educators were pleased to find that Theseus was selected for the position. This was an individual with the capacity to bring the system into a new age. There had been no new curriculum initiatives for compulsory school-aged students since 1970, when Theseus had been so directly involved. This was a person with the oratory, the intellect and the understanding to facilitate change. This person had a proven record for monster slaying! For a time, educators' expectations were met. Newly formed committees included a heavy representation of school-based personnel. Discussions ensued. Initially these were of a very broad nature producing varied messages about possible new curriculum structures. Increasingly, the arguments refined. This process was taking time.

As school-based personnel and Head Office people concentrated on the curriculum and new directions for the Education Department, the political arena was also changing. A new Minister for Education had very clear ideas of what would be the structure of his new Education Department. His vision did not include subject Superintendents, nor the Curriculum Branch. Theseus soon came to realise the different political influence around him. Perhaps a little late. Perhaps he had been politically unaware, or at least naive. Theseus negotiated with his Minister — unsuccessfully. Like the Theseus of Attica, this Theseus was pushed off the cliff. Or did he jump?

The initial reaction of Theseus' community to his resignation from his position as Director General of the Education Department mirrored that of the subjects of Attica. The Hero was no more. Tragedy! His resignation from the Education Department

was regarded as a sell-out. He had taken his superannuation and left the school community alone to negotiate or frustrate or buckle under the new Minister and his philosophies. Disappointment was huge and blame was everywhere. Any later career would always be clouded by perceptions of his cowardice in not maintaining a stand supportive of schools, the traditional Education Department system and structure, their teachers and personnel.

A decade on and the views of the science education community are more balanced. Time heals. The reality of the laws governing the employment conditions of senior public servants continue to be such that Theseus would never have been able to speak out publicly. His sudden departure did serve to alert educators to the enormity of the restructuring envisaged by the Minister. However, there is now developing support from the education community, for schools to be more independent from the centre. While no school educator would wish to revisit the personal anguish and group stress of those several years, many school-based individuals do regard their relationship with Head Office in a new light. For an increasing number there is now an acceptance that the traditional system needed to break away from the culture of central succession and paternalism.

Theseus too, is regarded differently. He will never again merit the unquestioned loyalty and admiration of his earlier years. As a young Hero he was invincible! Gradually though, he has regained respect for his successes and wisdom. He has continued to work in educational spheres, utilising his considerable persuasive, administrative and organisational talents to effect. However, he has never again been invited to speak to a large gathering of the science education community.

Yet experienced science teachers continue to regard Theseus as a highly influential, credible and ethical exponent of an appropriate science curriculum. His referents — science as knowledge and process, and school science as laboratory-centred and

hands-on and assessment as comparable — continue to be visible in the day to day classroom practice of science teachers.

What About Heroines?

As I became engrossed in this study, it became increasingly obvious that I was not going to include any heroines in my work. In my reading of archival material and interviews with science educators, not once was a female science educator mentioned. As a contemporary educator, I questioned the reason for the lack of feminine visibility in the data I was collecting. Were my informants biased? What was I missing? For me, this was a disappointing element of my inquiry — and demanded clarification for myself and for the reader.

Essentially, Campbell's heroes are also male. Although in *The Hero With A Thousand Faces* Campbell does describe the activities of female heroes, his pattern for the monomyth is fundamentally male and even more so where interpreted in the symbolically Jungian sense. However, Campbell does recognise females as heroes, in particular the mother as hero (Campbell, 1988, p. 125). In this modern hero myth then, why have I been unable to find a female hero?

The lack of female heroes seems to be endemic to the State Education Department, especially prior to the 1990s. Throughout this century, women have been employed by the Education Department in increasing numbers. Individual reports attest to their professionalism and exemplary classroom practice. However, I quickly found that none had ever risen to the promotional ranks of Superintendent of Science. Until the 1970s, not one woman had become a Head of Department of science.

The employment policies adopted by successive governments ensured the lack of promotional opportunities for most women. After World War II, when many women

entered the workforce to support the nation's commitment to war, there was a concerted effort to dissuade women from remaining in the workforce. The advantages of family life and women supporting a husband and children from the home were promoted in all media, print, radio and film. Women who remained in the workforce were regarded as selfish, taking employment away from returning soldiers.

Successive State Governments adopted a "breadwinner" policy. Only the male member of a married couple was employed. On marrying, a young female teacher was immediately placed on "supply." In effect, she became a temporary teacher with no promotional entitlements. At the end of each academic year, she was officially thanked for her efforts (by letter) and informed that she would be notified of any employment opportunity for the following year later in January. Often this notification arrived the day before the school year commenced. Women were actively disbarred from permanent employment and consequently, promotion.

Despite the official discouragement, the Education Department continued to need women in order to provide teachers for every classroom. This was particularly so in the mathematics and science fields. Inevitably, some women were continuously in schools for many years, without an opportunity to access promotion or long service leave.

My mother provides an excellent example of the effects of this policy. In 1955 with two small children and my father the Head of Department of science at the local high school, she was encouraged to return to work because of a lack of qualified mathematics teachers. She did so. Thereafter, every December she would receive her thankyou letter. Every January, she would be telephoned by the mathematics Superintendent and asked to take up an appointment at her local school. As a married woman on supply, my mother was able to accumulate sick leave entitlements, but was

unable to access any promotion or long service leave. For most of this time she was paid as a female employee — at about 80% of the male salary.

In the hierarchal system, two additional policies excluded most women from promotion. Promotion was awarded on the basis of seniority of years of continuous permanent employment. This policy alone denied higher status to almost all married women. Secondly, most available promotions were to rural schools. New appointees needed to spend several years in the country until they attained the required years of seniority to warrant the transfer to a metropolitan school. Generally, only unmarried women or widows were able to accept such challenges.

Inevitably, amongst the communication structures created by Perseus, no woman had access to the kudos lent by attending Heads of Department meetings. Perseus and the science education community did not perceive inequity in this system of networking. These arrangements reflected the understandings of the wider society of the day. While a woman might gain recognition within her school, there was no way she could gain system-wide acknowledgment. Until this system was modified in 1972, there was no avenue by which a female hero was able to officially or unofficially attain the status and credibility across the system to influence the science education community.

By way of a post-script: My mother was able to join the permanent workforce in 1972 at the same rate of pay as her male counterparts. It was not until 1982 that she was finally able to enjoy her first and only three months of long service leave — after nineteen years of unbroken service!

Hero and Leader - Is There A Difference?

Recent research into effective schooling and educational change, has focused on the value of school leaders. Inevitably the question arises, is a hero automatically also a

leader, or something more or different? Bolman and Deal (1991, p. 404) very clearly equate the hero with the leader, where the Anglo Saxon root *laedare* meant to lead people on a journey. Campbell's (1988) conversation clarifies his perception.

Campbell: Is the leader really a leader, or is he simply one out in front of a wave? In psychological terms the leader might be analysed as the one who perceived what could be achieved and did it.

Moyers: It has been said that a leader is someone who discerned the inevitable and got in front of it. Napoleon was a leader but he wasn't a hero in the sense that what he accomplished was grand for humanity's sake. It was for France, the glory of France.

Campbell: Then he is a French hero, is he not? (Later) Whether you call someone a hero or a monster is all relative to where the focus of your consciousness may be.

(Later) The hero sacrifices himself for something - that's the morality of it. Now, from another position, of course, you might say that the idea for which he sacrificed himself was something that should not have been respected. That's a judgement from the other side, but it doesn't destroy the intrinsic heroism of the deed performed.

(Campbell, 1988, pp. 126-127).

Campbell made several points. Firstly, he equates the terms hero with leader. These expressions stand as descriptors of the individual who is able to achieve something momentous, who has "bestowed a boon on that community." However, in the absence of such achievement, the individual cannot be either hero or leader.

Secondly, Campbell states that a hero from one culture may not be recognised as a hero to another. Theseus was recognised by his local education community as a hero. However, when he disagreed with the curriculum directions being proposed by science educators in other states of Australia, they regarded his view as lacking vision. He was very slow in agreeing to support an Australia-wide project to produce self-paced, laboratory oriented student science workbooks (Australian Science Education Project). For some time, Theseus saw little value in the project and said so very publicly.

They essentially developed the materials from a philosophy that any of the units could be chosen in any order, which meant that every unit had to sit on the ground. I have a very strong feeling that it is not a very tall building if you build every brick on the ground and you can't build brick on brick. (Theseus, justifying his lack of support for the ACER project, interviewed in 1993)

Long after he had eventually agreed to State participation in the national project, Theseus continued to be regarded suspiciously by the educators from other states.

Even within one's own culture, some individuals are unlikely to give such recognition. In particular, peers of similar age and experience harbour memories of the individual's personal faults and flaws which mitigate against their recognition of their friend as hero. Whilst excellent confidants, supportive of his actions, practice and policies, they are unlikely to regard the influential individual as a Hero.

Perseus picked up Science A and B as it emerged from the thinking of the day. He had a lot of people helping him but he was the main science man at the time and it was his job to follow it through. (Acrisius, a peer of Perseus, interviewed in 1992)

To the next generation, however, there is no question of status. Clearly as for Campbell, the recognition of a hero ultimately reflects from whence the bystander views the individual.

Do We Need Heroes?

Campbell is quite definite about who may become a hero and the exploits expected of the hero.

Even in popular novels, the main character is a hero or heroine who has found or done something beyond the normal range of achievement and experience. A hero is someone who has given his or her life to something bigger than oneself. (Campbell, 1988, p. 123)

Discussing the idea of a hero from an artistic, literary perspective, Calder states:

[He is a] hero at his best, embodying a fusion of thought and creative action, providing a genuine example of human endeavour and potential and containing a provocative duality. (Calder, 1977, p. 198).

Whilst from an organisational point of view, Bolman and Deal (1991), who understand the terms hero and leader as synonymous (p. 404), state:

Leaders are a source of help. They help us feel less fearful and more confident. They help us find attractive and plausible versions of what to think, feel and do. They help us to see possibilities and discover resources. (Bolman & Deal, 1991, p. 404).

Thus, across a range of paradigms, heroes are seen to have a critical role in modelling, supporting and extending the members of a community and culture. However, it is clear that many in my contemporary culture are a little uncomfortable with the hero myth. The reactions from fellow students or teachers with whom I have discussed my study has been revealing.

He was a wonderful person and a strong leader. And he did move our Department and our science curriculum along another major step. He was the right person there at the right time. I'm not sure that anyone else could have done it. But a hero? Is that an overstatement? (Tyndaris, a peer of Theseus, interviewed in 1992)

For these people, leader remains a more approachable term by which to identify the influential individuals of my study. It appeared to me that such caution reflected the belief that this metaphor inferred an exalted persona, too far removed from the actual man. Our contemporary community expectation has become that of the traditional hero being an individual of uniquely good attributes, unattainable in reality. Yet such understanding is at odds with each of the metaphorical Hellenic heroes. Perseus performed his great feat because he was obligated to do so for his king. His honour demanded it. This same sense of honour demanded that he attempt to reconcile with his grandfather, ultimately resulting in King Acrisius' death. While Theseus' many deeds were of enormous assistance to others, his flaw was his streak of rashness. In abandoning Ariadne he seemed to doom his future relationships. Unlike our current critics, the Greeks understood that one personality trait may provide both benefit and ruin. Whilst they regarded the adventures of their heroes as worthy, they were also aware of the two sides of heroism and did not balk from describing the price.

My own perception is of a more cynical local community retreating from the celebration of our recent heroes. This understanding forms the essence of Jenni

Calder's (1977) discussion as she argues for the continued cultural value and need of heroes and the hero idea. However, Calder (1977) is concerned that this value should not be uncritical and not become the hero-worship of inappropriate figures.

To accept the creative power of myth and the importance of heroes requires an act of faith that many have been taught or learnt to withhold.
(p. 196)

To recognise the need for heroes is not to suspend critical attention but to be generous about human weakness and optimistic about human potential.
(p. xii).

Campbell (1988) also expresses his concern at the lack of heroes in our contemporary society as well as his belief in our continued need to identify just such individuals.

Life today is so complex and it is changing so fast that there is not time for anything to constellate itself before it's thrown over again. In a high school questionnaire asking "What would you like to be?" two thirds of the students responded, "A celebrity." They had no notion of having to give of themselves in order to achieve something. Our society needs heroes. Because it has to have constellating images to pull together all these tendencies to separation, to pull them together into some intention.
(Campbell, 1988, p. 134).

Not only does Campbell reiterate the community need for heroes, but that these need to be acclaimed for legitimate attributes. Inevitably, he returns to his underpinning hero myth. Always for Campbell the hero is someone who gives of himself, who harmonises a culture in dissonance and who provides direction and with it an

acceptance of change. Similarly, others recognise hero leaders as being individuals able to provide focus and a direction for change in stressful times.

Heroic leaders are most likely to emerge when there is strong community feeling: oppression, danger or frustration. The hero is a focus. (Calder, 1977, p 194).

Like Campbell, Calder (1977) sees the hero idea as being more than solely the action of change, but also "how and why it is done and for whom." This recognition of the ethical nature of the hero who acts on his potential to benefit his community with something new and improved, is part of the complexity of the hero myth.

Education administrators and organisational theorists consistently argue that change must have a leader hero.

Improvements cannot happen without leadership. Energy needs to be created, released, channelled or mobilised to get the ball rolling in the right direction. (Deal in Sergiovanni, 1990, p. v)

I have used Campbell's hero myth as my framework for reviewing the beliefs and actions of Perseus and Theseus. Had I instead used an artistic literature analogy or one based in educational administration and organisation, the words might have differed but I believe that each framework would have generated the same interpretation — that a hero is integral to effective cultural change. In the words of Sergiovanni, (1990, p. xi):

Leadership is only part of the equation for sound schooling. Needed too is concern for first rate teaching, sound curriculum, sensible evaluation practices, parental involvement, issues of equity and political and financial

support. But none of these concerns can be fully attended to in the absence of the right leadership.

Cultural change requires the presence of influential individuals to provide direction and harmony to the process. I have framed my two heroes as contemporary metaphors of the two Hellenic heroes. Their beliefs, understandings and actions in creating change in their community are reflected in the varieties of stories, rituals and artefacts emanating from each.

CHAPTER 6

HEROISM AND CHANGE

Both Perseus and Theseus, were participants in the science education community at times of State-wide science curriculum change. In this centralised education system, the introduction of new referents and changes in some of the existing referents of science educators effected new understandings and new teaching practice.

Long-term members of the science education community continue to identify Perseus (during the late 1950s and early 1960s) and Theseus (in the late 1960s and early 1970s) as being the influential individuals who encouraged the community to adopt new customs. Because each was seen by his peers to "leave the old and go in quest of the seed idea that will have the potentiality of bringing forth that new thing" (Campbell, 1988, p. 136), I have nominated each of these persons as a Hero.

In scrutinising the tale of each Hero in this study, I have identified a number of common attributes and processes by which each Hero ensured that new referents permeated his culture. These common elements represent the mechanisms which together contributed to the process of change. These are clarified in the assertions which follow.

Heroes Are Credible "Knowers" Of Insider Referents

Both Perseus and Theseus actively participated in his local culture. Each produced teaching notes for junior teachers, attended the ritualised teachers meetings with the Public Examinations Board and even taught many of their younger colleagues. They were seen to be empathetic to the members of their community, to understand and hold the same beliefs and values. Perseus and Theseus were already highly regarded

members of the science teaching community prior to their promotion to Superintendent.

As members of this discrete group, however, each had been singled out. Perseus had travelled overseas to review European and North American practice of science and agricultural education. After successfully serving Perseus in the writing of texts and teachers notes and programs for the new Science A and B curriculum, Theseus spent several years studying science curriculum in the United States and returned with a doctorate.

Upon returning to their original community, each brought new understandings about science curriculum and its practice. In building this new understanding each Hero had accepted into his own belief system, additional referents which created the underpinning fabric from which each Hero's germinal idea, was to spring.

Once home in their own culture, both Perseus and Theseus continued to support the majority of the underlying assumptions governing the actions of local science educators. The language used by these Heroes to discuss school science remained familiar, the critical value placed on science knowledge was consistent and the reliance on Head Office persisted intact. Each was perceived to be an insider who had travelled away from the State and then chosen to return. On his reappearance, each continued to be at one with his science education community. As a consequence, each Hero's credibility and aura was enhanced.

Each quickly renewed friendships and acquaintances, visited schools and teachers and demonstrated his own knowledge and coherence with the system. Each belonged. From the standpoint of teachers, as long as the Heroes continued to speak with familiar knowledge, language and empathy for their part in the education system, both Perseus and Theseus were readily accepted in their influential positions. As Head

Office bureaucrats, each was seen to maintain strong links with classroom teachers and the science education community. They were seen to understand schools and teachers.

Science A and B emerged from the thinking of the day but Perseus picked it up. He could persuade teachers. He had a lot of people helping him but he was the one who followed through with it and got it accepted.

(Acrisius, peer of Perseus, interviewed in 1992)

Theseus gave the address and he was so good. It was the range of capabilities that he had. He could go into any environment and really communicate with educators of various levels. He would speak to them as being important and was understood. (Castor, doctoral student with Theseus, interviewed in 1991)

Only when accepted by school science educators as their authority, representative of the culture, was each Hero granted the status by their community to renegotiate some of the understandings governing that culture. As a consequence, as credible "knowers" of insider referents, these heroes were able to become agents of change in their community.

Heroes' Power And Authority Evolves From Insiders And Outsiders

In his unique position in the science community, Perseus was concerned with maintaining the trust of his teachers and approaching new decisions through discussion and persuasion. He was genuinely pleased to be able to help individual teachers and frequently talked paternalistically about *his* teachers. It was satisfying to be able to help people with whom one enjoyed a mutually respectful relationship.

We not only knew them all as teachers but when we went to the country and so on, they took us to their places. We knew their families and their circumstances. (Perseus, recalling his relationship with teachers, interviewed in 1991)

However, in the end changes had to happen. Individuals who resisted or undermined such changes were quickly excluded from the centre of debate. These people missed promotional opportunities, were not invited onto committees and generally marginalised from the centre of the culture. In these ways, Perseus used his informal "insider" organisational power as well as that formal power emanating from his position.

Power? I must admit I continued to use a bit of influence on things. We did make sure the right people were appointed to the right jobs. You had some people who missed out on Head of Department jobs, perhaps their teaching mark wasn't high enough. I myself was responsible for some of that because I'm thoroughly convinced that it's no use trying to do something unless you've got the right people there to do it.

(Perseus, reflecting on his own influence, interviewed in 1991)

While some languished, the majority participated in discussions leading to consensus and sometimes compromise. Certainly by the late 1960s there was a widespread acceptance by the community of the authority and the Superintendent position. Perseus and his early descendants had firmly established the leadership roles of the Superintendent, particularly in the provision of curriculum resources.

Theseus was eager to share many of his broad responsibilities with teachers in a participatory manner. However, decision-making power in the realm of his own central interest of science teaching and learning remained with the Superintendent.

Theseus retained control of changes in science curriculum and its practice. While he wielded this power in what became the content and pedagogy espoused in Achievement Certificate science, the teaching community invested its trust in him to do just that.

The secondary Superintendents were the engine room for curriculum change whether it was science or mathematics or whatever. Most of the initiatives for curriculum change came about because the science Superintendents were committed to it or brought together a group of people who were committed to it. (Theseus, thoughts on curriculum change, interviewed in 1993)

In the science education community, the balance of power remained firmly in favour of the Heroes. Heroes must be able to maintain intimacy and status within their own community as well as the legal authority invested by the bureaucracy. As Superintendents, Perseus and Theseus were the most powerful school science educators in the Education Department. Not only did each carry the power conceded to him by the science teaching community (insiders), but also the legal authority invested through the bureaucracy by the Government of the day (outsiders). This duality of power ensured that each possessed the means by which to push forward new curriculum initiatives as well as deal with dissension.

There was still the feeling around that people thought,
"Well, if the Superintendent says, then we're better off to go that way."
(Acrisius, peer of Perseus, interviewed in 1992)

Heroes Are Called When The Culture Is Threatened

When Perseus and Theseus became the authorities for the school science education culture, each was confronted by new external pressures impacting upon their community. During the 1950s, the rapidly increasing numbers of students accessing secondary school education created a concern for the quality and relevance of the school science curriculum provided for these children.

No-one will ever forget the baby boom years. Opening five new high schools in a year. Big classes, lack of equipment, the big thing was just coping. Coping in terms of numbers, getting desks under kids bums and teachers in front of the class. We had no money so there was just a tremendous boom of children into schools and a growing realisation and concern about what we were teaching. Perseus was singled out by [Zeus] because he needed a methods man, someone mechanistic. He was unsurpassed as an organiser. (Laomedon, teacher and school administrator in the 1950s, interviewed in 1994)

A decade later, the removal of the external examination at the conclusion of year 10 caused new anxiety amongst science teachers.

One thing which had become very evident was that you weren't going to be able to fully adapt curriculum, no matter how good the syllabus development was, you couldn't make it effective for a whole lot of kids at school as long as you were just stuck with the Junior Certificate structure and examination. Debate went on but was brought to a head by another committee report chaired by H.D. Then the anxiety really developed — what would school be like without the Junior? (Acrisius, peer of Perseus, interviewed in 1992)

People expressed all kinds of concerns. How would teachers persuade children to work without the exam? That sort of rubbish. (Helios, peer of Theseus, interviewed in 1993)

In each instance, the members of the existing culture were uneasy because their previously accepted customs were being challenged. While the existing beliefs which formed the basis of their teaching and learning activity in school remained unchanged, science teachers read the classroom signals that some of their current practices were inappropriate. Such critical times provide the opportunity for heroism.

Different ideas began to be discussed. However the Education Department of the day and the communities of teachers within it, continued to expect a common system-wide response which would reach across the State. Whilst individuals and small groups might discuss alternatives, all looked towards their Head Office Superintendents for permission to arrive at the new solutions. Science teachers of the day expected their Superintendent to provide the frameworks within which change might proceed. For the frantically busy classroom teachers, the role of the Superintendent was to find solutions to the issues flagged by their teachers. He had both the time and the resources to piece it all together. Of course, teachers would be happy to provide anecdotes and ideas and possibilities. In this environment, the community consistently looked towards the Heroes for guidance, future directions and details.

Perseus and Theseus are only two of a long line of science Superintendents stretching from 1956 until 1987. Individual science educators have specified a colleague or superordinate or Superintendent who was able to provide personal support or mentoring at a particular time. However, no other persons were recognised as having such a critical and all encompassing effect on the future directions of school science teaching and learning as were these two people. Both Perseus and Theseus were appointed at a time of intense speculation and unease with respect to the future

directions of school science curriculum. Few other Superintendents or individuals belonging to the culture were ever in the position to either rise to similar critical challenges from outside the community, or to gain such broad acceptance for an original solution to meet perceived concerns. That each was able to successfully garner community support and commitment to a widely applauded new curriculum was seen as an enormous contribution to the well-being of the culture. Perseus and Theseus were each in a unique position of power and authority in a time of apprehension and threat.

Heroes Conceptualise New Myths

In seeking to ease disharmony, Perseus and Theseus were fitting heroes. Both were insiders of the science teaching culture and as such held the same fundamental assumptions about school science as their community. They were credible advocates for their culture. Further, each had been able to step outside the culture in their journeys.

In moving away from their cultural home, these change agents had been able to make sense of school science in a different way. The opportunity to remove themselves had enabled the heroes to re-conceptualise the school science curriculum.

I wasn't initially aware of the driving force behind the change to Science A and B. I later came to understand that Perseus was the person, with considerable support from others who were most of the science Heads of Department. I understand that he been to the UK, Europe and the US before returning to Australia and had seen something like it on his travels. (Minos, teacher in the late 1950s and onwards, interviewed in 1991)

Well, then it hit me, that every student in the school, regardless of whether he was the top notch school student or not, should have science. So that science should be taught to everybody. The idea stuck firmly in my head that everyone should have science, but those who had the ambitions with it did a different science. Science A became the broad one that everybody should have and Science B was the one which prepared people for University work. (Perseus, reflecting on the idea of Science A and B, interviewed in 1991)

Well, then Theseus arrived back from America. He immediately saw this major change in course structure as a suitable time to make changes in the way science was taught in the classroom. The new materials would stress a laboratory centred approach to teaching science. (Chiron, teacher in the Curriculum Branch in the late 1960s, interviewed in 1993).

And the other thing we tried to do with the Achievement Certificate science was to change the process of teaching. To change the model of instruction in school science classrooms from didactic to enquiry, hands-on science. (Theseus, reflecting on the Achievement Certificate, interviewed in 1992)

When Perseus and Theseus reviewed the challenges faced by their community of teachers, each conceptualised a response which included unfamiliar and different practice.

Superintendents were charged with the job of implementing something as the public sign of a response. Much of this is or was the natural evolution of where each is at. (Jason, a Superintendent in the 1980s, interviewed in 1993)

Working with the creative members of their communities, both Perseus and Theseus had the diversity of experiences and understanding to bring into being new beliefs about school science learning and teaching. Before the participating members of the community could change their own classroom practice, each would need to accept these new understandings about science curriculum.

Heroes Enhance Change By Harmonising New Referents With The Old

Each change process was similar. Initially, in reacting to external changes the insider community felt its practice threatened. The Heroes were able to conceptualise new referents for modified practice. Then, through symbolic images communicated by the Heroes and their warriors as stories, rituals and artefacts, these new referents were linked with existing beliefs.

I think this was the first time that I had ever heard the (now) cliches such as "Science for All" and "Science for Citizenship." In those times these were powerfully persuasive arguments towards social equality as well as upgrading the perceived importance of science. (Minos, teacher in the late 1950s, interviewed in 1992).

I have no doubt that it was the group of people in Curriculum Branch who had a great impact. We brought together people who were committed to Achievement Certificate. Like G. He didn't have a lab assistant so the reaction to him from teachers was interesting. I can remember them asking him questions and he saying, "I arrive half an hour before school, that's all I need to get organised." He was quite influential because it was impossible to see what he was doing and then say it could not be done. (Theseus, discussing an exemplary teacher of the 1970s, interviewed in 1993)

The skill and challenge for each Hero was to be able to provide that bridge between existing understandings and those destined to become the additional referents of the future. As consistent stories and myth making permeated the culture, the members reached consensus, committed themselves to these new referents and adjusted their practice accordingly. The new and pre-existing referents had become indistinguishable. In building upon their insider knowledge and authority, each Hero harmonised new beliefs with the old.

Heroes Communicate New Myths As Insiders

Endowed with authority and power, these credible insiders then worked hard to communicate their new concepts to the community. In doing so, neither Hero undermined other existing referents. Science teachers understood that science knowledge had value. In the centralised system, science teachers continued to regard Head Office as the source of teacher support. Both built further upon these beliefs.

Perseus was an organisation man. All he wanted was a rational system which teachers could understand and they could support. His reform was at the margin, designed to retain as far as possible the familiar and just make a little bit of change at the edge. Perseus was genuine. He wasn't a stuffy eleven plus bloke at all. He would feel he had a mission to give science to everyone because everybody should have it.

(Laomedon, teacher and school administrator in the 1950s and onwards, interviewed in 1994)

But when it came down to it, Science A and B was very familiar, like re-arranging the deck chairs. Science B was really the old physics and chem courses, and Science A the biology and bits of physics and chem with the maths taken out. (Acrisius, peer of Perseus, interviewed in 1992)

Then along came the Achievement Certificate and really the content didn't change much but what changed was the philosophy and the external exams had gone, and that was a big plus. And of course, we had all of the booklets and materials! I used to say to my lot, luxury, luxury! We had a start and we didn't have to reinvent the wheel. It was wonderful!
(Cronus, about teaching in the early 1970s, interviewed in 1993)

The Heroes created a pattern of rituals and ceremonies within which the stories illustrating the new understandings might be shared. The school visits, Heads of Department meetings and ad hoc committees provided opportunities for discussion, debate and meaning making. Using familiar language and knowledge, existing rituals and working with accepted understandings, the Heroes were able to successfully weave the new referents into the fabric of the old.

Heroes Move The Culture Towards Consensus And Commitment

Throughout the ritualised opportunities for discussion, debate and clarification, the members of the culture reviewed their understandings.

Perseus — his strength was his weakness. Perseus was the most boring man I knew. He had an active mind and he would look at a range of options like a computer. He'd look at all of the possibilities as he went along chucking them out one by one. Rejecting things I'd never have thought of. But the point was that we always got to his end point long before he did.

Boring all as it was, he always got the "right" answer and by the time he'd laid it all out for you, you knew that this was the way to go. He had an unsurpassed capacity to put order into chaos and convince anyone that

they couldn't sort them out any better. (Laomedon, teacher and school administrator in the late 1950s and into the 1960s, interviewed in 1994)

Theseus was smooth like custard. I call it naivety but it might have been something else, like self protection. (Laomedon, teacher, school administrator and Head Office positions from 1970s, interviewed in 1994)

So it was just six of us at dinner and he (Theseus) mentioned to me that he so enjoyed being in a place where it was just old friends and he could be himself — which he generally couldn't do. (Castor, peer and friend of Theseus, interviewed in 1991)

In moving towards consensus, different people saw the persuasive role of the Heroes in variable lights.

Basically Superintendents are charged with a job to take leadership and to want a change to occur. Many people are with you. But do you sit back and wait until another group values the change sufficiently to do it? You might wait until hell freezes over! So you push and coerce and model. Reward, modelling, pushing a line — it's what we do when we want change! (Jason, Superintendent in the 1980s, interviewed in 1993)

Inexorably the culture moved towards consensus. The continued conversations about understandings and beliefs about school science and teaching and learning were pivotal to this transition.

In any change scenario we have to invest time in talking about our feelings and values about the new directions. We always have done this, but in the future maybe we need to spend even more. At some point though, you do

have to draw the line and say, "Hey, barlees, if you don't value it, the system is going this way, so get out of the system." (Jason, Superintendent in the 1980s, interviewed in 1993)

Gradually members of the community modified their perceptions to align with those espoused by the Hero. As a community, new shared understandings were reached. With consensus came commitment to the new referents underpinning school science knowledge and practice.

This community commitment translated further into the production of artefacts for teacher support. Of importance to this culture, these artefacts were written, developed and communicated by credible cultural insiders, experienced outstanding science teachers — warriors who then expounded the new beliefs to teachers more distant from the centre. The Superintendent's customary organisation of artefact production by cultural insiders acted to further consolidate the negotiated power and authority of each Hero.

Conclusion

The purpose of exploring the stories of Perseus and Theseus is to make sense of two instances of State-wide changes in school science curriculum. These influential science educators were identified by their colleagues as being the change agents primarily responsible for the effective implementation of new curriculum. In the context of this study the contemporary Perseus and Theseus have been nominated as heroes. In the recounting of their tales, the reiterative nature of the change process emerged.

The similarities between the qualities, knowledge and practices of each Hero made it possible to recognise commonality in the processes by which each ensured that new referents permeated the culture. These examples of successful changes in the beliefs and classroom practice of a discrete, isolated culture owe much to the combination of circumstances existing at the time. In each instance, the presence of a Hero was identified at a time of uncertainty in the culture.

In order to have the right to re-negotiate the referents and customs of the community, the Heroes exhibited a number of common attributes. The advantage of combining the power and authority bestowed by a culture alongside that promoted by the bureaucracy ensured that each Hero had insider knowledge of the culture as well as the legal authority within which to act. The introduction of new beliefs and insights by Perseus and Theseus was so effective precisely because each was a credible and powerful member of the culture.

To be a hero, one must have a boon to bestow. Both Perseus and Theseus possessed understandings about school science and its practice which were in addition to those of their fellow community members. In communicating these referents both created a pattern of rituals, ceremonies and artefacts. Through these opportunities each Hero was able to weave the new referents into the fabric of the old. The members of the community gradually modified their understandings to align with those of the heroes. Thus, in these contemporary contexts, the repetitive character of the change process is clearly defined.

CHAPTER 7

SO WHAT? CHANGE IN THE POST MODERN WORLD

This study has become a mirror of my own search to clarify the process of cultural change in an educational setting. In listening to the stories of senior members of the science education community, I accepted their view that significant and effective school science curriculum reform had occurred in the late 1950s and again in the late 1960s. I have tried to explicate the common features of the process by which the teaching and learning of school science was re-fashioned at each time. The assertions in Chapter Six exemplify my own understanding of how these examples of successful cultural changes progressed.

Since taking up the position of principal in a newly established lighthouse school in 1995, my collegial network across our State Education Department has expanded. I have maintained my links with the science education community through my membership of the science teacher association and participation on committees of the State curriculum certification authority. My continued interaction with colleagues involved in further study provides yet another opportunity to engage with members of the science education community. However, I am also developing my association with school principals and administrators through my membership of the local principals' association. I now feel as if I belong with colleagues from both the science education and principals' communities. These feelings of connection and community have their roots in the similar activities, conversations and experiences in which my colleagues and I participate.

In my practice as a school leader my actions reflect my beliefs about the attributes of being a good principal. In relating to colleagues discussing or working with science curriculum, I draw upon another, sometimes overlapping, set of beliefs. In the frantic

activity of each day I rarely think consciously about which beliefs underpin my decisions. These beliefs are deeply-held unquestioned understandings. These are my referents. In overhearing the conversation about collaborative curriculum planning between David and Diane, described in Chapter Two, I was reminded of, and a little confronted by, the resilience of referents as the powerful organisers of my own culture. I now recognise that these resilient referents must be attended to whenever a change in practice is to proceed. As identified in the curriculum change process described throughout this text, it is the cultural referents which are being modified, or added to, or removed for changes in action to follow. The enterprise of a credible Hero was significant in promoting the changing of referents in each instance.

During the course of this study I have become increasingly aware of links between it and my daily work. Whether working with school colleagues in developing school structures or curriculum, I began to recognise parallels between my own practice as an agent of change and that of Perseus and Theseus. In general, I believe that contemporary educators have failed to learn from earlier examples of successful change. The challenge I believe, is how to translate these previously effective and successful change processes into appropriate applications for the present. It is the explication of this translation, which becomes the *So What?* of this study.

The Changing Context of the 1990s

The "Big Picture" Change

At the coalface of teaching and learning, I am very aware of the community perception of advancing societal change (Naisbitt, 1990). For some time now I have read the reports of popular media, business people, politicians and scholars about the progress of our Western culture from an industrial age to an information age. Such understandings impact on community expectations for changes in the nature of school

education. However, there has been limited modification in our schools during this century. Across the Western world the early twentieth century reforms of school structure and curriculum continue to dominate the way in which the school is regarded. These early reforms rested upon the understandings of social efficiency of the time, which directed school students towards predetermined social roles as adults.

Our schools are, in a sense, factories in which the raw products (children) are to be shaped and fashioned into products to meet the various demands of life. The specifications for manufacturing come from the demands of twentieth-century civilisation, and it is the business of the school to build its pupils according to the specifications laid down. This demands good tools, specialised machinery, continuous measurement of production to see it is according to specifications, the elimination of waste in manufacture and a large variety in the output. (Cubberley, 1916, p. 338)

Compare Cubberley's statement with a recent statement about the current situation in American schools, made by San Diego City Schools Superintendent, Thomas W. Payzant.

Most schools in America are structured today much like the schools that existed at the turn of the century. Functioning as modern factories, they select, sort, grade, and process students. There is an assembly-line process that propels those who participate through a maze that successfully negotiated leads to annual promotion and ultimately a high school diploma. Too many fall off the assembly line. We call them drop-outs. (Sergiovanni, 1990, p. 2)

Many of my colleagues would argue that Australian schools are organised upon similar lines, with too many students finding achievement at school irrelevant or

unattainable. This *school as a factory* referent for secondary school education has endured throughout this century and continues to inform much of twentieth century school reform. However, along with fellow educators I increasingly participate in debates in the wider community which question whether our traditionally organised schools and school curriculum are delivering the kind of educational outcomes pertinent for our society of the next century.

In seeking school and school curriculum solutions appropriate to the needs of people able to live and work in a future information age rather than the passing industrial one, I find that I am inundated with articles from the popular media, education journals and the local Education Department. It seems to me that while much of the population may agree on the need for different schooling in the future, our difficulty lies in clarifying just what this schooling might look like. Commentators such as Caldwell & Spinks (1992), Fullan (1993), Hargreaves (1994) and Sergiovanni (1990, 1984) recognise the impetus for change and offer a number of solutions including the empowerment of school professionals, improved accountability measures, parental support, different curriculum and new structures. Across Australia each state is now implementing a variety of new procedures and structures reflective of these solutions. This diversity of responses is confusing to teachers as well as the local community. Hargreaves (1994) identified this layer of uncertainty as arising from the societal shift from a modernistic to a post-modernistic paradigm. He reasoned:

..the challenges and changes facing teachers and schools are not parochially confined to education but are rooted in a major sociohistorical transition from a period of modernity to one of post modernity. Schools and teachers are being affected more and more by the demands and contingencies of an increasingly complex and fast-paced, post modern world. (Hargreaves, 1994, pp. 23 - 24)

As society moves towards different understandings of what constitutes value, including value in education, so will schools and school systems try to respond to these pressures with changes in structures, curriculum and ways of working. Cuban (1990b) has warned that as school-based educators and others in our community try to make sense of these changes, reform should not necessarily expect to create improvement. The process of change in education is far more complicated than merely rearranging people and responsibilities. However, I continually hear current policy makers explain that it is the search for improvement (in student outcomes) that drives the structural and curriculum adjustments in the State Education Department.

Change In My State Education Department.

My State education system has been in a continuous flux of restructuring since 1988. New Ministers of Education, Chief Executive Officers and Director Generals have each contributed to the general instability as each searches for his or her own balance of State-wide curriculum initiatives, central and school-based decision-making, funding arrangements, human resource policies and quality assurance. Over the past ten years I have observed that while school resources and staffing levels have remained almost untouched, the Education Department's Central Office and District Offices have become the sites of continual reorganisation of power and people. For instance, the Central Office subject superintendent position which disappeared in 1988 reappeared in 1995, only to disappear again in 1997. In the struggle to define an appropriate school system for the future, my State Education Department has dismantled long-standing structures and moved personnel away from the centre. More recently, the redefinition of this State's education processes has included the construction of a newly-mandated curriculum framework deemed to meet the future needs of students. This latest curriculum undertaking overturns an earlier State-wide curriculum initiative adopted in 1988. It is clear to me that in working to meet the perceived changing needs of children in education, this system is not reverting back to

the traditionally acceptable structures of the past, nor is it retaining much of its recent organisational innovation (Hargreaves, 1994).

The organisational changes overtaking my local education system seem to reflect an international trend. For example, as a principal, I now enjoy a considerable degree of autonomy in our schools' decision-making. In concert with this new-found power over the expenditure of budgets, selection of staff and general resourcing are increasingly specific requirements for the reporting of school outcomes. Schools now have substantial independence in determining school budgets and organisation, leaving Central Office to be concerned with explicating precise accountability policies.

Another quite different trend that I have recently heard from members of my own school community relates to parents' concerns for their children. These parents ask teachers to adopt innovative teaching and learning practices so that their children might manage the complexities of adulthood more effectively. This same parent group also articulates the need for school curriculum to return to the basics of the three R's in tuition. Teachers are requested to provide flexibility and new experiences while also spending more time on previously accepted disciplines of the past.

Such trends are contradictory and confusing. With increasing decentralisation of decision-making comes greater central control. New learning experiences for students to be added to more of the old. These stances represent two of the many paradoxes with which my education community is now confronted. I find some insight into this new context reflected in Charles Handy's (1994) work, *The Empty Raincoat*. Handy's articulation of paradox as being a challenge to my generation seems especially relevant.

The acceptance of paradox as a feature of our life is the first step towards living with it and managing it. We can .. and should reduce the starkness of some of the contradictions, minimise the inconsistencies, understand

the puzzles in the paradoxes, but we cannot make them disappear, nor solve them completely, nor escape from them. Paradoxes are like the weather, something to be lived with, not solved, the worst aspects mitigated, the best enjoyed and used as clues to the way forward. Paradox has to be accepted, coped with and made sense of, in life, in work, in community and among the nations." (Handy, 1994, pp. 17-18)

The concept of paradoxes provides some appreciation of the apparent chaos of change. "Chaos in a scientific sense is not disorder, but a process in which contradictions and complexities play themselves out coalescing into clusters" (Fullan, 1993, p. 18). My sense is that the public identification of such contradictions may help minimise the anxiety that they engender. In this way the management of each paradox may be shared and school change able to go forward. In the context of this study, the clarification of these contradictions brings into sharp focus the difference in conditions between our 1990s school education community and the period from the late 1950s to the early 1970s.

The Change Process In The 1990s

For this study to be of value, I have to pose the question, "How can I apply the learnings from my study to the change process today?" For me, this is the paramount *So what?* question.

Referents, Stories, Rituals and Artefacts

A central feature of my understanding of cultural change is the critical role of referents in shaping the practice of a culture. My study has shown that it is the cultural referents which need to be modified, added to, or removed in order for changes in action to follow. In this inquiry such changes were facilitated by the initiative of a credible Hero.

Although schools and teachers today operate within a somewhat different framework than that of twenty or more years ago, classroom practice remains remarkably similar. Through their participation in similar activities, experiences and conversations, teachers today continue to make up a community of educators. It is the most fundamental of their shared understandings, the teachers' referents, which underpin professional practice in schools.

The referents identified in Chapters Three and Four, such as science knowledge for all school students, science teachers as experts, science as rigorous knowledge and as a process, science pedagogy as laboratory centred and hands-on, school science assessment as comparable, are still present in the conversations and actions of local science teachers. In particular, I consistently see the teacher as expert referent as representative of the beliefs of many teachers in my school system. This referent alone has the capacity to either sustain or obstruct the community acceptance of adjustments to its existing belief structures. It is these enduring referents which successful change agents must acknowledge and take advantage of, when embarking upon any cultural change process.

While heroes promoting changes in practice in the future must be cognisant of the referents already existing in the culture, the value of story and ritual in supporting the dissemination of new referents should not be overlooked. Both Perseus and Theseus

used stories to explicate successful practice, embellishing these with the deeds of colleagues, incorporating local knowledge and understandings as well as familiar language. In establishing rituals such as individual visits, committee structures and whole group meetings, Perseus and Theseus provided opportunities to debate new understandings one to one, in small groups and as a large community. Their reiterative process included the retelling of successful stories, discussing and debating different understandings in a variety of informal and formal public settings and then modifying some of these ideas ahead of further stories and debates. Through stories and rituals the science community of the past shared similar referents across the diverse geography of the State. In learning from the success of these earlier heroes, the use of stories and rituals provide an entertaining, non-confrontational approach for the participants of future communities to examine and perhaps adopt, new and different referents and practice.

Both Perseus and Theseus found the production of artefacts helpful in further cementing changes in schools. Through the provision of practical artefacts which supported the new curriculum and built upon the teacher as expert referent, they each helped to make the new practice manageable. In any future change process, support to make new experiences amenable, will increase the commitment of the community. For some participants, achieving success in the new practice will itself modify older referents.

Although several decades have passed since the exploits of Perseus and Theseus, the techniques by which each promoted the modification of referents in his culture remain relevant for today's change agents. Stories, rituals and artefacts are the mechanisms through which cultural change may be advanced.

Do We Need Heroes Today?

The change process today must reflect the context of today's culture. Work and workplaces have modified over the past three decades, as have some community referents and understandings. With the fragmentation of responsibilities from the once monolithic Head Office of the Education Department into District Offices and decentralised school centres, it is increasingly difficult to visualise any one hero being as influential as Perseus and Theseus. On initial reflection, it is tempting to renounce the significance of a hero and accept the advice given by Block (1987).

Cultures get changed in a thousand small ways, not by dramatic announcements from the boardroom. If we wait until top management gives leadership to the change we want to see, we miss the point. For us to have any hope that our own preferred future will come to pass, we provide the leadership.

(pp. 97-8).

The manager quoted by Block has become empowered in decision-making and creating new and legitimate policies and practice for the workplace. Ironically, while he rejects the elitist, *top management as hero* metaphor, Block himself is acting as a kind of hero leader for the organisation through his own writings. Already in Chapter Five I have discussed the continued need for organisations to have a hero leader. Senge (1990) reiterates the expectation that cultures will have leaders but calls for present-day heroes or leaders to be different from those of earlier times.

Our traditional views of leaders — as special people who set the direction, make the key decisions and energise the troops — are deeply rooted in an individualistic, non systemic world view. Especially in the West, leaders are heroes - great men (and occasionally women) who "rise to the fore" in

times of crises. Our prevailing leadership myths are still captured by the image of the captain of the cavalry leading the charge to rescue the settlers from attacking Indians. So long as such myths prevail, they reinforce a focus on short-term events and charismatic heroes rather than a systemic forces and collective learning. At its heart, the traditional view of leadership is based on assumptions of people's powerlessness, their lack of personal vision and inability to master the forces of change, deficits which can be remedied only by a few great leaders. (Senge, 1990, p. 340).

Many Australian cultural understandings differ from those of North America, including that of the hero-chief charging forth. Heroes such as Perseus and Theseus were perceived to have led from-the-front through having consulted and persuaded and shared understandings in a manner different from that of Senge's traditional hero leader.

Despite his criticism of the traditional hero leader, Senge conceptualises a new kind of organisation — called the learning organisation — which is being led by individuals with a diverse range of skills.

While traditional organisations require management systems that control people's behaviour, learning organisations invest in improving the quality of thinking, the capacity for reflection, team learning and the ability to develop shared visions and shared understandings of complex business issues. It is these capabilities that will allow learning organisations to be both more locally controlled and more well coordinated than their hierarchal predecessors. (Senge, 1990, p. 287).

Leaders in learning organisations have the ability to conceptualise their strategic insights so that they become public knowledge, open to challenge and further improvement. (Senge, 1990, p. 356).

The new view of leadership in learning organisations centres on subtler and more important tasks. In learning organisations, leaders are designers, stewards and teachers. They are responsible for building organisations where people continually expand their capabilities to understand complexity, clarify vision and improve mental models - that is they are responsible for learning. (Senge, 1990, p. 340).

Theorists like Senge (1990), Fullan (1993), Sergiovanni (1990, 1984) and Stacey (1992), assert that a hero leader is integral to the process of successful change in a culture. As a result of my study, I too understand the significance of a hero in advancing new ways of doing things. Whether the change in beliefs and practice occurs amongst a small group of people (as in just one school) or a larger community (made up of several schools or a district), a credible, influential change agent is critical in enabling the process by which new or modified referents merge with existing referents. This hero employs diverse strategies to mentor, coach, support and persuade and even coerce until the whole group adopts a new shared understanding.

The Time And Place To Find A Hero?

A Time of Crisis

My journey in history has indicated that significant change occurred when a culture became anxious and threatened. It is at this time that heroes become essential to the community. This belief is echoed by Calder (1977, p. 194), "Heroic leaders are most likely to emerge when there is strong community feeling: oppression, danger or

frustration." Senge (1990) also suggested that traditional leaders became prominent in times of crisis. In such circumstances, school and system educators of the past looked for new practices more appropriate for their changed environment.

The 1990s represents another time of overwhelming challenge. Already the frequent restructuring of Central Office and District Office responsibilities and personnel has created apprehension amongst my teacher community. With the advent of a newly mandated, State-wide curriculum framework there is a shared understanding amongst my teacher community of imminent change in school curriculum — especially in its pedagogy and assessment. Teachers in schools are expressing feelings of anxiety and uncertainty. In this context, the time is appropriate for the emergence of new heroes. However, where will these heroes be found?

A Place in Our System

In my recently re-organised State Education Department, I can no longer envisage a position for a central curriculum Hero or change agent. Central Office subject superintendency has disappeared as have all curriculum development positions. The people now inhabiting this office have policy-making powers rather than operational authority. Their responsibilities include overseeing school budgeting frameworks and the policy relating to how often schools should report student achievement to parents. In some positions, role descriptions specifically forbid visiting or working with school-based personnel. Without direct access to the participants of school and classroom practice, it is difficult to imagine a "remote control" change agent successfully introducing new curriculum action. In keeping with my culture's continuing referent of teacher as expert, I expect contemporary heroes to emerge from locations which have the ability to link closely with school practice.

It is informative to reflect on the previous practice of my own education system, before the institution of the Superintendency as a position of power. Until that time the local science teachers' association and its executive initiated and promulgated new understandings about curriculum directions (White, 1993). Amongst the science teacher community new ideas were debated, re-worked, discussed and finally presented to the central bureaucracy. In the 1990s, participants in the same professional association have the cultural knowledge and access to teachers to become the hero or heroes of the future.

The community of school and science educators to which I belong, is large. It is conceivable that at any time a number of individuals will have new beliefs about improving the work of teachers in the new structures and framework. In this recently devolved, self-managed school system, locally-based heroes will become the change agents for the local community. Different heroes will be recognised as each provides an appropriate and original solution for each one of the numerous challenges ahead. Not only might the community expect to recognise more than one hero located close to the school experience, but also accept that these people might not be from experienced and senior ranks of the profession. In this time of rapid change, heroes will not be created solely amongst the hierarchal promotional positions in the school system. It is possible that many local individuals will have a variety of problem solving understandings perceived to meet the new challenges. It is when one of these people resolves to change the group and improve community practice that he or she will embark on the journey of a hero.

What Is A Credible Hero In The 1990s?

Insider Credibility

Not only must this Hero be a person with some new, relevant and different understanding about the way to do things, but that person must have credibility within

the community. He or she must be seen to bring with him or herself, "insider" knowledge — a set of beliefs about teaching and learning generally congruent with that of the existing teacher community. This person must have a clear understanding of the circumstances surrounding the communal desire for change and as a consequence will communicate using familiar language, stories and rituals.

Where new practice and understanding relates to work in schools, the hero is increasingly unlikely to be found outside the school culture. I can already hear my own colleagues' voices whenever I have suggested that we consult with another experienced person from Central Office, District Office or a university. "S/he wouldn't know, S/he lives in Club Med. It needs to be someone who understands working with our kids." For most teachers in my State, credibility is linked with recent school-based experience and the teacher as expert referent.

Recent appointments to the Central Office have included people from other states of Australia and overseas. Whilst some understandings about teaching and learning are similar, many are not. Initially, when these newly-arrived individuals address school personnel, they communicate with stories and language unfamiliar to the members of the existing community. Their words and meanings were quickly discounted as of little value as local participants react to the alien phrases and understandings and referents. Yet these newcomers do bring to us new referents which may well support appropriate change for our local culture. However, for as long as these strangers are regarded as lacking in credibility, their referents will remain unheard. Over time, some may become credible as each learns more about the local rituals, artefacts, stories and understandings. Until that time, his or her ability to create cultural change in our community will be severely limited.

Outsider Credibility

In self-managed schools and school districts, outsider support as was reflected through Head Office no longer has the same relevance as in earlier decades. Today, schools and school districts are being encouraged to work more independently, on the proviso that each remains within the broad policy framework promulgated by the Central Office. However, in order to effect school or district change, any new hero must also find credibility amongst administrators — school Principals and other district Superordinates. However, many classroom teachers regard these administrators as outsiders. If the district or school community is to adopt new practices, the patronage of such outsiders is important. While the persuasion of each and every staff member is the ultimate goal, the assistance and public advocacy for change from administrators is invaluable. These people do possess the power to negate any school curriculum or organisational change deemed (by them) to be inappropriate. Thus a successful hero will have influence within the established authority structure of schools. It is the assurance that school administrators will not act against the new understandings which is critical.

Communication In The 1990s

As Senge (1990) suggests, contemporary heroes will articulate and make public their insights and proposed directions. New ideas will be challenged by teachers who continue to ascribe to the teacher as expert referent. However, future heroes need to test new concepts publicly, listen to criticisms and modify where necessary. Following this comprehensive scrutiny, heroes will then provide models and supportive structures to create a safe transition in practice. Persuasive and open communication on the part of these influential individuals will support the harmonising of new referents with the old.

More than ever before, time must be spent in consulting, disseminating, challenging, supporting and persuading members of the community. In today's world, these debates may happen in a variety of ways. Several of our local University graduate student groups and alumni continue to meet formally and informally in order to discuss new education possibilities. Within some Districts, District Office personnel and teachers have set up their own networking collegial groups. At irregular intervals, Commonwealth Government initiatives provide professional development monies to support collaborative work between schools both locally and nationally. These opportunities for continuing conversations amongst teachers enable the participants to test new ideas and understandings, recast and reorder to develop new ways of doing things which may be viable at one or many schools. After comprehensive discussion, new ideas can be taken back to schools and districts for further discussion and dissemination.

The local science teachers' association has been particularly effective in establishing its own rituals to enhance the shared understanding of its referents across all education systems in the State. This association continues to promote frequent meetings of science teachers, school related professional development opportunities for science teachers and an annual conference modelled on the pre-existing Heads of Department meetings. The association also produces its own artefacts in the form of locally written and produced science classroom texts as well as a teachers' journal. Already, in keeping with the information age, the association has its own web site and e-mail discussion group. Communication and debate amongst the geographically disparate members of this science teaching community is convenient and achievable in the 1990s. Heroes of the future will need to explore every available communication strategy to ensure access to the members of his or her community.

Consensus and Commitment In The 1990s

The consensual commitment to work differently happens only when each participant in the culture accepts the new referents and practice as reflective of the way in which each approaches the curriculum. As affirmed earlier, teachers do what they do because it makes sense to them. At the instigation of a credible hero, in a time of great anxiety, the communication of new understandings has to make sense before individuals will change their practice.

Fried (1995) views teaching as a profoundly emotional activity. In order to accept new referents, or modify existing ones, it is teachers' passion about what is meaningful in teaching which must also affirm new beliefs. Rational, well-structured argument and organisational outlines will not be sufficient to create commitment from individual teachers. In communicating with familiar language and vivid stories which embody the value of his or her referents, a hero must arouse teachers' reasoning and affective awareness. When each teacher grasps new referents as significant and able to satisfy his or her need for appropriate and satisfying practice, commitment to change will ensue.

Conclusion

It was Perseus who observed:

Ours was the battle of the plan, science for all. But it must change because the people who have to teach and those who have to learn will change, and that is to be expected. (Perseus, reflecting on curriculum change, interviewed in 1991)

In his own journey, Perseus recognised that every teacher brought to his or her practice a set of unique understandings. Each teacher is a different person. Nonetheless, as revealed by this study, new participants continue to share many of the enduring education community referents about the practice of teaching and learning. Each participant then, brings to classroom action a blend of shared and other referents. It is the combination of these referents which informs each person about his or her own inimitable practice of teaching.

At what seems to me to be increasingly frequent intervals, the education community is subject to calls for changes in schools and school curriculum. These demands create uncertainty and apprehension amongst school educators. At such times of crisis, it is those individuals with diverse beliefs and understandings about school and school curriculum, who provide potential solutions to address the perceived challenges. The presence of these individuals is critical to the capacity of the community to effectively manage change. Perseus understood that each culture must value its new (often youthful) participants because it is these newcomers who provide access to new beliefs about different ways of doing things.

Amongst the members of each education community then, are many shared referents and some diverse. These are reflected in teacher action. In an environment of anxiety, an individual may recognise his or her action as particularly appropriate and seek to modify the practice of his or her colleagues. This person will act in a variety of roles in an effort to induce participants to adopt new customs. It is the manoeuvring to change community understandings and actions, which identifies a change agent. In effect, this individual is "bestowing a boon" on fellow members of the community. As heroes or leaders such individuals and their actions will be critical to any future process of change in the practice of teaching and learning.

REFERENCES

- Barthes, R. (1972). *Mythologies*. (A. Lavers, Trans.). New York, NY: Hill & Wang.
- Bauman, Z. (1987). *Legislators and interpreters: Modernity, post-modernity and intellectuals*. Ithaca, NY: Cornell University Press.
- Block, P. (1987). *The empowered manager*. San Francisco, CA: Jossey-Bass.
- Blumenfeld-Jones, D. (1995). Fidelity as a criterion for practicing and evaluating narrative inquiry. In J. A. Hatch and R. Wisniewski (Eds.), *Life history and narrative* (pp. 25 - 35). London, UK: Falmer Press.
- Bolman, L. G. & Deal, T. E. (1991). *Reframing organizations: Artistry, choice and leadership*. San Francisco, CA: Jossey-Bass.
- Bower, M. (1966). *The will to manage: Corporate success through programmed management*. New York, NY: McGraw-Hill.
- Bruner, J. (1985). *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.
- Calder, J. (1977). *Heroes*. London, UK: Hamish Hamilton.
- Caldwell, B.J. & Spinks, J.M. (1992). *Leading the self-managing school*. London, UK: Falmer Press.
- Campbell, J. (1949). *The hero with a thousand faces*. Bollingen Series XVII. New York, NY: Pantheon Books.
- Campbell, J. (1988). *The power of the myth*. New York, NY: Doubleday.
- Carter, K. (1993). The place of story in the study of teaching and teacher education. *Educational Researcher*, 22 (1), 5 - 12.
- Cobern, W. W. (1991). *Worldview theory, science education research* (NARST Monograph No. 3). Manhattan, KS: Kansas State University.
- Connelly F. M. & Clandinin D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19 (5), 2 - 14.

- Cremin, L.A. (1961). *The transformation of the school: Progressivism in American education, 18876-1957*. New York, NY: Alfred A. Knopf.
- Cuban, L. (1990a). Reforming again, again, and again. *Educational Researcher*, 19 (1), 3 - 13.
- Cuban, L. (1990b). A fundamental puzzle of school reform. In A. Lieberman (Ed.), *Schools as collaborative cultures: Creating the future* (pp. 71-77). London, UK: Falmer Press.
- Cubberley, E.P. (1916). *Public school administration*. Boston, MA: Houghton Mifflin Company.
- Deal, T. E. & Kennedy, A. A. (1982). *Corporate cultures*. Reading, MA: Addison-Wesley.
- Eisner, E. W. (1994). *The educational imagination* (3rd ed.). New York, NY: Macmillan.
- Emihovich, C. (1995). Distancing passion: narratives in social science. In J. A. Hatch and R. Wisniewski (Eds.), *Life history and narrative* (pp. 37 - 48). London, UK: Falmer Press.
- Feyerabend, P. (1995). *Killing time*. Chicago, IL: University of Chicago Press.
- Foucault, M. (1980). Power/Knowledge. In C. Gordon (Ed.), L. Marshall, J. Mepham, K. Spoer (Trans.), *Selected interviews and other writings 1972-77*. New York, NY: Pantheon.
- Fried, R. (1995). *The passionate teacher*. Boston, MA: Beacon Press.
- Fullan, M. (1993). *Change forces*. London, UK: Falmer Press.
- Giroux, H. A. (1981). *Ideology, culture and the process of schooling*. Philadelphia, PA: Temple University Press.
- Goodson, I. (1992). Studying school subjects. *Curriculum Perspectives*, 12 (1), 23 - 26.
- Guba, E. G., & Lincoln, Y. S. (1989). *Personal communication*. Beverly Hills, CA: Sage.

- Hargreaves, A. (1994). *Changing teachers, changing times: Teachers' work and culture in the postmodern age*. London, UK: Cassell.
- Handy, C., (1994). *The Empty Raincoat*. London, UK: Hutchinson.
- Hatch, J. A., & Wisniewski, R. (1995). Life history and narrative: questions, issues and exemplary works. In J. A. Hatch and R. Wisniewski (Eds.), *Life history and narrative* (pp. 113 - 135) London, UK: Falmer Press.
- Hawkesworth, M. E. (1989) Knowers, knowing, known: feminist theory and claims of truth. *Signs: Journal of Women in Culture and Society*, 14, 533 - 557.
- Kisly, L., (1976) 'Living Myths: A conversation with Joseph Campbell. *Parabola*, 1 (Spring 1976), 70 - 81.
- Kliebard, H. M. (1992). *Forging the American curriculum: Essays in curriculum history and theory*. New York, NY: Routledge.
- Kliebard, H.M. (1988). *The struggle for the American curriculum 1893 - 1958*. Boston, MA: Routledge & Kegan Paul.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago, IL: University of Chicago Press.
- Lakoff, G. & Johnson, M (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.
- Lincoln, Y. & Guba, E. (1986) But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. In D. D. Williams (Ed.), *Naturalistic evaluation* (pp. 73 - 84). San Francisco, CA: Jossey-Bass.
- Lyotard, J-F. (1984). *The postmodern condition: A report on knowledge* (Trans. G. Bennington). Manchester, UK: Manchester University Press.
- Makler, A. (1991). Imagining history: "A good story and a well-formed argument." In C. Witherell and N. Noddings (Eds.), *Stories lives tell: narrative and dialogue in education* (pp. 29 - 47). New York, NY: Teachers College Press.
- Mossenson, D (1972). *State education in Western Australia 1829 - 1960*. Perth, Western Australia: University of Western Australia Press.

- Naisbitt, J. (1990). *Megatrends 2000: Ten new directions for the 1990's*. New York, NY: Morrow.
- Nussbaum, M. C. (1986). *The fragility of goodness: Luck and ethics in Greek Tragedy and philosophy*. Cambridge, UK: Cambridge University Press.
- Polkinghorne, D. E. (1995). Narrative configuration in qualitative analysis. In J. A. Hatch and R. Wisniewski (Eds.), *Life history and narrative* (pp. 5 - 23). London, UK: Falmer Press.
- Peshkin, A. (1985). Virtuous subjectivity: In the participant-observer's eyes. In D. Berg and K. Smith (Eds.), *Exploring clinical methods for social research* (pp. 267 - 281). Beverley Hills, CA: Sage.
- Ricoeur, P. (1991). *From text to action: essays in hermeneutics, II* (Trans. K. Blamey and J. B. Thompson). Evanston, IL: Northwestern University Press (original work published 1986).
- Ricoeur, P. (1984). *Time and narrative: Vol I* (Trans. K. McLaughlin and D. Pallauer). Chicago, IL: University of Chicago Press (original work published 1983).
- Rosenau, P. M. (1992). *Post-modernism and the social sciences: insights, inroads and intrusions*. Princetown, NJ: Princetown University Press.
- Samuel, R. & Thompson, P. (1990). *The myths we live by*. London, UK: Routledge.
- Sarason, S.B. (1990). *The predictable failure of educational reform: Can we change course before it's too late?* San Francisco, CA: Jossey-Bass.
- Sarason, S.B. (1971). *The culture of the school and the problem of change*. Boston, MA: Allyn and Bacon.
- Schein, E. H. (1989). *Organisational culture and leadership* (2nd ed.). San Francisco, CA: Jossey-Bass.
- Segal, R. A. (1990). *Joseph Campbell: An introduction* (Rev. Ed.). New York, NY: Mentor.

- Senge, P. (1990). *The fifth discipline: The art and practice of the learning organisation*. New York, NY: Doubleday.
- Sergiovanni, T. J. (1990). *Value-added leadership: How to get extraordinary performance in schools*. Orlando, FL: Harcourt Brace Jovanich.
- Sergiovanni, T. J. (1984). *Handbook for effective department leadership: Concepts and practices in today's secondary schools*. Boston, MA: Allyn and Bacon.
- Stacey, R. (1992). *Managing the unknowable*. San Francisco, CA: Jossey Bass.
- Tobin, K., Kahle, J. B. & Fraser, B. (1990). *Windows into science classrooms: Problems associated with higher-level cognitive learning*. London, UK: Falmer Press.
- Tobin, K., & Espinet, M. (1989). Impediments to change: An application of coaching in high school science, *Journal of Research in Science Teaching*, 26, 105 - 120.
- Vanhoozer, K. J. (1991). Philosophical antecedents to Ricoeur's Time and Narrative. In D. Wood (Ed.), *On Paul Ricoeur: Narrative and interpretation* (pp. 34 - 54). London, UK: Routledge.
- Van Maanen, J. (1988). *Tales of the field: On writing ethnography*. Chicago, IL: University of Chicago Press.
- Wallace, J. & Louden, W. (in press). *Teachers' learning: Stories of science education*. Dordrecht, The Netherlands: Kluwer.
- Witherell, C., & Noddings, N. (1991). Epilogue: Themes remembered and foreseen. In C. Witherell and N. Noddings (Eds.), *Stories lives tell: Narrative and dialogue in education* (pp. 279 - 280). New York, NY: Teachers College Press.
- White, R. C. (1993). Pursuing the agenda, *SCIOS*, 28 (3), 20 - 30.
- White, R. C. (1995). *We need heroes in science education: Fact or fiction*. Paper presented at the annual meeting of the American Educational Research Association, April 1995, San Francisco.
- Wood, D. R. (1992) Teaching narratives: A source for faculty development and evaluation. *Harvard Educational Review*, 64 (4), 535 - 550.

APPENDIX

MY JOURNEY THROUGH THE RESEARCH

The process of educational change is intriguing. Increasingly my own conversations with colleagues and friends about schools and learning have mirrored those overheard between my parents and their friends in earlier years. Despite multiple differences in context across the years and generations, there remains a recurring *déjà vu*. For me, the choice of this study was inescapable. How better to link my cross-generation local cultural knowledge and understandings with my own interest in teasing out a coherent pattern to this reiterative process of change?

Traditionally the methodology chapter of a thesis outlines the task set by the researcher for herself. This includes information about the sources, mechanisms and timing of data collection as well as mention of the process of analysis. To have inserted a section such as this into the flow of the thesis, appeared to me to interrupt and create a real discontinuity to the reflections of both the reader as audience, and myself as writer. Thus the decision to include the methodology as an appendix. Initially I will outline the circuitous path taken in order to locate appropriate data for this study — in itself a journey for the novice researcher. Then I will explicate my reasons for presenting the study in the form in which it is written. Early in this exploration, I struggled to identify similar research within the field of science education and wondered at the suitability of my chosen interest. However, when considered as a reflection situated within the broader scope of the culture of school education, I am convinced of its value.

Data Collection

In the naivety of my inexperience, I began this study expecting to spend hours pouring over documents in the quiet alcoves of our State Education Department archives. My thesis would be a tightly ordered document with frequent references to my private (photocopied) collection of historical paraphernalia — letters, draft programs, texts and so on. I visualised an outcome reflecting upon historical research such as that undertaken by Cremin (1961), Kliebard (1988) and Mossenson (1972). This was not be the reality of my study.

Initially, I spent hours, and weekends and school holidays with archives. I looked fruitlessly amongst the collection of the State Education Department library. As a part of the last decade of downsizing, older records had already been moved into the State archives. I immediately obtained researcher status from the State library and my world opened! Files and files of documents relating to all aspects of schooling in my State became available to me — student enrolment information, immunisation records, requests for the opening of new schools, school requisitions and so on. With infinite support from the ever-patient librarians, I learnt to specify the particular kinds of files in which my interests lay. Categories such as *curriculum* and *science* and *teacher training* became the foci of my delving.

This kind of data collection is most absorbing. I read a lot of detail about issues of particular interest to individual teachers as evidenced in the many letters from Head teachers in small rural schools. As the size of the Education Department grew, documentation became focussed into reports and proceedings. Some of these were pertinent. Personal letters and outlines became scarce. Memos were non-existent. Throughout the files and files, curriculum documentation and specifically science curriculum materials were relatively few. Some draft curriculum proposals and occasional letters reflecting the views of an association or individual provided the

bulk. After the 1950s there was little of interest except letters between senior State educators regarding Year 11 and 12 courses and exit certification. I was immensely disappointed.

In my full-time role at school and meeting with colleagues, I expressed my frustration at the lack of information and especially the lack of individual and group responses to the curriculum reports and statements. Whereas today, I frequently submit personal and staff concerns about, and support for, new innovations to appropriate committees and boards, there were no similar documents on file. However, as happens so often, a shared problem tends to uncover solutions — or at least partial solutions.

Firstly, a close colleague working with our State post-compulsory accrediting agency spoke about some old books he had discovered in the agency library. Amongst the collection of national and international books describing numerous Year 11 and 12 courses and accreditation processes, were some books inherited from pre-existing agencies. In his wisdom, the Chief Executive Officer of the agency had determined that these books could provide a historical reference point for the organisation and retained them in the library collection. They did exactly that for my study. These books were the publications of the Public Examinations Board of my State, outlining the Junior Certificate (Year 10) and Leaving Certificate (Year 12) examination courses from 1914 until 1974. Thus I was able to track science subject content statements over the years from 1914 until the last Junior Certificate examination in 1972. The similarity of content and the gradual expansion to include new scientific understandings was clear.

The second important input came from one of my older superordinates. He reminded me of the way we work today. Whilst letter writing to the Head Office was an effective means of communication in the 1920s, when road and rail transport was paramount and telephone connections variable, time has changed. Telephones do not

leave a paper trail. At his suggestion I talked with two recently retired science curriculum consultants who had worked in the Head Office. They provided further reasons for the absence of paper evidence.

In the 1970s our Minister gave instructions that we were not to communicate with any Commonwealth officers, or anyone from another state. That was just impossible! So we used the telephone all the time. You won't find any archival records - they were "lost" for excellent reasons. (Proteus, Superintendent of mathematics in the 1970s interviewed in 1992)

When [*Pol Pot*] came (the 1987 Central Office restructure) I packed several cardboard boxes with the science curriculum materials I'd collected over fifteen or more years. We had no time to do much more. I packed them properly with mothballs, the lot, then labelled them with "Not to be destroyed" and "Refer to Jason before removal" and gave addresses and phone numbers. I personally took the boxes down to the old Records Department in the basement. It's the last I saw of them.

Two years later when I arrived back in the city to this District Office, I went to collect them. The Records Department had been disbanded a year earlier. I spent ages searching around until I found one of the clerks working in the mail room. He reckoned that the boxes had all been opened and texts sent off to a library somewhere and all of the papers and documents shredded. I nearly cried! What an enormous loss! So you won't find much for your study. The philistines have beaten us all. (Jason, Superintendent of science through 1980s until 1987 interviewed in 1994)

Following these discussions, the need to rethink the form of my data collection was inescapable. Rather than physically remove myself to analyse papers written years previously by people I knew only by reputation, I now had to get close to my subjects in order to obtain any viable data. If I was to access the understandings and knowledge associated with these events, I needed to sit down and talk with the long-term participants of my science education community. Many of the individuals associated with events of interest from the 1950s were already advancing in years and memories.

Consequently, over the following years I became very close to my tape recorder and computer as I recorded and painstakingly transcribed interviews averaging about an hour in length. Initially, I used a reasonably loose interview protocol asking individuals to talk about their own understandings of science, school science, school science curriculum as a student and as a teacher, the teaching and learning of science over this time, and the names of others to whom I should talk who were in the local field of science education. I am indebted to each of my informants for giving of their time so freely. Theseus participated in two lengthy interviews, as well as critiquing two of my earlier papers (White, 1993, 1995). I was able to spend some time with Perseus only a short time before his death. He was eager to tell his own story but also that of his beloved teachers and Department. His loyalty towards, and trust in, the science teaching community remained untainted.

Over the years of interviewing I learned to listen and interrupt less often. Inevitably many inter-linked issues became part of our conversations. I am immensely grateful for the trust given to me by those who became involved in the process. My own commitment on requesting an interview was that each informant would retain anonymity when the study was documented. As well as Perseus and Theseus, science Superintendents later promoted to become Director Generals, my interviewees included a Director in the Head Office during the 1950s until 1969, six

Superintendents (of the 1950s until 1987), five Heads of Department (1960s until present), five science and education university professionals (1950s until present) and four science teachers (1950s until 1980s), representing well over two hundred pages of transcript. Whether because much of the conversation was about people and events in the past, or that interviewees saw much of the information focus as not personally confronting, each discussion flowed freely, embroidered with anecdotes about individuals, groups and the organisation. Like Perseus, each wanted to tell their own story and more. The advantage for myself as colleague, sometimes friend and researcher, was that inevitably one story reinforced many parts of another — and I was able to recognise repeated sequences in time, negotiation and decision-making. It was a totally absorbing task to listen to the unhesitating interest, open-mindedness and enthusiasm of these people.

In meeting and talking with participants in the culture to which I identify, I learnt far more than can ever be described in this study. I was repeatedly reminded of the resilience of beliefs about learning and teaching and science, as those as expressed in interviews resonated with my own. The nature of the issues which emerged to trigger change became a repetitive cycle. At the same time I learned more about the understandings of the people involved in the policy making and implementation of past instances of curriculum change.

Approach

In seeking to document this qualitative study, I cast around for some time. My embryonic papers were written more or less as traditional historical studies (White, 1993, 1995). Written in the expository language of the objectified and non-emotive researcher, these scribblings included timelines, dates, sequences of events and a naive researcher's conclusions. Such papers gave information and some interpretation. However, they didn't resonate with me as a reader. In my hands the

traditional historical framework seemed to be inadequate to the task of providing the complex context inherent in this study.

Narrative Inquiry

At the same time as I was piecing together these early progressions of events, I was interviewing members of my community. Our conversations consisted of anecdotes and stories. My data was a wealth of descriptions and tales about schools and science curriculum and teachers in schools. It was in the form of narrative as prosaic text as defined by Polkinghorne (1995), where "narrative has been employed to signify that qualitative inquiries are concerned essentially with everyday or natural linguistic expressions, not with decontextualised short phrases or with abstracted counts designed for use in computational analysis" (p. 6). As I discussed my own progress with my supervising professor I found myself relating not dates and events but whole stories. Increasingly I thought about my study with a different lens. Like so many scholars before me, I too began to make story a central element in my own analysis (Carter, 1993). As so cogently expressed by Witherell and Noddings (1991):

We learn from stories. Stories are powerful research tools. They provide us with a picture of real people in real situations, struggling with real problems. They banish the indifference often generated by samples, treatments and faceless subjects. They invite us to speculate on what might be changed and with what effect. And, of course, they remind us of our persistent fallibility. Most important, they invite us to remember that we are in the business of teaching, learning and researching to improve the human condition. Telling and listening to stories can be a powerful sign of regard — of caring — for one another. (p. 280).

This recognition of stories and narrative as not only providing a form in which human experience as lived can be expressed (Ricoeur, 1986/1991) but also as a legitimate tool for research, is reiterated by Connelly and Clandinin (1990).

Perhaps because it focuses on human experiences, perhaps because it is a fundamental structure of human experience and perhaps because it has a holistic quality, narrative has an important place in other disciplines.

Narrative is a way of characterising the phenomena of human experience and its study is appropriate to many social science fields. (p. 2)

Arguments such as these gave additional credibility to my emerging focus and understanding of the possible worlds of research. My time studying at Florida State University had already broadened my understandings to include inquiry quite different from the traditional, positivistic horizons nurtured throughout my science degree. Amongst others, I had read, debated and accepted Bruner's (1985) argument for two legitimate forms of knowing, the paradigmatic and narrative. In particular, Bruner articulated the distinctive features of each mode of cognition.

Each of the ways of knowing moreover, has operating principles of its own and its own criteria of well-formedness. They differ radically in their procedures for verification. (p. 11)

As a researcher undertaking disciplined inquiry, I needed to be clear that my primary data was as authentic as possible. In my time spent in archives, libraries and sorting through the forgotten staff bookshelves of several established schools, I was able to verify many of the sequences of events related in my study. In addition the accuracy of much of my interview material as primary data was reinforced as different informants reported on the same activities. While interviewees provided recollections mediated by their own position in the organisational hierarchy (from Director General

to classroom teacher) and tempered by their own retrospective understanding of significance and meaning, the combination of perspectives assured confidence in the authenticity of the data.

Analysis

Having consolidated my decision to use narrative as stories in this qualitative study and being satisfied that the data was legitimate, the need to clarify my process of analysis intensified. In presenting my data I have made use of both of Polkinghorne's (1995) primary forms of narrative enquiry — a narrative analysis (Chapters Three and Four) as well as an analysis of narratives (Chapter Six). Polkinghorne recognises each of these approaches as significantly different.

Narrative analysis relates events and actions to one another by configuring them as contributors to the advancement of a plot. The story constituted by narrative integration allows for the incorporation of the notions of human purpose and choice as well as chance happenings, dispositions and environmental processes. The result of a narrative analysis is an explanation that is retrospective, having linked past events together to account for how a final outcome might have come about. (p. 16, 1995)

The stories of Perseus and Theseus in Chapters Three and Four are representative stories produced from the data of a number of different informants as well as documents. Interspersed with the accounts of events and actions, I have endeavoured to answer questions about how science curriculum change proceeded in the particular context of each era.

The paradigmatic analysis of narrative seeks to locate common themes or conceptual manifestations among the stories collected as data. The

researcher inspects the different stories to discover which notions appear across them. (p. 13, 1995)

In Chapter Six, I present a number of assertions based on the stories of Perseus and Theseus. These assertions reflect the common elements perceived to form a coherent pattern in the process of change. In the tradition of Polkinghorne (1995), they were derived through a continual inductive process of defining and modifying categories or assertions to attain a "best fit" with newly collected data. However this study did include only the two narratives of Perseus and Theseus. Was this sufficient evidence from which to draw such generalised assertions? I was convinced that the repeating patterns emerging in my stories would be recognisable in other cultures undergoing change. In the absence of any one unambiguous expression for the quality of narrative research I found guidance in the position of Guba and Lincoln (1989). These authors made a case for "transferability" as a viable expression for generalisability. I believe that the assertions made in Chapter Six reflect the understandings of the documentation and the many individual accounts which made up this study. As our schools and systems continue to change, I hope readers will also recognise the transferability of the assertions of Chapter Six.

My Role As Researcher

A critical decision early in my documenting of this study was to determine my own role. Very early on, when I saw myself analysing text materials only, I expected to write a thesis in the expository formal style of discourse. As a result of my need to interview living people from my own culture, the way in which I was able to represent my data was radically altered. I have already noted the way in which my lens for description, debate and analysis moved into that of a narrative inquiry. Within this process, I also found that my understanding of my role as researcher had changed.

In particular, I found that I could no longer feel comfortable writing as a supposedly unbiased, objective arbiter of *truth* as so often perceived in the simplistic recounting of past events which sometimes passes as history. For me, this history needed to be more complete, "in the ordering of the experience of others, in tracing connections between cause and consequences, continuity and change" (Makler, 1991, p. 46).

However, in meeting and talking and knowing my informants and the subjects of my stories, my study could become weighed down by too much evidence. As researcher my role had to include determining which evidence was to be selected as part of my constructed representation of reality. This was far more difficult once I had met and interacted with my subjects. For instance, although he may have been a stickler for rules, boring and conservative to his colleagues, the Perseus whom I met was a delightful, gentle man whose carpentry skills were superb and who remained immensely proud of his Department and his teachers. It would have been much easier to select evidence from written reports and documents than it was to weigh up that from people I had grown to respect and had no wish to hurt. Consequently, in constructing the stories of Perseus and Theseus I have endeavoured to be fair in my representation. However, I could not appropriate the language of objectivity for my account.

As a student, teacher, Head of Department, Deputy Principal and Principal of schools in my State, at no time could I see myself as any other than a participant in the culture upon which I was reporting. Thus, I realised that in the very act of writing I was presenting my personal meaning of the events and activities related to me. Unlike the writers of the modern, scientific culture from which my initial academic education began, in this study I felt that I needed to explicate my own position. I am not the modern author suggested by Bauman (1987).

The modern author in society is a "legislator," defined as a specialist, a manager, a professional, an intellectual or an educator ... they "know"

and "decide things" by weighing up the positive and negative and determining what is "true." What they select becomes "correct and binding." (Bauman, 1987, p. 27)

Rather than trying to be politically neutral I have provided a perspective mediated by my own knowledge of my community and its history, understandings and culture. Chapter One is my attempt to clarify my predicament and my position for the reader. It tells my own story, or at least my construction of life events which may have influenced my approach to and analysis of this study. Throughout the remainder of the study I consistently refer to my own relationship with the narrative so that the reader might more easily recognise the effect of my role and views in shaping the story.

Truthfulness?

I hesitate to use the word "truthfulness", and yet when one evaluates paradigmatic research it is the rational discourse revealing true knowledge which is communicated. However, in making sense of human endeavour, such a unique outcome does not do justice to the complex context of our lives as lived. Peshkin (1985) explained:

When I disclose what I have seen, my results invite other researchers to look where I did and see what I saw. My ideas are candidates for others to entertain, not necessarily as truth, let alone Truth, but as positions about the nature and meaning of a phenomenon that may fit their sensibility and shape their thinking about their own inquiries. (p. 280).

Researchers who have presented their studies as narratives have provided explanations for different ways to evaluate the quality of narrative. Bruner (1985) looked for "verisimilitude", Van Maanen (1988) added "apparency" as another underrated

alternative to validity and reliability. Other constructions have defined "trustworthiness" and "authenticity" (Lincoln and Guba, 1986), "adequacy" and "plausibility" (Connelly and Clandinin, 1990) and "fidelity" and "believability" (Blumenfeld-Jones, 1995, p. 26). Hatch and Wisniewski (1995, p. 120) identified the issue of clarifying criteria for judging quality in narrative and life history to be a continuing and unresolved issue for researchers. These researchers provided an extensive list of possibilities for the reader (p. 129).

In this study I hope that the reader will find "believability" and that the stories in the study resonate with your own life-experiences. For myself, I am very aware of the range of documentary evidence and of the many individual accounts upon which this study has been based. Throughout the writing process I have endeavoured to include as many voices as possible, although my own remained the one consistent throughout. I am particularly aware of the warning articulated by Catherine Emihovich (1995) as she tried to account for quality in narrative research:

But who decides that it rings true; even more importantly, in the world of meaning and perception where there are no tangible physical referents to guide us, can the truth ever be established? My contention is that while truth cannot be definitively established, social scientists must act as if the world is real, or more importantly, as if "the world is more than a text" (Hawkesworthe, 1989, p. 555). This position suggests that we need to reflect self-critically on our actions, to examine whether they are consistent with the meaning of theories we have constructed (p. 44).

Throughout the years of this study, my world in education has remained very real, to continually remind me of my responsibility to produce a trustworthy representation. I have remained acutely aware of the multiplicity of contexts in which these human negotiations took place and have confronted the difficulty in presenting these fairly.

While I accept that truth cannot be established, my wish is that this portrayal "rings true" to my readers, that it is understandable to those from within the culture I describe as well as to those from without.

Metaphor

Metaphor permeates not only our language but also our culture and our meaning making. As Lakoff and Johnson (1980) discovered when they set out to write about how people understand language;

Metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature (p. 3).

In my mind, I had identified my reconstructed stories as metaphors well before any link to Greek mythology had been imagined. In using my data to create the stories in Chapters Three and Four, I designed a vehicle whereby I hoped the reader might more easily understand the actions of two men trying to progress towards particular outcomes. As Vanhoozer (1991) states, "Other things exist in time, but only humans possess the capacity to perceive the connectedness of life and to seek its coherence" (p. 43). In explicating these human activities as stories, my reconstruction is itself a metaphor.

In recognising this reconception as metaphor, I was then drawn to the Aristotelian concepts of *muthos* and *mimesis* in devising stories (Ricoeur, 1983/1984a). As a science educator, this opened up a different understanding of the Greek philosopher. This newfound knowledge was extended by his discussion quoted in Lakoff and Johnson (1980, p. 190):

It is a great thing indeed to make proper use of the poetic forms, .. But the greatest thing by far is to be a master of metaphor (Poetics 1459a); ordinary words convey only what we know already; it is from metaphor that we can best get hold of something fresh (Rhetoric 1410b).

As one educated primarily in the empiricist Western culture, articulated by the ancient Greeks of whom Aristotle was a crucial figure, I had failed to connect my education in the sciences with that in the field of literature. I needed to investigate further. Through Diane Wood (1992), I was introduced to Martha Nussbaum (1986). Nussbaum identifies two strands of thought amongst the early Greeks, one pertaining to truth and the other to art. In the first, logical and rational argument, objective and unemotive reason, ultimately define moral order and valued knowledge. Greek theatre and art however, described their tragic heroes as unable to avoid fate.

Greek tragedians portrayed the detached, rational character as guilty of hubris, a tragic and fatal flaw. They made the case that the truly virtuous must recognise and consciously live with human vulnerability, with the essential fragility of mortal existence. (Wood, 1992, p. 539)

Although both schools of thought co-existed in early Greek culture, the increasing power of the sciences and technology over art led to the modern Western tradition. Throughout recent centuries, knowledge based upon rational, logical, reasoned argument and formal, objectified discourse has been recognised as valuable. It seems that in recent decades there may now be a return to a more equitable balance between the power of each school of thought.

While my stories themselves may be viewed as metaphors, the recognition of the change agents in my culture as heroes was a different use of metaphor. Early on in my conversations with colleagues, one made the remark that, "He was a one of my

heroes" when referring to an influential science educator. In the course of the discussion this was an appropriate metaphor, and passed without further comment. Later on, in moulding my narratives through listening to anecdotes, the power of underpinning referents in determining individuals' beliefs about science and school science and learning, became increasingly significant to my understanding. My analysis moved further and further into a cultural framework. It was then that I began to refer to these two men as "Heroes." For me, the metaphor worked and certainly helped me in comprehending their role within my community. Of course, for those of us who have been raised within the Western European culture, heroes also invoked thoughts of Greek and Roman mythology. It took very little imagination on my part to extend the metaphor to Perseus and Theseus. Greek rather than Roman, because so much of our Western philosophy has emanated from this heritage. Perseus and Theseus because their particular Hellenic myths so effectively mirror the life histories of the modern Perseus and Theseus. Further evidence of why these men could be so closely identified with the Hellenic heroes is found in Chapter Five. I am convinced that the use of these metaphors would resonate with both of my modern Heroes.

Why Chapter Seven?

One of my enduring concerns about academic research lies in its relevance to the everyday enterprise of schools and school systems. As a practitioner I have always read scholarly papers with the underpinning question, "So what?" What does each assertion mean for everyday practice? It follows that Chapter Seven is my "so what?" chapter. In this study I articulate definable and recurring patterns to a cultural change cycle. How might such processes be recognised and utilised to effect, in the 1990s? This final chapter is largely hypothetical. However, it does offer advice for readers seeking to improve the change process in their own context. In research terms the chapter has a second purpose. This chapter poses possibilities and makes predictions which may be tested over the next decade.

Conclusion

Narrative provides a vehicle within which researchers may study the human experience in a holistic way. However in working in this paradigm each participant is confronted by the perceived need to comprehensively justify his or her methods. This represents one's identification with that nebulous quality — scholarly standards.

Wallace and Loudon (in press) state that one outcome in identifying science as being a metanarrative, has been their recognition of the problem of method. As they explain:

.. no method can guarantee the truth in a postmodern world. Whatever emerges from a program of disciplined inquiry must be constructed within a web of intersubjective agreement, reflecting the preconceptions of the authors and the power structures within which the knowledge is constructed. (Wallace & Loudon, in press)

For the graduate student like myself then, one way in which to reiterate the authenticity, credibility, believability of each study lies in explicating the elements of the method. In clarifying not only the physical steps of data collection but also the decision-making with respect to the analysis and the written presentation, I hope to re-affirm to the reader, the rigour underpinning this study.