PART A: PRELUDE

The reader who wishes to obtain an overview of this thesis is advised to read Chapter 1 (second half), Chapter 9 (second half), Chapter 24 (first half), Chapter 25 and Chapter 26.

CHAPTER 1: *RAISON D'ETRE* FOR THIS THESIS

Pysadow an Orseth

Ro, a Dhew, dha Wyth,
Hag yn Gwyth, Nerth,
Hag yn Nerth, Skyans,
Hag yn Skyans, Gothvos,
Hag yn Gothvos, Gothvos an Ewn,
Hag yn Gothvos an Ewn, y Gara,
Hag a Gara, Cara a bup Bewnans,
Hag yn Pup Bewnans, Cara Dew:
Dew ha pup-oll Dader.[1]

Since this thesis is being submitted at a time when post-modernism is in the ascendant, to start from a pre-mediaeval perspective might seem anachronistic. But the prayer is as aware of the fragility of our knowledge as any post-modernist tome. And it conveys a feeling for humanity which any educator might be happy to embrace. Steiner has persuasively argued that when meaning is found within an aesthetic experience then the possibility of a real presence of God must necessarily be inferred.[2] So the prayer seems a good place to start the pilgrimage of fragile and tentative reflection which forms the content of this thesis.

APOLOGIA

The man who writes about himself and his own time is the only man who writes about all people and about all time.[3]

But firstly, if the time you'll not begrudge,
I'll tell you how I came to be a judge.[4]

This historical study covers events which have happened during most of my adult life and which have impinged significantly on my professional experiences.

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1 *Fourth Assembly of the Bards of the Gorsedd of Cornwall in Australia May 18th, 1991*

The Gorseth Prayer
Grant, O God, Thy Protection
And in Protection, Power,
And in Power, Wisdom,
And in Wisdom, Knowledge,
And in Knowledge, Knowledge of what is Just,
And in Knowledge of what is Just, the Love of it,
And from Loving, to Love All Existence,
And in All Existence to Love God:
God And All Goodness.

2 G. Steiner (1989)

3 Attributed to George Bernard Shaw by the Library of Congress *Literary Companion* Calendar for 1999.

4 *Trial by Jury* Gilbert (1875)

In some cases I have been a player in the events themselves. No commentator can be totally neutral, especially not one of the players. This matter will be discussed further in Chapter 7 where Eisner's connoisseurship model will be established as a basis for the historical commentary. So, following and increasingly common practice among researchers,[5] I start this exploration by declaring my interests.

My primary schooling was at Westbourne Park Primary School, a government school near my home in Adelaide. Here I learned arithmetic, geometry, fruit salad algebra and a little about betting on the horses. My secondary schooling at St Peter's College, a prestigious independent boys' school in suburban Adelaide, was mainly at the school's expense. Here I was advised to study mathematics in case I ever became an economist, in spite of my real interests in languages and history. No matter that the mathematics did not include the statistics which any economist would need.

From 1959 to 1962 I read Pure and Applied Mathematics and Education at the University of Adelaide.[*] Two young, enthusiastic professors of mathematics had been recently appointed,[†] but neither these able men, nor their sometimes less than able colleagues, could inspire me to achieve mathematical academic excellence. Nor did they teach me any statistics. The fault is not theirs. But my relative failure in this field has always meant that I have been particularly sensitive about Shaw's adage: "He who can, does. He who cannot, teaches."[6]

Fortunately, in the latter part of 1959 Professor L.F. Neal came to occupy Adelaide's first Chair of Education[7] and argued that teaching was a science, an art, and an academic discipline. Prior to his appointment Education had been taught on behalf of the University by the staff of Adelaide Teachers' College. This formed part of the Education Department of South Australia (often referred to as "the Department") and its posts were part of the career ladder to which a young Departmental teacher might aspire. So the staff were not necessarily academics with an interest in ideas, but often older teachers with experience on how to get on within the system. Neal was for me an inspiration: a broad-thinking, educated man who breathed fresh air upon Adelaide's dreary educational establishment. He was not popular, but only some of the fault was his. He slowly built up a

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5 *Vide* Astill (1998, pp. II–IV).

* Strictly until 1964 because of the practice at that time of delaying the reading of one's final Education subject until after having had some full-time experience in a classroom.

† Barnes & Potts; *vide* ch. 11.

6 Shaw (1903, p. 230)

7 *South Australian Teachers' Journal* May 1959, p. 13

8 *South Australian Teachers' Journal* May 1959, p. 13

Department of Education§ with some vision, but in my time Education lectures were still taken mainly by men from the Teacher's College. In 1961 Dr Z.P. Dienes also arrived in Adelaide with an international reputation which I had not previously believed could exist. Dienes' work in Adelaide will be examined briefly in this thesis. To Dienes and Neal I owe the beginnings of my vision of what mathematics education might be. And to the Department of Education I owe the opportunity to learn some statistics within my psychological studies.

From 1963 to 1964 I taught junior mathematics and many other subjects for which I had neither qualification nor interest to bottom streams at Unley High School, a huge "prestigious" high school in suburban Adelaide. This belief that teachers can teach anything is as long-standing as it is detrimental to the profession.

> 'It doesn't do to be too modest', said Mr Levy. 'It's wonderful what one can teach when one tries. Why, only last week we sent a man who had never been in a laboratory in his life as Senior Science Master to one of our leading public schools. He came wanting to do private coaching in music. He's doing very well, I believe.' [9]

Since this thesis deals in part with this period of time, I must declare my distaste for the system in force then and for the way it was administered by many of those in power. Some of my reasons will become clear in the following chapters, but I hope that any negative views I express are supported by arguments largely independent of my own experiences. It is legitimate that I use this thesis to come to a deeper understanding of my own experiences; it is quite illegitimate that I use this thesis to express views appropriate only in more intimate discussions.

At this time I also took up what was to become a life-long interest in ornithology. This provided me with an environment where statistics were of value, and the opportunity to learn about methods of scientific inquiry which had not been presented to me in my formal educational training.

In early 1965 I was appointed to teach mathematics at Edmonton County Grammar School, North London. Fortunately, I was not asked to produce the disparaging reference with which my previous Principal had furnished me. Edmonton's Principal was not quite Waughian:

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§ The "Department of Education" was part of the University of Adelaide; the "Education Department" was the government body controlling public schooling.

9 E. Waugh (1928/1953, p. 17)

> Well, I shall not ask for details. I have been in the scholastic profession long enough to know that nobody enters it unless he has some very good reason which he is anxious to conceal.[10]

Rather, his criteria were that I was properly certificated, available, without competitors, and not South African. Edmonton was a sound, well-regarded school in upper working-class London. Its staff were coming to terms with the New Mathematics, and using at least at least two sets of new texts within the school. But the head of mathematics was about to retire and the culture of the school gave each teacher substantial autonomy, so my initiation into the New Mathematics was a rather solitary experience.

After two terms at Edmonton, I taught from 1965 to 1968 at Abingdon School, Berkshire,[*] a pilot school in the School Mathematics Project (SMP), one of the largest and most influential of the New Mathematics projects at that time. I was invited to become a Project author and was involved in the writing and trialing of textbooks. The experience of working in a large team of people was invaluable. At Abingdon I also taught several courses on statistics with a special emphasis on biological applications and began my interest in leading natural history field excursions which had an emphasis on practical applications of statistics. This led to an increasing interest in probability and to my undertaking the writing of a summary chapter on probability and statistics for the final book in the SMP 1–5 sequence of texts.[11] I remain grateful for all that I learned at both Edmonton and Abingdon.

From 1969 to 1973 I taught senior mathematics classes at Melbourne Church of England Grammar School, one of the few schools in Australia at that time which used SMP for its junior secondary classes. The requirements of the Victorian year 12 public examinations meant that it was felt that a bridging text would be necessary for Year 11 students. I worked with others to write appropriate classroom material.[12] The way we presented ideas of probability worried me and led me in later years to rethink these ideas in considerable detail. I continue to appreciate all I learned about mathematics teaching at this school, which put great emphasis on the professional development of its teachers. My revised ideas, which are significantly at variance with the received wisdom in the wider academic community, formed the basis in later years of the first part of my

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10 E. Waugh (1928/1953, p. 18)

* Now Oxfordshire

11 SMP (1969, ch. 12; 1970tg5m, ch. 12)

12 J. Truran (1973a; 1973b)

Masters Dissertation. I was also able to develop my ideas of ways of linking field work, statistics and biology through the Field Studies Group which I led.[13]

From 1974 I have worked, mainly in Adelaide, as a freelance teacher and tutor of mathematics. This work has been done in schools, TAFE Colleges, universities, and with individuals. I have also taught mathematics education in the Schools or Departments of Education in all three universities.

In 1993 I received a Masters degree for my thesis *The Development of Children's Understanding of Probability*.[14] This contained a mathematical analysis of some aspects of probability, a summary of research into the learning and teaching of probability, the results of investigations into children's understanding of some probabilistic ideas, and a proposal for a teaching sequence for a traditional course of probability in secondary schools. The thesis argued that much current pedagogic practice was often not in harmony with either mathematical precision or research findings.

After my Masters thesis was submitted I started work on this Doctoral thesis, which is really the second volume of a single piece of work, and picks up some of discrepancies noted in the earlier volume. In order to link the two volumes there are many references to "J. Truran (1992)". Self-citation should be done in moderation, if at all, but it is necessary here to show which parts of this thesis are the original ideas being submitted for examination. Furthermore, because substantial amounts of the work forming this thesis have been published previously, and therefore need to be acknowledged here, the self-citation has to be extensive.

This dissertation is being submitted within the discipline of mathematics education whose case for existence has recently been strongly put by Sierpinska & Kilpatrick.[15] Some claim that there is no need for such a discipline—teachers are born, not made. Others deny that the subject is either mathematical or educational. They see mathematics education as being like a mule, with "without pride of ancestry, or hope of posterity".[16] Given the current situation in Australian universities, this may prove correct. Recent commentators have seen it is "inbred"[17] and "inchoate",[18] based on a morass of shifting paradigms.[19] Personally, I am

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13 J, Truran (1973fsg)

14 J. Truran (1992)

15 Sierpinska & Kilpatrick (1998)

16 John O'Connor Power, Irish lawyer and politician, speaking of the Liberal Unionists, cited in Partington (1996). Also attributed to Benjamin Disraeli by Fenner (1940).

17 Steen (1999, p. 240)

18 Steen (1999, p. 241)

19 King & McLeod (1999, pp. 229–231)

comfortable working within this mixed discipline and believe, as I argue in Part E, that it is a valid medium for study. I see both education and mathematics as being, along with theology and philosophy, all-encompassing disciplines, any one of which would be adequate for the development of a rounded person. It will become clear that I see the weaknesses which are certainly found to exist within mathematics education to be failings of achievement rather than of purpose. This sets me firmly in the Liberal-Humanist tradition, as will be described in Chapter 3, but it is a Humanism strongly tempered by a concern for pedagogic skills of the highest order. Many of the failures of mathematics education have arisen from the neglect of sound educational and pedagogical principles as well as of the mathematics being taught.[§] Mathematics education is only a part of education, a part with threads stretching right across that seamless robe which is the knowledge we seek to weave on wisdom's loom.

Having summarised who I am and why I am writing this thesis, I now define my objectives and define the methodology which I shall use.

INITIAL OBJECTIVES

> O happy pair! And happy still might be if not misled by false conceit. Ye strive at more than granted is; And more desire to know, than know ye should.[23]

The period from c. 1960 has seen the introduction of new topics and a succession of new approaches to both primary and secondary mathematics teaching in many parts of the western world. These have been the subject of a number of investigations,[24] but their primary focus has been administrative structure rather than the content being taught. So this thesis adopts a different approach and examines the changes from the point of view of one specific topic.

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§ *Vide* especially chs 20, 21, and 24 for some justifications of this belief.

20 Steen (1999, p. 240)

21 Steen (1999, p. 241)

22 King & McLeod (1999, pp. 229–231)

§ *Vide* especially chs 20, 21, and 24 for some justifications of this belief.

23 *The Creation* No 33

24 E.g., in Europe Cooper (1985) and Moon (1986) for mathematics projects and Waring (1979) for science. In SA, J. Baxter (1972), Brinkworth (1970) and Sumner (1969) have all examined mathematics projects; Hunwick (1970) has examined a biology project.

In Australia at least, many of these changes have subsequently fallen by the wayside. One change which may become permanent has been the introduction of the topic of probability, one which makes quite different types of intellectual demands on pupils compared with traditional mathematical topics. Its non-determinism is particularly appropriate to a post-modernist world,* yet it is a topic with which many teachers are not comfortable.

For these reasons probability is an ideal topic to form a basis for examining the effect of curriculum change within schools and the behaviour of all those involved in the process. When it was introduced, the majority of teachers had no formal experience of its content or its pedagogy. The topic has no strong links with the more traditional mathematical topics, so its content and pedagogy have had to be developed from scratch. Such a situation is rare in educational circles, so the important forces are the more likely to be overt. Furthermore, probability's fortunes have waxed and waned significantly, and there are still many who believe it is inappropriate for schools.† Also, the period is recent enough for most records to be still extant, and for key people to be still alive.

When this thesis was conceived it had two main objectives. The first was to analyse the teaching of probability within a wide theoretical framework and also within the specific context of its teaching in South Australian schools. The second was to use this analysis to propose and test effective ways of improving the teaching and assessment of the topic. Eventually the magnitude of this task proved overwhelming, and some damage limitation had to be employed. The next section outlines how I came to construct the thesis in its present form, and is followed by a revised set of objectives.

METHODOLOGICAL CONSIDERATIONS

> Though this be madness, yet there is method in't.[25]

Traditionally there have been two main approaches used in educational research. One examines a wide and possibly eclectic set of data, which in historical studies are usually written, in order to paint a broad picture, or construct an explanatory

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* *Vide* ch. 3.

† Such views tend not to be reported in the literature, because they run against the prevailing trend. But I have heard them expressd privately from time to time; the most recent, in August, 1998, came from a retired senior academic in SA.

25 Shakespeare *Hamlet* II (2) l. 211

narrative, of major trends validated with evidence from the data. The other sets up a systematic and standardised procedure to collect data for analysis in a structured way, usually statistical. Each approach is, of course, amenable to substantial variation in emphasis, but the broad patterns remain.

The adage "history is written by the victors" has been known for a long time, yet only in recent years have feminist scholars, particularly those working in historical and sociological fields, argued that methods are available for filling in aspects of the historical picture which are not clearly illustrated using traditional methods. This has resulted in the development of a third approach which uses a much wider variety of evidence and more flexible methods of collecting the evidence.[26] Such methods need not be any the less rigorous, but they do tend to be much more dependent on the "theoretical sensitivity"[27] of the researcher.

Dilemma

My initial concern was to understand what happened when a difficult topic was introduced into a complex environment. This aim is strongly multi-disciplinary and all three approaches seemed to be of value for examining different aspects of the process being observed. Of course they all have strengths and weaknesses which are discussed as a matter of course in books providing an introduction to research methods.[28] It is also possible to use more than one method to develop a *triangulation* which can provide very convincing evidence indeed.[29]

As my studies progressed I found it difficult to fit my work into any one of these approaches, or even into a triangulation of all of them. The width of the endeavour was too broad; in order to make sense of the process I needed to use all of the theoretical ideas to be discussed in Part B and which could easily have become a thesis in itself. I was working within all of the disciplines of history, psychology, assessment, didactics, and curriculum theory, but employing all three of the basic methodologies to most of these disciplines in what superficially looked like a most unstructured way.

Furthermore, it became increasingly clear that the full scope of the project could not possibly be completed in the time available, and some of the work done could not be presented as I had hoped. Paradoxically I was also concerned that my studies were too narrow. I was concentrating on one quite small topic in a

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26 *Vide* Tesch (1990, pp. 1–75).

27 Strauss & Corbin (1990, ch. 3)

28 E.g., *vide* J. Bell (1987); Burns (1990).

29 Burns (1990, pp. 248–9; 267–8)

curriculum and divorcing it from its much more developed sibling, statistics. In the historical section I was looking mainly at events in one small and rather insignificant State, even though I was also able to provide some data from other comparable places. Such restrictions were obviously sensible if the work were to be completed in reasonable time. It would be easy to use this data to present a moderately entertaining narrative which could provide rigorous counter-examples to rebut the over-generalisations of others. But could the data also be used to permit valid generalisations to be drawn, generalisations of a depth appropriate to doctoral studies and with some degree of predictive power? Buck has stated that "[t]he individual case study … makes an important contribution to the comprehension of human experience as a result of its unique structural properties.[30] Hardy has pointed out, within mathematics, that "the 'seriousness' of a mathematical theorem lies, not in its practical consequences, which are usually negligible, but in the *significance* of the mathematical ideas which it connects".[31] Furthermore, Eisner, from a wider perspective, has argued that

> generalization is possible because of the belief that the general resides in the particular and because what one learns from a particular one can apply to other situations subsequently encountered. … Artistic approaches to research … attempt to shed light on what is unique in time and space while at the same time conveying insights that exceed the limits of the situation in which they emerge.[32]

These comments provided some comfort, and also some indications of the approach and style which would be required. But Eisner's connoisseurship approach requires considerable discipline for a novice,[§] and so some form of model would be helpful. My biological interests seemed to provide an answer.

Behavioural Studies in Zoology

The classic method for doing behavioural studies of the higher animals is essentially sitting, watching and recording. This may be refined in a number of ways: using hides which allow a very close view of the animals involved, banding to allow each individual to be individually identified, using radio transmitters to monitor movement, and using physical examination to measure parameters which might indicate bodily health or age. Each approach has strengths and weaknesses which must be set against the cost of their implementation. In this

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30 Buck (1976, p. 49)

31 Hardy (1940, p. 29)

32 Eisner (1985, p. 193)

§ *Vide* ch. 7.

context "cost" might refer to money, but more often will refer to time and convenience.

Such systematic research is often supported by isolated reports of individual incidents indicating aberrant distribution, breeding behaviour, or feeding behaviour. These notes, often published in learned journals, can be used for a broad analysis providing a better understanding of the meaning of the individual data.*

So systematic and unsystematic data can contribute to knowledge about the specific animals concerned. But the overall aim is to understand the species as a whole, not individuals. Sample sizes are usually an infinitesimal fraction of the total population, and the more intense the methodology employed the smaller the fraction will be. Increasing the sample size requires more collaborators, who tend to increase sampling bias, and to decrease reliability and perhaps precision.

Yet zoological researchers can also make general knowledge claims for a whole species, at least in fairly well-defined circumstances. For example, Darwin's theory of natural selection has been able, one hundred years on, to be observed in action in the field among the Galápagos finches.[33] Why are such generalisations possible? They assume that most aspects of animal behaviour are innate and that the innateness has become embedded in the species by a selection procedure which tends to ensure that the most efficient responses to a complex set of circumstances are those which tend to survive in the species. So, while conceding that there is a significant amount of intelligent and learned behaviour among the higher animals, it is highly likely that behaviours observed among a small sample will be common to most members of the species under similar circumstances.

This is not to suggest that the study of animal behaviour is simple. Far from it. Indeed, it is a discipline which draws on a wide range of other disciplines, from palaeontology to psychology and from sociology to statistics. It is a study which draws a variety of evidence ranging from deep analysis of highly specialised aspects (e.g., DNA descriptions) to anecdotal reports of isolated incidents. Many of its conclusions remain highly provisional, but that does not prevent researchers from presenting what they see as the best interpretation of the evidence available. By doing so they provide future workers with a well-defined framework for interpreting further information as it arises.

But zoological studies have gone even further than all of this. For at least the last 50 years they have been set within the overall framework of ecological studies,

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* E.g., Read et al. (1996) use a set of references, of which over half represent anecdotal reports with little theoretical base, to analyse the distribution of the Flock Bronzewing.

33 Weiner (1994, ch. 7)

where the individual animal and the individual species are seen as operating within complex physical and biological systems. The individual and the species are subject to so many constraints that to understand them fully requires an appreciation of their position within a wide biological system. So it seemed that ecological methods, particularly as practised within zoology, might provide a helpful way of interpreting educational events.

Ecological Methods and Educational Studies

This study is about human beings, whose behaviour patterns are vastly more complex than those of birds, and who are to some extent able to circumvent the forces influencing Natural Selection. But, like animals, human beings live in environments which can change rapidly and unpredictably, and they tend to behave in similar ways in similar circumstances or when under similar pressures. Expressions like "if you change the syllabus this way, the teacher will do such and such" suggest that there will be some generality of behaviour. Howson talks about the diminution of ideas as they spread through an educational system and suggests that this is a common phenomenon.[34] Tobin & Fraser summarise what good teachers do in a classroom, and by implication suggest what most teachers do not do.[35] Desforges & Cockburn describe what some very good teachers do not do, even though they would like to, and give reasons partly based on the constraints within which the teachers have to work.[36] Vinner observes that phenomena like "traditional classrooms" have remained in spite of intensive efforts by administrators and reformers to change them, and suggests that they must have some inherently positive features to be so resilient to change.[37]

Such arguments suggest that there is some constancy of behaviour among educators in similar circumstances. It may well not be as constant as that observed in higher animal studies, but will be sufficiently constant to allow generalisations to be made. It is on this assumption that the argument of this thesis is based. Its generality lies in its particularity. It represents an intensive study of a very small area, which is supported by a large amount of less systematic, rather eclectic, data. But such data is sufficient to satisfy the purpose of this thesis, which is to describe some aspects of human behaviour within educational circumstances in an attempt to present a first approximation of an ecological model for seeing our schools and their systems more clearly than we do now. The precise way in which

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34 Howson et al. (1981, p. 134)

35 Tobin & Fraser (1988)

36 Desforges & Cockburn (1987)

37 Vinner (1994)

the ecological analogy is applied to education is explicated in Chapter 9. The potential value of such increased clarity will be obvious to all of us who live in such unstable educational times, but this thesis will merely suggest ways in which such understanding might be applied, without attempting to test its predictive power. Such testing must be left to a later date.

REVISED OBJECTIVE

As a result of these deliberations my revised objective became the single one of assessing the value of the ecological model to be described in Chapter 9 as a tool for increasing understanding of change processes in the teaching and learning of probability since about 1960. As mentioned above, probability is ideally suited for such a project. It allows the model to be assessed against the introduction of an important idea of western culture into our educational system in order to help sustain an important aspect of our intellectual culture.

I have chosen to set 1959 as the date in which the movement to bring probability into schools really started to gain ground. In that year the Royaumont seminar in France[38] marked the beginnings of formal international discussion on the New Mathematics, of which probability was a part and an influential secondary school textbook on probability and statistical inference was published in the USA.[39] Fortuitously, 1959 was also the year when I started to prepare formally for my lifetime in mathematics education and involvement in some of the events which form part of this story. So the choice is a happy one for me.

Although probability has come into most western culture schools since the 1960s, it was clearly easiest for me to concentrate my researches on its story in my own city-state and my own country. Since SA has chosen to move against the tide with respect to probability, this made it an excellent choice for detailed study because the reasons for such a decision are more likely to have been openly stated. While I have not neglected happenings in other systems, I have written principally from a local perspective, and generalisations should be assumed to apply only to SA unless otherwise stated. In most cases the generalisations will extend to other parts of Australia, but this country of 17 million people has eight autonomous, different government educational systems, as well as many religious systems and some more independent schools, so there are often exceptions whose detailed listing would disturb the flow of the main argument.

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38 OEEC (1961)

39 CEEB (1959a)

The broadness of the model means that the methodology of this thesis is particularly diverse. It is historical in the sense that it seeks to explain the process of change and continuity in one aspect of education. It is a piece of curriculum evaluation in that it reviews the success of an innovation in the school curriculum. It is pedagogical in that it is deeply concernedwith the interaction between teacher and student. It is deliberately eclectic and looks much wider than the sources traditionally used in educational research, because it believes that education is an all-encompassing activity. It might be seen as using a *grounded theory* where the theory is built up from the data and "data collection, analysis, and theory stand in reciprocal relationship with each other".[40] But such a description is rather too grand. Rather, it is an attempt to use data relevant to a single topic to describe and try to understand how people involved in education sometimes behave in order to develop principles which might have some predictive power. For this broad approach I claim the support of Buck, who has written

> [T]he open exploration of all human experience is the first priority—the problem comes first. Only when the issue is sufficiently delineated should methodology even be considered. "Science" can better be judged by the degree to which it attempts to understand its subject matter with some scope than by allegiance to a single method.[41]

May this thesis be one small step towards an understanding of how children may be led to one aspect of Wisdom and Knowledge. May it be also one small step to understanding how they may be led beyond these to the higher virtues sought in the Gorseth Prayer.

> And his heart within him fluttered,
> Trembled like the leaves above him,
> Like the birch-leaf palpitated,
> As the deer came down the pathway.
>
> Then, upon one knee uprising,
> Hiawatha aimed an arrow;[42]

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40 Strauss & Corbin (1990, p. 23)

41 Buck (1976, pp. 31–32)

42 Hiawatha comes towards manhood by killing a deer—Longfellow (1886, p. 137)

CHAPTER 2: EDITORIAL POLICIES

> Hâtez-vous lentement; et, sans perdre courage,
> Vingt fois sur le métier remettez votre ouvrage:
> Polissez-le sans cesse, et le repolissez;
> Ajoutez quelquefois, et souvent effacez.[1]

One of the less pleasant aspects of academic life is the way in which editors dictate the layout, the structure, the referencing and even the spelling of their authors' work. They allow no room for debate, they cannot listen to reasoned argument. Such a position is remarkably at odds with the traditional intent of academia. It would not be tolerated by artists or musicians; can it be that those who work in words are not seen as having a true creative spirit?

Fortunately, the author of a dissertation has rather more freedom than at any time before or after the period of writing up. In this thesis I have tried to use this freedom to provide a structure and layout which are easy on the eyes and facilitate the interpretation of words and references. Inevitably, I have made some controversial choices. In this chapter I justify or explain these decisions.

SEMANTICS

> *[C]ircumvention device* means a device (including a computer program) having only a limited commercially significant purpose or use, or no such purpose or use, other than the circumvention, or facilitating the circumvention, of an effective technological protection measure.[2]

A recurring theme in this thesis will be the need to emphasise precision in language when teaching, not to demonstrate erudition, but to enable a topic to be addressed meaningfully. So I must clarify my own terms, some in common use and one important unfamiliar one.

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1 Boileau-Despreau (1674) *Art poétique* from J. & G. Marks (1948, p. 37)
Make haste slowly, without losing courage,
Use your skills to remake your work twenty times over:
Polish without ceasing, and repolish yet again,
Add a little more occasionally, but strike out often.

2 Australia. *Copyright Amendment (Digital Agenda) Act 2000* Schedule 1, 3

Chance & Data or Probability & Statistics?

Standard dictionaries[3] confirm that the words "probability" and "chance" are often used interchangeably to refer in a general way to unpredictable events. Perhaps for this reason, but perhaps more for reasons of brevity and simplicity, the term "chance & data" is coming to replace the older term "probability & statistics", at least in Australia. There are two reasons why this trend is undesirable.

Firstly, the term "chance" has vernacular meanings as well as any possible meaning which is close to the technical meaning of "probability".[4] As will be argued in Chapter 4, we do our students a disservice if we ask a common vernacular word to do duty as a crucial technical word as well. Secondly, since there seems currently to be no place in formal mathematics for the word "chance" in any technical sense, we do our students a further disservice by providing them with baby language, when technical language will do just as well.[*]

Secondly, the terms "chance" and "data" are static, rather than dynamic. "Data", for example, does not emphasise both the collecting of numerical information and the use of formal techniques for interpreting it.[5] Manfred Borovcnik, an Austrian with a first language of German, but who writes extensively in English, considers that "chance does not cover the theoretic relations around probability, … and data does not cover the inferential part of statistics, at least to my understanding."[6]

So in this thesis the terms "chance" and "data" are not used as synonyms for "probability" and "statistics" except in quotations or when describing situations and texts where the words are used.

Stochastics

The term "stochastics" is used here to encompass probability, statistics and elementary combinatorics.[†] Its root is the Greek word for "aim" or "guess".[7] "Stoch-

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3 E.g., NSOED (1993)

4 K. & J. Truran (1994 mavpri, pp. 128–129)

* Any adult who has observed how easily young children use scientific names for dinosaurs will be aware that they are not fazed by long words which have meaning for them.

5 J. Truran (1994mob2)

6 Borovcnik, pers. comm. , April 1996

† Combinatorics—the study of ways of counting the number of ways in which items might be arranged or selected—might be seen by the uninitiated as an unlikely bed-follow for statistics and probability. However, it is of importance in calculating theoretical probabilities which requires the calculation of the total number of ways in which a set of events might

astic" as an adjective is an acceptable technical English word, but there has been no corresponding noun.[8] A singular form, "la stochastique", meaning "branch of mathematics concerned with the interpretation of statistical data using the calculus of probabilities" has been used in French since 1953.[9] Freudenthal, from the Netherlands, used "stochastics" in English, but with contradictory meanings, in 1974.[10] Heitele used it in *Educational Studies in Mathematics* in 1975.[11] Bentz, from Germany, defined it in English in 1982 to include probability, statistics and combinatorics.[12] In German "stochastik" has been used as a shortcut for "wahrscheinlichkeitstheorie und statistik" since at least the 1970s.[13] There is a need for such a term, especially one which has a simple adjectival form.[14] Recently, some writers in English from Europe,[15] North America[16] and Australia[17] have also used the term, and Kath Truran and I have used it orally since at least 1993 and in writing since 1994.[18] In Australia its use has been opposed because it would not be widely understood,[19] or because it emphasises probability which is a deductive topic and so does not subsume statistics which is an inductive topic.[20] But since it has now been accepted by the Mathematics Education Research Group of Australasia (MERGA),[21] it will be used here. Since the decision to use the word was taken in c. 1996, it has become much more commonly used, notably as the descriptor of a Working Group at Psychology of Mathematics Education (PME) Conferences, to some extent at our urgings. Nevertheless, our urgings have been accepted, and it

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happen. In the nineteenth century, probability was often seen as a simple application of combinatorics, which itself was seen as a branch of algebra. This balance has now changed. *Vide etiam* discussion on Piaget's work in ch. 8.

7 OED (1989)

8 OED (1989); Websters Dictionary (1981); Macquarie Dictionary (1987)

9 *Trésor de la langue française*

10 Freudenthal (1974, pp. 267–268). The contradictions in his definition are discussed in J. Truran (1992, pp. 18–21).

11 Heitele (1975, p. 187)

12 Bentz (1982)

13 Borovcnik, pers. comm., April 1996

14 James, pers. comm. June 1995

15 Schupp (1986); Stoyanov (1986); Szendrei (1990)

16 Garfield & Ahlgren (1988, p. 46); Shaughnessy (1992, p. 466); Shaughnessy & Bergman (1993, p. 178)

17 Watson & Collis (1994)

18 K. & J. Truran (1994 mavpri p. 126)

19 Editorial debates prior to the publication of Sullivan et al. (1996)

20 James, pers. comm., June 1995

21 J. & K. Truran (1996)

has been interesting to be a small, identifiable part of the development of our language.

Strategies and Heuristics

The distinction between these terms is not always understood. A strategy is "the decision players make or the rules players use to determine which of the available moves to make at any given turn".[22] The term is often used only of successful decisions.[23] An heuristic is a process used to solve a problem or to find strategies for playing a game[24] or "a rule or item of information used in such a process".[25] Obviously the term does not necessarily imply success.

Statistics and Mathematics

There are some who argue that statistics should not now be seen as a branch of mathematics because both its interests and its methods are quite different.[26] Whatever the merits of this argument, in this thesis I take statistics to be a branch of mathematics because that is how it is commonly seen in schools, and schools are the principal focus of this investigation.

Obuchennyi

Unlike in Hebrew and some other languages the roots for "teaching" and learning in English are different.[27] My attention has recently been drawn in an English language article[28] to the Russian word "obuchennyi",[†] which is used to cover both learning and teaching in a sense which sees these activities as being "deeply inter-related in complex ways". Although some dictionaries suggest that the root "obuchit-" refers to "instruction" or "training", rather than deep learning,[29] the root is formed from "uchit"—teaching—and "ob-" which conveys

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22 Schroeder (1989, pp. 41–42)

23 OED (1989)

24 Schroeder (1989, pp. 41–42)

25 OED (1989)

26 E.g., Glencross (1998)

27 Dr Stephen Lerman, South bank University, UK, e-mail posting, 21 May 1996. In Hebrew the words are "lilmod" and "lelamed".

28 Adler (1998)

† I have preferred this form to Adler's "obucheni", probably a misprint for "obuchenie", because it is closer to the Cyrillic script and Russian pronunciation, and hence makes its roots slightly more obvious at first encounter.

29 E.g., M. Wheeler (1984), Akhmanova (1987)

the idea that the task has been completed,[30] i.e., learning has been achieved and the learner is able to make use of the new knowledge.[*] The term has been used by Vygotsky mostly in the context of schooling and especially with respect to the teaching and learning of meta-cognitive skills.[31] It seems to fill such a very important gap in the English language that I have decided that the benefits of its use outweighed any inconvenience to a reader in coming to terms with it. Indeed, it will prove of considerable value in developing an overarching structure for interpreting the events described in this thesis, particularly in Chapter 24. The word is spoken with emphasis on the second syllable.

OTHER POLICIES

> You must lie upon the daisies, and discourse in novel phrases of your complicated state of mind,
> The meaning doesn't matter if it's only idle chatter of a transcendental kind.
> And everyone will say,
> As you walk your mystic way,
> If this young man expresses himself in terms too deep for *me*,
> Why what a very singularly deep young man this deep young man must be.[32]

Approach to Time and Place

For convenience, the main historical summary has been divided into six chapters, delineated roughly by time. Inevitably the times overlap: historical developments are not tied to arbitrary divisions. For simplicity events from overlapping periods are placed without specific comment in the chapter where they seem to fit.

Similarly, although the major focus of the work is South Australia (SA), I have chosen examples to strengthen my argument from other places where appropriate. Such selection is eclectic, designed to show SA's place within a broader picture, not to provide a thorough study of other places. Again, no specific comment on these choices is made in the text because, as argued in

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30 M. Wheeler (1984, p. 415)

* I wish to thank Oksana Feklistova, Barr Smith Library, University of Adelaide, for her assistance in consulting some Russian language sources and clarifying the ideas presented here.

31 van der Veer & Valsiner (1991, p. 330)

32 *Patience* Gilbert (1881, p. 120)

Chapter 1, the use of eclectic data is seen as a crucial part of the method being employed here.

Bons Mots

At many places boxed quotations will be found, which might be described as "bons mots", even though not all are witty, and some are closely related to the text. This diversity is deliberate. It was originally intended that this thesis should be accompanied by an audio-visual CD-ROM with tracks appropriate for different sections of the text. This proved impracticable in the time available. In some ways the *bons mots* serve the role of the Fool in *King Lear*—they comment on the text without being subject to punishment for saying the unsayable or the not politically correct.[§] In other ways they serve the same role as the Story Teller in *The Caucasian Chalk Circle*,[33] and in other ways as the Fiddler in *Fiddler on the Roof*.[34] They are an attempt to add another dimension to the thesis without disturbing its traditional academic argument. This diversity too is deliberate.

Sexist Language

Many societies attempt to proscribe the use of certain linguistic forms by their members. Western society in the late twentieth century is prepared to tolerate many base forms of language which remind us that we are animals, but not any expression which might appear masculine, but imply the inclusion of feminine. Illogically, the reverse is often tolerated. The University of Adelaide has prescribed that all theses should conform with these conditions, so I shall not use what has been proscribed. What else can one do when six years of hard work is at stake? So one learns that even academic freedom is not absolute. If, however, I have from time to time failed to forget the language I learned at my mother's knee I can only plead support from a distinguished female ethicist and philosopher: "If we are watching out for sexism so keenly that anything which mentions 'man' or 'Lord' puts us off, both men and women will be the poorer."[35]

However, quotations will neither be altered to conform with these proscriptions, nor liberally sprinkled with "sics". For much of the period under review the use of the masculine gender was understood to include the feminine unless there was

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§ This is almost true: Lear's Fool does sometimes need to beat a hasty retreat when he strikes too close to the bone.

33 Brecht (1956)

34 Stein (1964)

35 Oppenheimer (1993, p. 437)

evidence to the contrary. Since all historical texts must be interpreted against their time, it is inappropriate to try to make them conform with today's *mores.*

Technical Matters

Italics are used for non-English words throughout unless they are judged to have become part of our language or are common abbreviations. They are also used when new terms are first defined, and also for emphasis. Context should make the distinction clear. **Terms from other languages** are used where they seem to provide *le mot juste.*[*] I have allowed myself the indulgent luxury of using archaic Latin terms like *infra* and *supra* in footnotes, but have retained English for such terms in the body of the text. Translations are not provided for terms which are found in the OED. **Quotations from other languages** are presented in the text in the original, and translations are provided in the footnotes.

A distinction is drawn between the usage of "**and**" and the ampersand "**&**". The latter is used only to link nouns which form part of a noun phrase. Such a phrase may arise in quoting joint authors (e.g., Splatt & Weedon (1996) said … or in listing elements of a commonly used couplet (e.g., "the Chance & Data Strand of the National Curriculum" or "learning & teaching" for *obuchennyi).* The form "and" is used in all other cases. So a statement like "… as discussed by Caravaggio and Tam" will refer to distinct works by two single authors, not to a joint work by two authors.

Capitalisation of titles is an area where conventions are particularly varied. The general policy in this thesis is to capitalise all main words in titles, but not at all in any explanatory sub-titles apart from proper nouns. So Acredolo et al. (1989) becomes "Children's Ability to Make Probability Estimates—skills revealed through application of Anderson's Fundamental Measurement Methodology". In the Index only the first word is capitalised, unless the term is a proper noun.The programme I am using is not very effective in adding **diacritics** to capital letters and I have chosen to omit them where their inclusion would be aesthetically unpleasing. A particular problem arises with the use of the word string "chance and data". In formal documents this is sometimes referred to as "Chance and data"[36] and sometimes as "Chance and Data".[37] Since the ampersand is to be preferred in this case anyway, the form "Chance & Data" is used consistently here, regardless of the form of the original document, except in direct quotations.

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[*] A particularly apposite phrase

[36] AEC (1991)

[37] AEC (1994a)

In journal titles which start with "the", the "the" is omitted to conform with common practice, although this is not strictly logical.

Initial capitals are often used for technical terms, particularly those forming part of the BSEM.

Making index entries where the author is an **official organisation** is always difficult. In general, I have used the common name as the principal entry, and made references from the more formal title. So "Education Department of South Australia" is the principal entry rather than "South Australia. Education Department" which is what might be found in a library catalogue. Similarly, if a title of a work with an official organisation as author does not start with the name of the organisation, there is an entry under both the organisation and the title. So there are entries for "Publication Manual of the American Psychological Association" and also for "American Psychological Association. Publication Manual". The term **United Kingdom** is preferred to "Great Britain" on political grounds, even though the Kingdom is becoming increasingly Disunited.

In a number of cases I have worked from a **translation** or a **later edition** of an original work. In such cases the date of the original work is given first, followed by a slash (/) and the date of the translation, reprint or new edition which has been cited to indicate clearly when the work first made an impact.

Square brackets [ ] are used to indicate any editorial alteration to a quoted text. Such alterations may be an explanatory insertion, or a modification to spelling or grammar to enable the quotation to fit within a sentence.

The form "**syllabuses"** has been employed rather than "syllabi". The word is etymologically impure,[38] the former is preferred by authorities, and seems to read more comfortably. The ending **"-ise"** is in general preferred to "ize", but the original is retained in quotations.[§]

The terms "**above**" and "**below**" always refer to writing within the same chapter; in other cases the number of the chapter is specified.

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38 OED (1989)

§ Peters (1995) makes it clear that Australian usage is divided, although "-ise" is more popular. She also argues that the situation is too confused for an etymological argument to have sufficient generality to sustain either usage.

Minor Matters

The term **New Mathematics** is used to refer to the movement of the 1960s based on presenting mathematics as structural system. It is never used pejoratively.

Hispanic[†] **surnames** are more complicated than most Western ones because they reflect more of their owner's parentage. This makes them rather long, and it is sometimes difficult to decide which are fore-names and which are surnames. The situation is further complicated because not all names are used all of the time, and not even all of the time in formal documents like authorship of articles. My Spanish friends tell me that they have used different forms of their names at various times in their lives for various reasons. I have used the full formal surname when this was available to me, but I may not always have done so correctly. In cases where a shortened form was used in a specific article I have used the shortened form. This has meant that some authors are referred to in more than one way. It is impossible to avoid all inconsistency in this matter.

Modern educational writing is beleaguered by a multitude of **abbreviations** which can easily overwhelm those unfamiliar with the field. I have tried to balance the need for familiarity against the demands of space and convenience, but some decisions, such as normally abbreviating the names of Australian States and consistently using "RG" rather than "Random Generator", will not be well received by everyone. All abbreviations used are spelt out when first used and listed in Appendix 1. They are not used at all in the Indexes or the author and title sections of the Bibliography.

There is an increasing trend for authors to use familiar or diminutive forms of their **forenames** when they submit material for publication. This will generate some fine challenges for future historians, because it is frequently not possible to be sure from an individual article what an author's formal name is. In general, but certainly with some exceptions, the most formal name known is used for all listings of a particular author, and abbreviated names (e.g., "Marj") are printed without full stops because it is often not possible to be sure whether that is the name by which a person in usually known.

Many of the **tables** quoted have come from a variety of sources, While the basic structure has been standardised, I have not attempted to provide a standard internal layout and have preferred to retain the original form as far as possible in order to facilitate the checking of my sources.

[†] The term is used here to include Portuguese.

Excerpts from **clinical interviews** are quoted where appropriate. Each speaker is identified by a letter or letter string. Unless stated otherwise "I" stands for "interviewer", "S" for "Subject" or "Student", and letter strings for the initials of the child. Gender, as well as age in years and months, is stated where relevant.

For convenience the term "**Year n**" is used in most places for all systems and all time periods. This disguises the fact that the mean age of children in different years in different States may differ by as much as 6 months. It also disguises the fact that the term "year" replaced the term "grade" at a time when in some places promotion to a higher level was still contingent on success in one's current level and not on one's chronological age.

Following standard mathematical use, wherever feasible I have used the term **"sequence"** in preference to **"series"** for a set of textbooks.

Books and administrative structures may for brevity be personalised. For example, statements like "The *National Statement* recommends … " are used in place of lengthy, more precise statements like "The authors of the *National Statement* recommend … ".

Because of my personal involvement in some of the events described, I have written in the **first person** if this has made for a more straight-forward presentation. Those workers whom I have met are usually introduced using their **first name** (e.g. Lennart Råde), while those whom I have not met are introduced using only initials (e.g., A. Engel). **Titles** (e.g. Professor or Doctor) are usually omitted.

BIBLIOGRAPHIC STRUCTURES

Sources

Secondary sources are usually seen as documents likely to be found in university libraries. But the **provenance** of some items listed in this way is dubious, especially minor dissertations and long essays, which universities increasingly do not accession, even though they may be regularly cited and a real contribution to knowledge. Frequently, such documents find themselves on a lecturer's shelves until he or she leaves the institution, after which they may or may not join their friends in a cupboard in the administrative offices. Clearly, some skill is needed to find such documents and success cannot be predicted in advance. Neither teachers nor librarians can be proud of the mess into which they have allowed the recording of scholarship to fall. In all cases where the provenance is not simple or

obvious, I have tried to indicate enough information to enable the reader to locate the document. Inevitably, this information may quickly become inaccurate.

Because of the nature of this study, many of the primary sources are public documents which have been formally published and so fairly easily accessible. Others are public documents which have been informally distributed, sometimes widely, sometimes not, and which may be difficult to locate through normal channels. Because of the size of the bibliography I have not separated **primary published documents** from **secondary published documents** in order to make the references easier to find. So while I have listed primary unpublished sources separately, all other sources have been linked together into one list headed "Secondary and Published Primary Documents". E-mail comments which I have read on electronic networks are not listed in the Sources, but the documents are held by me, and the full date is listed when the comment is cited. Ideally, the nature and purpose of the discussion group being read should have been cited, together with the URL of any archive, but such approaches were only beginning when this thesis was commenced, and sound recording principles had not really developed. E-mail comments are specifically distinguished in the Citation Index.

Referencing

This thesis contains material written within both the historical and the psychological tradition. None of the commonly used styles from different disciplines seems adequate to communicate what I want to say. Rather than adopt a rigid style, in a way beloved by the editors of many journals, I have decided that just as a benign leader will "[l]et the punishment fit the crime",[39] so will a perceptive editor let the presentation fit the text. If some inconsistency arises from chapter to chapter, then so be it.

Conventions for **citations** in the Sources have been framed after consulting the Australian *Style Manual for Authors, Editors and Printers,* the *Publication Manual of the American Psychological Association* and *The Cambridge Australian English Style Guide*.[40] No one guide can be followed precisely, so I have just tried to use a style which is helpful and consistent within this thesis. The didactic, rather dictatorial style of the two Manuals is off-putting to a thoughtful person, so Peters' more tolerant, reasoned approach has been of more help when considering difficult cases. References to electronic materials on the World Wide Web follow the American Psychological Association but with electronic addresses being enclosed

39 Gilbert (1885, p. 202)

40 Peters (1995)

by "< >" Such materials have unreliable life-spans: they are only provided when absolutely necessary, and I retain hard copies of all such documents. **Electronic journals** usually have no pagination, but their web-sites are indicated. However, the status of such journals is still not secure, and their medium makes it inevitable that both they and their URLs* are more ephemeral and transient than printed texts. Surprisingly, there is little or poor formal guidance given for citing the material available only in **audio-recorded form**, including **oral history** material. So I have consulted two standard works[41] and devised my own scheme for listing such material, trying to include as much detail about sources as possible.

Sometimes I have deliberately chosen non-standard forms. At least one **forename** is given wherever possible—the minimalist approaches usually employed may save space, but they are not reader-friendly. The names of **multiple authors** are separated by semi-colons to avoid using a comma with two distinct meanings in close proximity. Where an article is taken from a book or conference proceedings then to save space only a **short title** is usually provided in the article reference and the full title of the book is listed separately.

The **Harvard system** of referencing can become ungainly and unhelpful when referring to reports. For example, Australian Education Council (1991) is less easy to interpret quickly than *A National Statement on Mathematics for Australian Schools* or, where the context makes it clear, "the National Statement" or the *National Statement.* Similarly "the Karmel Report" may be preferred to Karmel (1971). Such variants are cross-referenced in the Bibliography where appropriate.

The Harvard system utilises lower case letters in alphabetical order to distinguish works by the same author published in the same year. This can lead to difficulties in a large work when a new reference is inserted at a late stage, perhaps requiring changes in several chapters. It may also require all previous ones to be re-lettered because its title took alphabetical priority over the others. So, since the **letter codes** have no intrinsic meaning, I have sometimes used other codes to modify the date of a publication. For example, the text may contain references to

Smith (1987)
Smith (1987b)
Smith (1987merga)
Smith (1987mich)

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* Initially Vince Cerf, one of the founders of the Internet, used the term "Unique Resource Locator". In recent times some have replaced "Unique" by "Universal. (Hyde, pers. comm., 2 August 1998)

41 *Publication Manual of the American Psychological Association;* Robertson (1994)

Smith (1987sem)

Such a list would suggest that something like the following had happened. One article by Smith had appeared early in the writing of the thesis. A second appeared later and was called "1987b" with the unfulfilled intention of renaming the first as "1987a". Once it was realised that there would be several articles by Smith from 1987, letter string additions were used to indicate either where the papers were presented (at a MERGA conference or in Michigan) or their topic (semantics). Such an approach retains the one-one mapping of citation onto article, but has the added advantages of being easy to work with and of minimising the likelihood of errors arising when symbol strings are changed to fit the traditional rules. A negative consequence is that the titles of the works for a specific year may not appear in alphabetical order, but there will never be so many of these that this will prove a serious problem for the reader.

Historical material requires many references to support the arguments made. **Footnotes** have been used rather than endnotes for the convenience of the reader.[§] Those which indicate merely the source of a statement are indicated by a number, and footnotes which contain additional comment are indicated by one of the usual non-numeric footnote symbols (*, †, §). Footnotes to entries in tables are indicated by a non-numeric symbol enclosed within brackets and are placed immediately below the table itself.

My wife, **Kath Truran**, is also doing research into children's understanding of probability. This is of mutual benefit, as I have mentioned in the Acknowledgements. Our individual work is referred to as "J. Truran" and "K. Truran", joint papers as " J. & K. Truran" or "K. & J. Truran".

Indexing

It has been relatively unusual for academic dissertations to supply an **index**. But "[a]ny book that ever served as a reference in any sense of the word (and what book does not, except light fiction?) should have a quality index to make its information quickly and completely available. A good book is not to be read and forgotten but reread and used".[42] Now that efficient indexing facilities are a

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§ "Like the high whine of the dentist's drill, the low rumble of the footnote on the historian's page reassures; the tedium it inflicts, like the pain inflicted by the drill, is not random but directed, part of the cost that the benefits of modern science and technology exact." (Grafton, 1997, p. 5)

42 D. & A. Cleveland (1990, p. 33)

normal part of a word-processing package, providing an index is relatively easy. The difficulty is to decide what the index should contain.

The task of an indexer is to try to decide what information is likely to be wanted by potential readers, and to make it accessible as easily as possible. Given that dissertations tend not to be read widely, for this index I decided that the most likely user would be myself, who could be seen as a representative example of academics working in this field. Based on my experiences using the index to my Masters dissertation, I decided that the index should provide access not only to main ideas and to all authors who have been cited, but also to small points which might well be difficult to locate in any other way. It should also provide an alternative way of browsing the text by making linkages which would not be obvious from a standard reading or from a reading of the Table of Contents which should in many cases be the first point of contact soe a specific search. This has meant that the index is more detailed than would be found in a normal book, and that some topics have a large number of subheadings, which means that some index entries provide a comprehensive indication of how a topic is approached. The recommendations of D. & A. Cleveland (1990) have been of great value in providing guidelines for how the indexing might be done, but the version finally produced would probably be seen by them as being excessively detailed.

Three indexes are provided—Citation, Individuals & Institutions, and General—to make it easier to see both my sources and the topics which are discussed. There is one disadvantage to this approach. Sometimes an author's work is discussed without being quoted. These references appear only in the Individuals & Institutions Index, so, if an author's ideas are being searched for, both indexes should be consulted. While footnote comments are included in the Index where appropriate, the program I am using does not provide a way of specifying that the information indexed is to be found in a footnote. Again, because of the way my indexing program is constructed, the order of entries in the Citation Index does not match exactly the ones in the Sources, particularly for jointly authored works and for "Mc" names.

> And with that word we riden forth our way;
> And he began with a right merry cheer
> His Tale anon, as said as ye shall hear.[43]

[43] Chaucer *Canterbury Tales. Prologue* ll. 853–855