

**THE MYTH OF THE STANDARD GAUGE:  
RAIL GAUGE CHOICE IN AUSTRALIA,  
1850 – 1901**

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## ABSTRACT

This thesis describes the rail gauge decision-making processes of the Australian colonies in the period 1850 – 1901. Federation in 1901 delivered a national system of railways to Australia but not a national railway system. Thus the so-called “standard” gauge of 4ft. 8½in. had not become *the* standard in Australia at Federation in 1901, and has still not.

It was found that previous studies did not examine cause and effect in the making of rail gauge choices. This study has done so, and found that rail gauge choice decisions in the period 1850 to 1901 were not merely one-off events. Rather, those choices were part of a search over fifty years by government representatives seeking colonial identity/autonomy and/or platforms for election/re-election.

Consistent with this interpretation of the history of rail gauge choice in the Australian colonies, no case was found where rail gauge choice was a function of the disciplined search for the best value-for-money option. To the extent to which economic variables were considered in rail gauge choice, the initial cost of construction became the proxy for value in building and operating railways. In Australia engineers’ opinions in the role of advice to governments or parliamentary committees were substituted for rigorous evaluation.

These and other findings were reached by reference to primary documentation including companies’ minute books, official correspondence and reports of the proceedings of parliamentary committees, generally missing from earlier studies. This study analyses and interprets them by reference to the history of the “standard” gauge, to the economic and constitutional settings of the time, and by reference to rail gauge choices and decision-making processes in other large developing economies of the time, notably Brazil, India and the United States. In so doing a new narrative and interpretive study of early rail gauge choice in Australia has been created.

The finding that previous studies of the early development of Australian railways either ignored or misread important documents has led to a reappraisal of the part played by several individuals, including engineers in all four colonies, Lieutenant-Governor LaTrobe and WE Gladstone in his role as Secretary of State for the Colonies and for War.

**DISCLAIMER**

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published, or written by another person except where due reference is made in the thesis itself.

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Signed John A Mills

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I alone am responsible for the errors.

**ABBREVIATIONS**

ARA	Australian Railway Association
ch.	Chapter
CYB	Commonwealth Year Book
EIC	East India Company
EIRC	East Indian Railway Company
F	Financial year
FC	Ferro Carrile (iron road)
ft.	foot; feet
GDP	Gross domestic product
GIP	Great Indian Peninsula Railway Company
GWR	Great Western Railway (Company)
in./ins.	inch(es)
LA	Legislative Assembly
LC	Legislative Council
m.	metre
NSW	New South Wales
PP	Parliamentary Papers (UK Parliament)
p./pp.	page/pages
Q	Queensland
Q Pp	Queensland Parliamentary Papers
QYB	Queensland Year Book
RN	Royal Navy
SA	South Australia
SAPP	South Australian Parliamentary Papers
SMH	Sydney Morning Herald
SRC	Sydney Railway Company
UK	United Kingdom
US	United States
USA	United States of America
V	Victoria
V&P	Votes & Proceedings
V&P NSW LC(A)	Votes & Proceedings New South Wales Legislative Council or Assembly

## 1. INTRODUCTION

### 1.1 The Research Question

“How did Australia’s mixed rail gauge systems come about?” The history of rail gauge choice in Australia is poorly understood. It is characterised by oversimplification and distortion, and in some cases, its arguments are methodologically and substantively unsound. To the extent to which decisions of the future depend on our accurate understanding of the past, it is as well to document that understanding. This thesis does so.

The decisions that led to Australia’s mixed rail gauge systems are between one hundred and one hundred and fifty years old, yet they have a contemporary echo. This is because the Commonwealth Government has in recent years shown a much greater interest in fostering investment in rail. Following commissioning of the Adelaide-Darwin investment in January 2004, (Fischer 2004), consideration was given to an inland railway through the hinterlands of the eastern states (see House of Representatives Standing Committee on Transport & Regional Services enquiry “*Integration of regional rail & road networks and their interface with ports, 2005* – also Laird (2001)). Given that investment in railway infrastructure is large in relation to some other infrastructure items, the consequences of success and failure are both large.

Australian railways are unusual in the diversity of railway track gauges they employ. Track gauge, or rail gauge, is the width between the inside faces of a pair of rails (Puffert 2000, p. 933). In many regions and nations of the world, main lines of trunk railways use a single gauge. For example, the railways of Europe and North America use a track gauge of 4ft. 8½in. almost exclusively for their main trunk line railways (Harris (ed.) 1998/9, otherwise known as *Jane’s World Railways* 1998/1999).

There are exceptions. India has a main trunk line gauge of 5ft. 6in. (Koshal 1971). Not only that, other lines have a gauge of 1 metre (Bell 1887), and certain local “hill” railways use a very narrow gauge to cope with the steep terrain. Japan too is an exception: its main trunk lines were built at a gauge of 3ft. 6in., and 4ft. 8½in. was adopted for its famous “Bullet” trains (Imashiro 1995). Argentina and Brazil are also exceptions. Argentina uses 5ft. 6in., 4ft. 8½in. and 1 m. gauges on its main lines. Brazil’s main gauge is 1 m., but 15% of its current trackage was laid at 5ft. 3in. (Lavis 1914). Australia is most like Argentina in

its use of three main line gauges. Australia uses 5ft. 3in. in Victoria and South Australia, 4ft. 8½in. in New South Wales and Commonwealth-owned railways, and 3ft. 6in. in Queensland, South and Western Australia. At the turn of the nineteenth century, a fourth gauge of 2ft. 6in. was in use in Victoria. By 1940 there were 11 breaks of gauge in the Australian systems (Laird 2001, p. 4).

In short, the use of a single, uniform gauge is far from universal practice, and the gauge of 4ft. 8½in. (1435mm.), though widely regarded as *the* standard gauge, is in fact far from standard in Australia, and in many other parts of the world. Table 1.1 below identifies the distance covered by tracks built to various rail gauges around the globe. A number of gauges dominate, yet 4ft. 8½in. accounts for only about 58% of the world total. Table 1.2 sets out the data for the railway systems of Australia. The share of 4ft. 8½in. in total trackage has not yet achieved 50% in Australia, although its share is now greater than that of the 3ft. 6in. gauge. The Australian result has been achieved primarily because of the new construction involved in the Commonwealth Railway from Port Augusta in South Australia to Darwin in the Northern Territory.

Standardisation was largely achieved in Europe and North America by 1900. Elsewhere, where more than one gauge was in use, the mix was stabilised at minimal diversity. Standardisation was everywhere regarded as the preferred economic structure, on the grounds that it was more efficient than diversity (Puffert 2000). Even as early as 1900, Australia was almost alone in not only maintaining a diverse system of rail gauges, but in diversifying further.

**Table 1.1**  
**Principal Railway Track Gauges, 2000**  
**Regions/Countries with more than one Gauge**

<b>English</b>			
<b>Gauge (ft. in.)</b>	<b>Metric (mm.)</b>	<b>Major countries and regions</b>	<b>Proportion of world total - %</b>
2' 6"	762	China, India*	1.7
3' 0"	914	Colombia, Guatemala, Ireland*	0.6
3' 3.37"	1000	East Africa, Southeast Asia*, Argentina*, Brazil* Chile*, India*, Pakistan*, Spain*, Switzerland*	8.8
3' 6"	1067	Southern Africa, Southeast Asia*, North Africa & Middle East*, Australia*, Japan*, New Zealand, Newfoundland	9.0
4' 8.5"	1435	Europe*, North America, North Africa & Middle East*, Argentina*, Australia*, Chile*, China*, Japan*	58.2
5' 0"	1524	Former USSR, Finland, Mongolia	12.8
5' 3"	1600	Australia*, Brazil*, Ireland*	1.2
5' 6"	1676	Argentina*, Chile*, India*, Pakistan*, Portugal & Spain	7.0

Notes: \* Percentages add to less than 100 due to additional, rare gauges.

Source: Puffert 2001b, Table 1

**Table 1.2**  
**Track Lengths by Gauge (km.)**  
**Australia 30 March 2003**

<b>Jurisdiction</b>	<b>Gauge</b>			<b>All</b>
	<b>3ft. 6in.</b>	<b>4ft. 8½in.</b>	<b>5ft. 3in.</b>	
1. Queensland	9380	118		9498
2. NSW		7346		7346
3. Victoria		451	3609	4060
4. South Australia	748	595	408	1751
6. Sub-total	No. 10128	8510	4017	22655
	% 44.7	37.6	17.7	100.0
6. Western Australia	4032	1598		5630
7. Tasmania	890			890
8. Sub-total	15050	10108	4017	29175
9. National		6081		6081
10. Total	15050	16189	4017	35256
11. National (under construction)		570		570
12. Grand Total	No. 15050	16759	4017	35836
	% 42.0	46.8	11.2	100.0

Source: Australasian Railways Association Yearbook 2003, p. 8. Excludes dual gauge track (281 km.) and the Queensland Sugar Cane Railways network of 2ft. gauge.

This thesis provides an account of how Australia's diversified rail gauge systems came about. It does this by describing and analysing the rail gauge choice decisions made in the Australian colonies between 1850 and 1901, the year of Federation. The conventional descriptions of the origins of the mixed gauge systems in Australia usually attribute them to a difference of view between two engineers of the Sydney Railway Company.

Australia suffers from a diversity of gauges today largely because of a stubborn Irish engineer and a stubborn English engineer who each wanted to adopt the gauge of their homelands (that's a bit of an oversimplification, but essentially correct).

Puffert 1996, p.1

Other writers who allocate the prime responsibility to one or both of these engineers are Blainey (2001) and Shann (1930).

Puffert is correct in describing this as oversimplification. It fails to recognise that the decision-making process was one which involved boards of directors, local legislatures, colonial governors, the British Secretary of State for the Colonies, and advisers in the British Board of Trade (Ward 1958; Parris 1965).

Conventional explanations of the origin of the mixed gauge also confine themselves largely to the original decision of NSW and Victoria – see for example Kernot (1907); Denniss (1942). They give little weight to the choice of 3ft. 6in. gauge by either Queensland or South Australia, which occurred ten to fifteen years later than the original gauge choices. Neither do they recognise that issues of gauge choice were not simply one-off decisions, but part of an on-going debate about the most economical way to construct railways, a debate that continued for at least forty five years after the original mixed gauge decision. For example, the last of Australia's four gauges was not introduced until the 1890s (Harrigan 1962, pp. 95 - 6), and after a series of Victorian parliamentary enquiries spanning forty years.

## **1.2 Methodology**

This thesis is empirical. It sets out to find out and document what actually happened to bring about the gauge choices made by the Australian colonies. The scope of the thesis was defined to include the railway systems of NSW, Victoria, Queensland and South

Australia. This scope excludes the systems of Tasmania and Western Australia because they were not connected to the eastern states systems in the material period, that is 1850 to 1901. Neither the Tasmanian nor Western Australian systems added to the colonies' gauge diversity. After early trials, both settled on gauges used in other Australian colonies. Commonwealth railways are not considered in this study because they did not exist prior to 1901.

The identification of sources was a process which continued throughout the study period. It iterated between secondary and primary sources as study efforts became increasingly refined. As data from primary sources accumulated, it seemed that some had not been consulted by authors of secondary sources, or had been consulted but were arguably misconstrued. The secondary sources are identified in Chapter 2 – Literature Review. Those primary sources that proved to be of most value were found in the State Archives of the four subject states, and the public libraries of Victoria and South Australia. The primary resources consulted include the original minute books of the board of directors of the Sydney Railway Company in NSW and of the Melbourne & Hobson's Bay Railway Company in Victoria, both held in their respective state's Archives. The LaTrobe Library in Victoria contains a collection of papers generated by LaTrobe and associated officers, although upon examination, they threw no light on rail gauge issues.

The parliamentary proceedings of the day were consulted extensively, including both records of parliamentary debates, and of the proceedings of parliamentary select committees and other enquiries. The select committee reports and proceedings were of particular value. There were scores of parliamentary reports on railway issues from the inception of the four colonial parliaments to 1901. A large proportion referred either directly or indirectly to gauge issues. Those reports customarily include copies of official correspondence which took place before the enquiry commenced, and sometimes during it. They contain questions from enquiry members and responses from witnesses generally selected for their capacity to give a specialist and/or representative point of view. They often contain technical reports as appendices. Reliance on the sources described above followed an early finding that certain material, key to the debate, had been misrepresented in the literature, sometimes serially. In some cases, key material was overlooked by some

authors. It was decided that as far as possible, this thesis should allow participants in the gauge debates to speak for themselves, even at this remove in time.

A second feature of the methodology of this thesis lies in its recognition that the history of rail gauge choice is embedded in the history of railways. Further, the history of railways is embedded in the constitutional, economic and social characteristics of the period under consideration. The history of railways cannot be properly understood without understanding their links to those aspects of culture. For example, many of the key decisions about railways were made by people in government. But what roles did they play in government? What authority did they have to make railway-relevant decisions? And how wisely did they use that authority? These are all questions the answers to which influenced railways' development paths. Hence this thesis gives weight to economic and constitutional features of the society in which colonial railways developed.

A third feature of the methodology of this thesis is its recognition that while rail gauge choices were made *locally*, the technology and the debates within the technologies had been taking place in *global* settings since the 1820s. This thesis will work with many examples which illustrate this point. One such is the fact that much of the rail gauge debates was conducted within the Proceedings of the Institution of Civil Engineers, which though British in origin is a global body. Founded in 1818, this body represented professionals engaged in railway design and construction (Lee 2000). The presentation and discussion of papers about rail gauge issues in this forum took place over a period from 1873 to 1922 (Kerr 1995 p. 21), with case material drawn from India, Norway, Queensland and the UK.

In the second half of the nineteenth century, the Australian colonies were not alone amongst the developing economies. All were confronted with how best to bring railway technologies and properties into economies whose transportation modes were predominantly road or water. Other economies at not dissimilar stages of development included Argentina, Brazil, Canada, India and North America. This thesis seeks to incorporate perspectives from those economies into its treatment of Australian colonial rail gauge choices, and is unique in this respect.



Part of this thesis' contribution lies in some analyses and conclusions that challenge certain long-standing and widely-held views about the subject. For example, standard histories of the first rail gauge controversy (for example Gunn 1989; Harrigan 1962) do not attribute an independent role to the Lieutenant-Governor of Victoria, LaTrobe. As opposed to this, the research described in this thesis demonstrates that LaTrobe was the sole decision-maker on behalf of Victoria, and that his decision was not based on rational economic grounds. Another example is the common attribution of an injunction to standardise at 4ft. 8½in. by William Gladstone in January 1846 in a despatch which is in fact silent in respect of both gauge and standardisation.

### **1.3 Economics and Railway Technologies**

As pointed out above, the way in which railways developed was in part a function of local constitutional, economic and social factors. It was also a function of the technologies embedded in it, and of the economic features attached to those technologies. A basic understanding of these features is needed in order to understand how and why controversies developed about railway gauge choice, and if and how those controversies were resolved. Inevitably, the subject entails its own jargon, and familiarity is needed with this too in order to understand the gauge debates.

Railways are a function of changes in two technologies. These are the technologies of propulsion and of adhesion. The first critical change in the technology of propulsion occurred when Trevithick produced the first steam locomotive in 1804 (Rolt 1960, Chapter 5) The first critical change in the technology of adhesion occurred when parallel rails could be made strong enough to take the weight of a moving steam locomotive. Railways resulted from the two being combined. While Trevithick triumphed with the first, he failed with the second – his locomotives kept breaking the rails on which they ran.

As noted, rail gauge is the distance between the inside edge of a pair of rails. The gauge of working railways has varied between the 1ft. 11½in. of the Festiniog railway of Wales (Kerr 1998, p. 5), and the “broad” gauge of Isambard Kingdom Brunel’s Great Western Railway, running between London and Bristol at 7ft. 0¼in. in the period 1835 to 1892 (Robbins 1962, p. 21). Some would argue that that the 15 inch gauge of the Romney Hythe and Dymchurch Railway make it the smallest working gauge. While it has earned revenue

from conveying commuters over its 13.5 mile length, it is arguably a working toy of its wealthy entrepreneurial parents. In any event, it was not built until 1927, and thus made no contribution to the “battle of the gauges”. Not uncommonly, railways in particular regions have been built at different gauges. For example, there were fourteen different gauges in use in north-eastern USA before the US Civil War began in 1861, ranging from 4ft. 3in. to 6ft. (Westbay 1933 p. 32). The term “break of gauge” is used to describe the point at which two different gauges meet. Progress in either direction from that point requires passengers and freight to be transhipped from one railway to another. A “mixed gauge” system is a railway which operates with one or more track gauges.

A number of techniques was developed to manage breaks of gauge. All of them involved railroad operators in incurring capital and operating costs in excess of what would have been incurred with through running. One commentator described these consequences of mixed gauges in the USA as follows:

By about 1870 railroad traffic had increased until it constituted a burden of no small consequence at gauge-breaking points. The necessary transfers not only caused delay but were expensive. It was necessary to provide at such points facilities for handling locomotives, cars, and all other equipment of both gauges, as well as to maintain yard and other tracks for both gauges. In order to reduce the volume of traffic actually transferred to a minimum, it became the practice to change trucks under cars whose lading was destined beyond the gauge-breaking point and handle the car through. Obviously it was necessary that the car return via the same gauge-breaking point through which it had already passed in order to replace its trucks. The number of cars which were so handled through any gauge-breaking point depended upon the number of available trucks at that point.

Westbay 1933, p. 33

On the face of it then, a railway operating with a single gauge is likely to be more efficient than a mixed gauge system. Given complete freedom to choose any gauge, it might be thought that any region installing a railway would elect a uniform gauge as the most economic option. Many regions did not however do this. There is a range of reasons why a non-uniform solution might be chosen. These are explored in subsequent chapters.

It should be noted that in some respects, railways may be regarded as community goods; that is, they create costs and benefits for the community in addition to those attaching to their own producers and consumers. They may also create costs and benefits which attach

to some classes of consumers more than others. These additional costs/benefits are referred to as “externalities” in the economic literature of today – see Varian (1996, Chapter 31). One example of a community-wide externality with positive economic effects is the siting of a railway terminal in a community for the first time. This usually creates employment and adds to consumption in the local community. It may also accelerate the provision of infrastructure to cope with the expanded population. An example of a restricted externality may be found in the debate about Britain’s “silly little bob-tailed” coal wagons – see Scott (1999) and (2001) and Van Vleck (1997) and (1999). Other potential shippers were crowded out of use of British rail freight capacity because of its over-utilisation by coal wagons. The terminology [that is “externalities”] was not in use in the nineteenth century, but the phenomenon was widely recognised. See for example, the case put by early advocates of railways to the Governor of NSW.

Many of the controversies about railways are a function of difficulties in identifying externalities, which stakeholders are affected by them, and how those effects might be measured. Perhaps the classic example concerns an argument for *introducing* a mixed gauge into India where previously a uniform gauge ruled. The argument for doing so runs that the benefits to the region (the “externalities” – unquantified) from the introduction of a mixed gauge railway system were so great that they vastly outweighed the costs of managing a mixed gauge system, or worse, of relying on the historical transport solution, roads. So manifestly great were the benefits that there was apparently no need to identify them or measure them (Thornton 1873).

Railways have some peculiar characteristics as investments. The first is that the cost of installing a railway over any significant distance is very large indeed. The second is that design and construction may take a number of years, so long time periods elapse between the stages of conceiving, planning and committing expenditure and earning a dividend. A third is that the expenditure is “lumpy” – its break-even may be high in relation to revenue flows. A fourth is that investment in railways is a “sunk” cost, that is, once the investment is made, the capital involved cannot be redeployed. There is, for example, little alternative use for a disused railway embankment. See Bitzan (2000) for a detailed exposition of the cost structure of railway systems.

Given these features of railway investment, most investors in new railways continually searched for ways of getting the best possible return on their investment as early as possible. In this context, the conventional wisdom in many quarters came to take the rather simplistic view that the cost of constructing and operating a railway was proportional to the gauge selected for the railway. Thus, a railway at 4ft. 8½in. would necessarily cost 26% more than one built at 3ft. 6in. – or more pointedly, a 3ft. 6in. railway would cost only 74% of the cost of its 4ft. 8½in. counterpart. This proposition proved difficult to validate because there are a number of other design parameters involved, such as loading gauge, (the smallest aperture through which a train could pass, and thus a determinant of the diameter of tunnels etc.), gradients (and thus the extent of the need for embankments and cuttings to level a route), and the tightness of curves. Variances on these parameters are capable of swamping any variance due only to rail gauge. Many years elapsed before the first “battle of the gauges” was resolved by a consensus that a gauge of around 5ft. was probably optimal, and there was little to choose between 4ft. 8½in. and 5ft. 3in. on efficiency grounds (Puffert 2000, p. 950). Thus 4ft. 8½in. emerged as the standard gauge in North America, because there was more of it when it came time to make the choice.

In the 1860s the “battle of the gauges” shifted to argument about the respective merits of the “narrow” gauge (including 3ft., 1 m. or 3ft. 3⅜in., and 3ft. 6in.) against the standard gauge. This battle is still being fought. For example, the Federal Government’s recent enquiry has heard about concerns regarding the narrow gauge railway from Toowoomba to the Port of Brisbane. Another example may be found in the report by Ferrandiere *et al* on the derailment of Queensland’s tilt train (Ferrandiere *et al*, 2005, p. 45). This article reports old questions being re-raised about the suitability of narrow gauge track for the running of very fast trains.

#### **1.4 Thesis Structure**

Chapter 2 of this thesis sets out a review of relevant literature. The first part refers to the European sources used to establish the early history of rail gauge and to trace emergence of the 4ft. 8½in. as the main claimant to the title of standard gauge. This part also includes a review of sources used to establish rail gauge choice histories in India and North and South America. The second part reviews Australian secondary sources. These are separated into sources from the nineteenth century, and later material. Later sources were used separately

by subject matter: general/economic history as one set, railway and local/regional history as a second, and constitutional history as a third. This review led to the production of Appendix 5, “*A Chronology of Selected Secondary Sources about Railways and Railway Gauge in Australia*”, which is regarded as an original if minor contribution in its own right.

The gauge of 4ft. 8½in. was first established as a “standard” gauge in England. The third chapter recounts the history of the emergence of 4ft. 8½in. as *the* standard gauge to the point where in 1846, British legislation established it as the standard for England, Scotland and Wales – *and* continued 5ft. 3in. as the standard for Ireland.

The fourth chapter gives an account of the history of rail gauge choices in India, Brazil, and North America. These accounts depend entirely on secondary sources. These accounts are not intended to provide material comparable in depth to those in Chapter 5, but to provide sources of insight that may be useful in interpreting Australian histories. It stops well short of presenting a general theory of the *non-standardisation* of railway gauges in places such as Argentina, Brazil and India.

The fifth chapter is the largest chapter and is central to the work. It traces the history of rail gauge choices in each of the colonies of NSW, Victoria, Queensland and South Australia. Each of the four main sections makes extensive use of primary material, including parliamentary proceedings, and minutes of railway company board meetings.

Chapter 6 brings together the main points and themes of both overseas and Australian colonial experience, pointing to parallels or differences as appropriate.

Chapter 7 is the final chapter. It draws conclusions on issues of rail gauge choice in Australia.

## **1.5 Summary**

This thesis addresses the question “How did Australia’s mixed rail gauge systems come about?” It does so by examining the history of rail gauge choice decisions in NSW, Victoria, Queensland and South Australia in the period starting with the inception of railways in the Australian colonies, and ending with federation. It relates those decisions to

the economic and constitutional circumstances in the colonies in the period 1850 to 1901. It results in a new cohesive narrative of rail gauge related events in four colonies over a single time frame.

It reviews the development of railways in the developing economies of India, North and South America in the same time frame, and notes similarities and differences. Its extensive use of primary sources in Australia has resulted in some conclusions which challenge some accepted versions of rail gauge choice history, and its contribution is unique in this respect. It has also resulted in the construction of a unique compilation of sources which could be of some value to students of the history of Australian railways.

The thesis notes that after nearly one hundred and eighty years of railway technology, 4ft. 8½in. has failed to emerge either as a global standard rail gauge, or as standard in Australia. It is recognised as predominant, and it is recognised that in some regions its adoption is to all intents and purposes, universal. But there are large regions such as Argentina, Brazil and India, where other measures have been adopted as standard, and which show no sign of conversion to 4ft. 8½in. At the end of the nineteenth century, Australia was close to unique in its use of four gauges. Three remain in use to this day.

The main reason for Australia's mixed rail gauge system is that its railways consist of components originally designed not to serve the needs of the nation, but to serve the needs of the railways' parent colonies. The colonies were autonomous and independent units of government, given the authority by the "parent" British government to make their own choice of rail gauge. They made their gauge choices in accordance with their perception of their own economic and geographical circumstances, and to buttress if not promote, their individual identities as colonies. That they now constitute a sub-optimal national system is a function of the constitutional arrangements at the time of their birth, arrangements which changed at Federation.

Previous studies attribute Australia's mixed gauge system to the work of the two engineers of the Sydney Railway Company. This study shows this attribution to be incorrect. The decisions which led to the mixed rail gauge system were made by the Governors of NSW and Victoria. The Governor of Victoria decided to adopt a gauge of 5ft. 3in. and in doing

so, introduced the first of the mixed gauges. Previous studies have either not considered or have misinterpreted the documentary evidence for this conclusion. They have also misconstrued the role of WE Gladstone in rail gauge decision-making in the British colonies.

## **2. LITERATURE REVIEW**

### **2.1 Introduction**

This review analyses the academic literature concerning the history of railways and railway gauge. The material reviewed was chosen primarily because of its potential to provide data pertaining to rail gauge choice. Literature pertaining to the European history of the “standard” gauge is analysed first. Because railway technologies originated in Europe this provides a logical point of departure to the subsequent review of rail gauge choice decisions in Brazil, India, and the United States of America. Literature in relation to Argentina was also reviewed, but it was found to be inadequate with respect to rail gauge choice in that country. The early consideration of these subjects provides a global context within which to review the literature about Australian rail gauge choices.

The review of Australian literature gives precedence to contemporary nineteenth century contributions. This provides views about how analysts and commentators then saw rail gauge choice issues. Sources from after 1900 are divided into three categories in order to facilitate treatment of component issues. The first group consists of contributions from national history and economic history. The second covers sources which are railway-specific and/or specific to the history of particular regions. The final category embraces accounts of constitutional history as they relate to decision-making about railway gauges. This last includes analysis of a case in the literature of misrepresentation.

### **2.2 International Sources**

The greatest volume of work about the history of railways originates in the United Kingdom and North America. Significant works also exist about railway history in many other countries. India, Ireland and South America, as well as the UK and North America, are of particular interest to Australia, since they all began and/or persisted with, mixed gauge systems. Those UK writers who stand out are Gourvish (1980, 1985, and 2002); Hawke (1970); Jackman (1916); Lee (1948); Marshall (1971); Robbins (1962); and Simmons (1978). Since modern railways were born in the coalfields of north eastern England, the history of the coal industry constitutes useful background to understanding the origin of railways. Nef (1932) and Flinn (1984) are important in this context, and the work of Lewis (1970) is a strong bridge between the coal and railway industries. The Proceedings of the Institution of Civil Engineers and of the Institution of Mechanical



Engineers, particularly over the second half of the nineteenth century, contain a number of significant papers in respect of railway gauge issues.

Railways developed early in Ireland. The Dublin to Kingstown line was the first of these and was commissioned on 17 December 1834. It was laid at a gauge of 4ft. 8½ins. As railways proliferated in Ireland, so did the selection of railway gauges (Robbins 1962, p. 96). It was deemed necessary for the British government to legislate a standard gauge for Ireland, and it mandated 5ft. 3in. for this purpose in 1846, in the same Act of Parliament which mandated a standard of 4ft. 8½in. for England, Scotland and Wales. The history of railways in Ireland is recounted in Conroy (1928); Doyle and Hirsch (1983); Middlemass (1931); and O'Connor (1999).

Work on rail history in North America has been produced by Fogel (1971); Hilton (1990); Jenks (1944); Puffert (1991, 1996, 2000, 2001a, 2001b, 2003); Stover (1997); Taylor & Neu (1956); Vance (1995); and Westbay (1933). Puffert's work is particularly relevant to this thesis because of its exploration of the role and mechanics of path dependent processes in bringing about railway gauge standardisation in the USA. The work of Chandler (1977) is also indirectly relevant as he seeks to explain how the management structure of American businesses, especially the railroads, emerged in response to the challenges faced by those rapidly developing organisations. The part played by market forces in creating pressure for gauge standardisation is of particular interest. An earlier North American contribution of note to the gauge debate is Seymour (1871).

One of the longer-running, and still unresolved, controversies surrounding railways is the extent to which investment in railways has acted as a stimulus or catalyst for economic development in regions in which railways were built, and/or from which items of a significant capital nature were supplied. In the UK the main contributors to this debate have been Hawke (1970), and Gourvish (1985). In the USA the main participants have been Jenks (1944); Fogel (1971); Fogel & Engerman (1971); and David (1975).

As indicated above, Indian, and some South American railway systems, have some relevance to the Australian experience. Construction of railways began in India in the 1850s, as it did in Australia, with India choosing a "standard" gauge of 5ft. 6in. In 1870,

the colonial government of India opted for a system of what was to be a separate system at a gauge of 1 m., but in practice introduced a system in which there were multiple points where breaks of gauge occurred. There is a wealth of material available in respect of India, with major contributions from Kerr (1995, 2001). As Kerr points out, the gauge controversy can be most easily followed by reference to four papers, and subsequent discussion and correspondence, found in the Minutes & Proceedings of the Institution of Civil Engineers. As noted by Kerr (1995, p. 21) these papers were authored by Thornton, (1873); Waring (1889); Upcott, (1906); and Royal-Dawson, (1922). They are important contributions to the gauge debate because they illustrate the arguments on both sides of the debate, and how they changed over time. Although they occurred in the context of Indian railways, they took place in a forum which was essentially global in its audience and influence, and over a period of time in which new railways were being developed all over the world. Indian views and experience were widely quoted to select committees and other enquiries in a number of Australian jurisdictions.

In terms of scale and density, the two South American railways of greatest relevance to Australia are those of Argentina and Brazil. Both have mixed gauge systems to this day. Built initially at 5ft. 6in. in Argentina and 5ft. 3in. in Brazil, with planning commencing in the 1850s, they both introduced metre gauge railways. Argentina also built a major network to the 4ft. 8½in. gauge (Wright 1936, p. 70). Works of history (for example Bethell 1989), economic history (for example Bulmer-Thomas 1994) and railway history (for example Duncan 1932; Lewis 1983; Wright 1936) consider South American countries. The issue of breaks of gauge in national railway systems does not loom large in their accounts of railways' role in the economic development of South America. Those works focussing specifically on the role of railways in Argentina and Brazil's economic development, such as Lewis (1983); Summerhill (2003) and Wright (1936) are almost silent on this issue.

One of the earliest international contributions to railway issues in what was to become Australia was the engineer Fox's *On Light Railways in Norway, India and Queensland* (Fox 1866 - 67). He noted that in Great Britain, the earliest railways were trunk lines designed to transport large volumes at high speeds. Forty years later, "A demand is now arising for railway intercommunication between places not of sufficient importance to justify the cost of a first-class railway" (Fox 1866 - 67, p. 49). He refers specifically to the

“colonies” and other countries where the volume of future traffic was expected to be low. He defined “light railways” as being either “branch lines from existing trunk lines, or being intended for districts requiring the development of their traffic”, which should “be constructed in a thoroughly substantial and durable manner”, capable of bearing a maximum axle load of 6 tons (Fox 1866 - 67, p. 49). As Fox envisaged them, they would operate precisely the same rolling stock as was used on main trunk lines – the only difference is that light rail locomotives would be lighter and probably slower than those used on the main trunk line. The first national railway to be constructed at 3ft. 6in. was Norway’s. The only other 3ft. 6in. railway in the world at the time of Queensland’s decision was an 18 month-old 19 miles line in Madras, India. Much of Fox’s article is devoted to technical specifications and to issues of construction cost – indeed, his “argument” for light rail is advanced solely in terms of construction cost.

There were two assessments of Australian railways published by overseas authors in the first decade of the twentieth century. The first is entitled *Australian Economic Problems. I The Railways*. It contains the substance of a series of lectures given at Harvard University (Clark 1907 - 08). It notes that as at 1901, Australia had 13,821 miles of railway, and reported that the mixed gauge system of that time contained 6,749 miles of 3ft. 6in. gauge (or almost 47% of the Australian total), 4ft. 8½in. in NSW accounted for 3,107 miles, or almost 22%, and 5ft. 3in. in Victoria and South Australia accounted for 3,896 miles, or more than 27%. As to the break of gauge, Clark had this to say,

The difference of gage [*sic*] is a great embarrassment to interstate commerce. It is necessary to transfer passengers and freight at the Queensland and Victoria borders of New South Wales. A similar transfer is necessary from freight passing from the narrow to the broad gauge lines of South Australia, tho [*sic*] the inconvenience is less felt because these lines centre in Adelaide.

Clark 1907 - 08, p. 415

Clark does not elaborate on the “great embarrassment”. His only reference to the economic consequences of the break of gauge quotes certain rates for the transshipment of goods at Albury, representing additional costs to shippers. Clark’s concluding observations, cast as a comparison between the ownership structure and performance (loosely defined) in Australia and the United States respectively, omits any reference to the central fact that by

the time Clark's lectures were drafted, the United States was standardised on 4ft. 8½in., and Australia had diversified to four main line gauges (Clark 1907 - 08, p. 451).

Pratt's work of 1912 was produced in response to an observation by Britain's Prime Minister Asquith to consider instituting an enquiry to recommend whether or not Britain's railways should be nationalised. Pratt considered there to be sufficient similarities between Australian and British governance to warrant comparison of the performance of Britain's private sector ownership of railways and Australia's public sector ownership. How objectively Pratt sought to do this may be judged by reference to the title of his work *The State Railway Muddle in Australia*. Pratt devotes a chapter to "Difference of Gauge". Like Clark, he quotes freight transshipment charges at Albury. He states only that these must constitute additional costs to shippers. But he takes his analysis down to a further level of detail as follows:

Then the break of gauge causes delay and increases the congestion on the single-track lines of the State railways. When the inter-State traffic is passing mainly in one direction, full trucks taken to the border may have to return as empties because they cannot run on to a different gauge; and a train of empty trucks may have had to be brought to the border from the other side in order to fetch the produce or the merchandise the first train has conveyed there. Even if one or other of these trains should fail to cause extra congestion on the main lines along which it travels, there may well be congestion on the border itself, caused by the processes of unloading and reloading. In the matter, again, of trucks, the need for two trains to do between them an inter-State journey which a single train should accomplish may increase the truck shortage in one State or another; while it might very well happen that trucks were standing idle in one State at a time when, owing to an exceptional demand, there was shortage in a neighbouring State.

Uniformity of gauge would have allowed of an interchange of trucks according to the requirements of traffic in one State or another. An arrangement of this kind would, in turn, not only have greatly facilitated operation, but have reduced working expenses. It would also have effected a saving in the aggregate capital expenditure on rolling stock, since under a system of interchange of wagons there would no longer be the same necessity for each separate State to provide fully for times of abnormal pressure.

Whilst this quotation barely refers to gauge issues unique to Australia, it is relevant to conditions in Australia. Further, it underlines that debates on railway issues were carried out in a global setting from relatively early in the history of railways.

Much of Pratt's work concerns the costs of transferring people and freight across gauges. However, the passage quoted above is significant because it introduces non-transfer costs into the debate. These include congestion costs, excess capital costs incurred with respect to rolling stock, and additional working expenses. In doing so, it creates the framework for debates about the relative significance of "externalities", that is economic impacts on parties other than producers and consumers.

### **2.3 Australian Sources**

The review that follows deals firstly with writings about railway economics which were contemporaneous with the initial development of railways in the colonies of what was to become Australia, and most notably those published in, or in respect of, NSW, Victoria, Queensland and South Australia. Secondly, the review considers contributions with a national/inter-colonial perspective, such as those of Blainey (2001) and Manning Clark (1973), of economic historians such as Butlin (1964); Coghlan (1969); Goodwin (1963); Loughheed (1977); Matthews (1967); Shann (1930); and Sinclair (1976). The works of economic/transport/railway economists which tend to focus on particular colonies are then considered. Finally this review considers the work of constitutional historians such as Grey (1853); Melbourne (1963); Shaw (1997); Ward (1950 and 1958); and Wentworth (1956). See Appendix 5 for a chronology of works regarding Australian railway economics.

#### ***Contributions from the Nineteenth Century***

In the 1850s, economics was in an early phase of development as a distinct body of thought – yet 1850 saw the publication of Dionysius Lardner's *Railway Economy*, a text book which brought a discipline to issues of costing, pricing and the management of railway monopolies that is robust even by the standards of today. (See Lardner 1850; also Hawke 1970 – Appendix B to Chapter 2). It is not known whether the architects of Australian colonial railways made use of Lardner's work but according to Goodwin, Lardner's book was one of the first dozen or so books on economics in the Library of Melbourne

University in 1856 (Goodwin 1963, n. 22, p. 84). That library has no record of who, if anybody consulted Lardner's work.

There was lively local debate in the 1850s about investment in railways in the colonies and elsewhere as to its general wisdom, whether or not that investment should be public or private, and whether or not particular projects should be undertaken. Goodwin's (1963) paper reviews the contributions of contemporary economists to debates about the economics of rail. He concluded that:

The writings examined in this paper were not lasting contributions to economic science. Taken together, however, they constitute an impressive collection of attempts to study seriously an urgent contemporary problem. In addition to mere panegyrics, they include rigid interpretations of classical theory by the *Sydney University Magazine*, Pell and Jevons; speculation about possible gains to the community by Parkes, Norton, and Woolley; estimates of costs, revenues, and external economies by Denison and Chapman; and perceptive observations on the uses of railway capital by Corbett.

Goodwin 1963, p. 80

By the end of 1855, the introduction of mixed gauges as between NSW and Victoria was an established fact. It is curious that although this outcome was, and is, generally deplored, contemporary references are in general silent about its *economic* consequences. Denison, the Governor of NSW and for a time, Governor General of all Australian colonies, was a military engineer by training. His 1858 paper evinces close familiarity with the technology of railway construction, and with local cost of material and construction. His analysis is driven almost exclusively by the need to minimise the initial cost of construction, to the point where he advocated the use of horse-drawn, rather than locomotive-driven railways (Denison 1858).

Pell's paper was delivered in 1856, but not published until 1858. Pell held the positions of Fellow and Senior Wrangler at St. John's College, Cambridge, and was Foundation Professor of Mathematics and Natural Philosophy at the University of Sydney from 1852. The purpose of his paper was to demonstrate the validity of the proposition that:

The material prosperity of a community is not advanced by the construction of railways, until the circumstances of that community are such that the revenue derived from the traffic can, by a proper adjustment

of the charges, be made sufficient to pay the working expenses and the current rate of interest on the outlay.

Pell 1858, p. 125

Pell concluded that investment in railways in NSW was premature because the likely volume of business was unlikely to generate revenue at such a level (Pell 1858, p.128). This conclusion is identical to that reached by the anonymous writer (possibly Pell himself) of the article entitled “Railways” which appeared in the first issue of the *Sydney University Magazine* in 1855. Both articles are silent about the economic consequences for the colonies of a mixed gauge system, focussing for case material only on the railway in NSW.

Jevons’ views are very similar to those of Pell – see Jevons (1857 a, b, and c). Jevons observed that “insolvent railways are not a public benefit” (Jevons 1857a). He also argues against the inclusion of indirect effects in calculating potential returns on investment in railways. The views of Jevons, Pell and the *Sydney University Magazine* were generally at odds with those of railway promoters who saw railways as capable of developing benefits for the colony as a whole as distinct from producers and consumers alone. Even though the notion of externalities had not yet entered economic discourse, observers of the day saw the possibility of gains to the community in addition to surpluses generated for consumers and producers (Goodwin 1963, p. 80). The concept of railway investment as a stimulant to economic development was well established in the rest of the world at this time. This phenomenon is reflected in the works of commentators such as Taylor and Neu (1956) with respect to the USA, Summerhill (1998) with respect to Brazil and Kerr (1995) with respect to India.

Corbett’s extensive paper of 1857 is notable for a number of reasons. The first is that unlike those referred to above, it examines railway issues specifically in a local context – so much so that in drawing parallels between the position of Belgium and Victoria, Corbett conceptualises Victoria as a “country”:

There is also some resemblance between the geographical position of Belgium and Victoria. Both countries have the sea at one side only; and on the other three sides each of them is enclosed by a great continent. New South Wales and South Australia are to Victoria as Prussia and

France are to Belgium; and we must look forward to have, within no very distant period, a trade with both of those colonies, across our frontiers.

Corbett 1857, p. 63

The second is that he expresses concern about the *ad hoc* nature of government debate and legislation about railways, and is thus determined to lay down what he sees as useful principles. The first such principle is that cheap and lightly constructed railways were both desirable and feasible in the colony. This statement foreshadows what was to become a debate, spanning decades, about construction standards for railways in all four of the eastern mainland colonies. It involved recognition, *inter alia*, that variation in design parameters other than gauge had the potential to swamp gauge-determined cost variances. It also put the view that the role of engineers should be confined to issues of engineering, and that others should lay down policies and principles. The following quotation embraces both points:

The legislation ought, in the first instance, to come to a determination respecting certain general principles of railway construction of far more importance than even the great question of the narrow or wide gauge, which so long occupied committees of the House of Commons. A general standard of action should be fixed upon. The expense per mile which it is undesirable to exceed, in the grading or laying out of the track on which the rails are to be laid should be specified; the maximum of gradients and curves, in the various circumstances which combinations of different level entail, should be specified; the tracts of country which it is most desirable to traverse should be pointed out, and other limitations and obligations imposed; and then, and only then, should the surveyors be sent out ... In determining all these things, professional knowledge and experience should be consulted and given due weight; but in availing ourselves of them, we should bear in mind the costly consequences of yielding in too facile a manner to the narrower propensities of professional enthusiasm, when not chastened by economical reflections or the more enlarged views which ought to characterise the statesman.

Corbett 1857, pp. 10 - 11

Thirdly, Corbett argues for state ownership of railways with a built-in device for preventing over-capitalisation (Corbett 1857, p. 18). Fourthly, Corbett argued for the early specification of a “main trunk line of railway” and for its route to be determined by the economics of markets served rather than by the cheapness of construction.

Finally, Corbett acknowledged the significance of neighbouring colonies:



The benefit of proclaiming, at an early period, a great midland trunk line, as a fixed part of our railway system, would be important, inasmuch as it may influence the neighbouring qualities of New South Wales and South Australia to adopt a systematic plan in the construction of their railways, to correspond with ours and thus form a stream of traffic from Sydney to Adelaide through the centre of Victoria.

Corbett 1857, p. 66

Nowhere however did he or any other contemporary author as much as mention that the mixed gauge system, by then in place, represented a constraint to railway utilisation and performance. Perhaps he and/or they did not think it was. The contemporary views discussed above will be referred to again, together with views contributed by other contemporary sources, in those parts of this thesis which deal with the gauge decisions taken in individual colonies – see Chapter 5. In summary, the economic analysis of the time did not perceive the economic consequences of the decisions which led to the first break of gauge to be significant enough for any disciplined cost/benefit analysis to have been justified.

### *Historians/Economic Historians*

More recent work includes contributions from two of Australia's most prominent historians, Manning Clark and Geoffrey Blainey. Manning Clark had little to say about railways in his multi-volume *A History of Australia* (Clark 1973). He supplies a two-paragraph account of the origin of the mixed gauges but does not acknowledge that the adoption of mixed gauges entailed economic consequences (Clark 1973, vol. IV, p. 120). His major theme sees railways as an agent for civilizing “the bush” – he refers repeatedly to the “iron rail’s” role in “tethering the mighty bush” to the city. He acknowledges only that railways intensified competition between colonies for the trade of the Riverina (Clark 1973, vol. IV, p. 338).

Blainey devoted a single book to the development of Australia's transport and communications industries (Blainey 2001). This book published originally in 1963, devoted Chapters 10 and 11 to the development of railways in Australia. He also wrote prolifically about the development of other Australian industries, some of which, notably mining, had strong connections to railways: see particularly Blainey (1953 and 1963).

Blainey, as suggested in Chapter 1, allocates responsibility for original mixed railway gauges to Sheilds and Wallace, the Sydney Railway Company's engineers at material times:

The blame for the break was invariably laid on two engineers. Wentworth Sheilds was a young Irishman who planned Sydney's first railway, and he rejected the advice of the Imperial Government that all Australian railways should be built on the English gauge of four feet eight and a half inches – a gauge which had reputedly arisen in Roman time when chariot wheels were that far apart. Sheilds preferred the Irish gauge of five feet three inches, and so the Sydney to Parramatta railway was planned on the broader gauge. Victoria and South Australia began to build their first railways in the early 1850s and also decided to use the Irish gauge. Unfortunately, Sheilds had by then resigned, with his railway still uncompleted, and his successor persuaded the New South Wales parliament to sanction the English gauge. It was then probably too late for the neighbouring colonies to alter their plans and their orders for rolling stock, and they went on to complete the first ten miles of what eventually became the largest network of Irish gauge in the world.

Blainey 2001, p. 250

However, he also acknowledges that there are other agents involved such as businessmen and politicians. Some commentators have criticised such people involved in the mixed gauge decision as lacking in “vision” – or more particularly *the* vision of a continent-wide rail system with a standard rail gauge. Blainey argues that these people did not lack vision – they simply had a *different* vision – that of the railway as a servant of their respective colonies, rather than as infrastructure in a nation which did not yet, and might never, exist (Blainey 2001, pp. 250 - 52).

Even so, there *were* men of vision in the colonies whose imagination embraced a continental if not national railway system. One such was Sir Henry Young, Governor of South Australia. In 1853 he proposed a transport system which coordinated the use of the NSW railways with traffic down the Murray River (Hodder 1893, p. 277). Governor Denison promoted the concept of a continental system (Denison 1858) and Corbett is another to have done so (Corbett 1857). A further example of continental vision can be found in the advice given to the Victorian Legislative Council in 1853 by Harrison, engineer to the Melbourne, Mt. Alexander & Murray River Railway Company. Harrison stated a personal preference for a gauge of 5ft. 3in., but even so considered that

circumstances favoured the adoption of 4ft. 8½ in. because the NSW choice had set a continental precedent (Harding 1955, pp. 28 - 9).

Other works of history tend to be more specialised. These included *History of Land Settlement* (Roberts 1924) and *The Squatting Age in Australia 1835 – 1847* (Roberts 1935). These are among the first serious academic works devoted to an account of land settlement in Australia, and to the development of the pastoral industry, the mainstay of the colonial economies for the entire nineteenth century, a key driver of the colonies' economic development, and an agent of prime demand for wool freight services, that is railway transport.

The President of the Victoria Institute of Engineers, Professor WC Kernot, presented a paper entitled *Railway Gauge* to his colleagues on 26 August 1906; according to Blainey, Kernot was Melbourne University's first Professor of Engineering (Blainey 2000, p. 150). His first objective in presenting this paper was "to bring to light the true history of the lamentable break of gauge at Albury and to exonerate Victoria from the blame attaching thereto". Kernot's paper is valuable – he introduces the role of legislatures and legislation into his account of the mixed gauge decision-making processes. He seems to have been unaware of evidence that Governor LaTrobe of Victoria saw value in Victoria's taking a path different to that of NSW (see Chapter 5.3 of this thesis). More than fifty years elapsed between the time the original mixed gauge decisions were taken, and the appearance of Kernot's rationale in print: none appear to have preceded it.

In 1942, a paper entitled *History of the Break of Gauge in Australia* was delivered to the Institute of Transport in Sydney by AG Denniss, then Chief Traffic Manager of the NSW Railways Department. This paper is notable for a number of reasons. It appears to be the one of the earliest publications to have discussed the operational disadvantages which accrued to the Australian railway system as a function of its by then numerous breaks of gauge, and which might therefore have provided a rational basis for costing purposes. It further listed the generic economic advantages which might be anticipated from gauge standardisation, and thus provides a rationale for modelling revenue expectations under standardisation. This is such a useful paper that relevant parts are reproduced in Appendix 1 as "Operational issues pertaining to mixed rail gauge systems in Australia".

Coghlan's works are amongst the earliest contributions by economic historians. A *Statistical Account of the Seven Colonies of Australia* was published in 1902, and his four volume work entitled *Labour and Industry in Australia* was first published in 1918. Coghlan was initially trained as an engineer, and later became Government Statistician in NSW from 1886 to 1905. In 1905 he was appointed Australian Agent General in London. Coghlan's account of railway beginnings is located in Chapter IX of Part IV: pp. 830 – 845 in Volume II. Recounting the sequence of events which led away from a standard of 4ft. 8½in. to 5ft. 3in. in Victoria and South Australia, and reversion to 4ft. 8½in. in NSW, Coghlan notes:

... the line from Sydney to Parramatta was laid to the 4 feet 8½ inches gauge, and as the work of construction was proceeding in Victoria and South Australia with the wider gauge, the inconvenience of two gauges was thus wantonly inflicted on the country. There can be no doubt that the fault was originally that of the New South Wales government, but the evil might still have been avoided if there had been goodwill displayed on both sides. The coming of responsible Government however, bred much inter-colonial jealousy, and neither side was willing to make a sacrifice for the general good.

Coghlan 1969, p. 843

It is one of the earliest statements to acknowledge that institutions, broader in scope than the work of two engineers, might be relevant to the mixed gauge decisions. However, the “wanton” infliction of two gauges is apparently no more than an “inconvenience” (Coghlan 1969, p. 843). At no point in his extensive work, does Coghlan explain that inconvenience (as others did later – see for example Denniss 1942, pp. 59 - 60), nor does he attempt to calculate either positive or negative *economic* consequences. Coghlan's statement raises two other points of interest. The first is that strong feelings of inter-colonial jealousy were not *initiated* by the conferring of responsible government as he suggested, but existed well before its coming (see Ritchie 1974; Shaw 1997). The second notes that political decision-makers of the time gave much more weight to local near-term issues than to long-term national issues – see Quaife (1969) for further evidence of this.

The first significant work of economic history following Coghlan was Shann's *An Economic History of Australia* (Shann 1930). His treatment of railways is embedded in Chapter XVI *Land Transport*. Of the introduction of mixed gauges, Shann had only this to say:

The Sydney Railway Company, after struggling for eight years to raise enough capital to build a line from Sydney to Parramatta, collapsed and left the uncompleted task to the State. Its engineers earned eternal infamy for it by involving the two leading colonies in their disastrous choice of different gauges.

Shann 1930, p. 289

Shann's analysis focuses on the failures of private enterprise to initiate railways, and their acquisition by respective colonial governments. Although Shann's remarks are confined to NSW and Victoria, private sector initiatives failed in Queensland and South Australia as well. Shann's analysis also makes much of the public works policies of colonial governments in the second half of the nineteenth century of which railways were a major component. Shann is silent about the economic consequences of the breaks of gauge in the Australian railway "system", despite the emotional terminology of the above quotation.

The work of Noel Butlin over almost half a century has made major contributions to the understanding of the processes of economic development in Australia, the role of public investment in those processes, and the great significance of expenditure on railways in public (and total) investment. He focussed initially on the structure of government and government expenditure (Butlin 1950 and 1956). His most influential work in respect of the contribution of railways to Australian economic development was his *Investment in Australian Economic Development 1861 – 1900* (Butlin 1964). His final work, *Forming a Colonial Economy, Australia 1810 – 1850* (Butlin 1994) provides an understanding of the structure of the colonies' economies in which the state of demand for and supply of transport services led to the initial investment in railways.

Butlin perceived mixed railway gauges in Australia as just one component in a flawed transportation system. The following quotation exemplifies this view:

Divergent attractions to traffic and passenger flows; duplication of lines; the use of constitutional limitations to prevent the most efficient and shortest traffic routes between inland settlement and main ports; the concentration of main lines on the three main cities; these were serious limitations on the effectiveness of the growing transport system. To these were added other obstacles; intercolonial tariff warfare, differences in railway gauge, even delays in completing intercolonial rail links added to the problems of long-distance movement.

Butlin 1964, p. 296

It appears as though Butlin may have been speaking from a national point of view, and that he may have under-weighted the significance of the colonies' autonomy prior to Federation. According to Butlin, Australian colonial governments' investments in railways in the second half of the nineteenth century had four objectives (Butlin 1964, p. 358). The first was to connect main centres of settlement, supplanting inadequate roads. The second was to facilitate the movement of exports to port. The third was to encourage internal migration and settlement, and the fourth was to provide a communication link between the colonies. These objectives had different priorities in different colonies at different times (Butlin 1964, p. 358). Butlin concluded that what investment in railways achieved for Australia was destruction of a system of transportation by river, and creation of heavy debt and interest payment obligations, so great as to become "a critical element of instability by the end of the eighties" (Butlin 1964, p 369). Butlin's analysis of investment in railways does not examine the key issue raised by mixed railway gauges, that is to what extent the added costs of construction and operating of mixed gauge systems detracted from the railway systems' performance potential.

Other economic historians, such as Matthews (1967); Sinclair (1976); and Jackson (1977) add no distinctive contribution to our understanding of the decisions which generated the mixed gauge outcome, or to the economics of mixed gauge systems. The only academic economists who appear to have taken issue with Butlin's work on railways are Beever (1971); Frost (1986); and Lougheed (1977). Lougheed concluded that:

There is some truth in all Butlin's arguments but the conclusion that emerges from the discussion above is that he underestimated the importance of several aspects of railway construction, in particular, the developmental nature of the transport investment. On the basis of the foregoing analysis, the conclusion is that, despite some diseconomies and other shortcomings associated with the construction programmes, the contribution of the railway investment expenditure to Australian economic growth between 1860 and 1914 was substantial.

Lougheed 1977, p. 40

### ***Railways/Territorial Specialists***

Here the focus is on works which specialise in the history of particular state systems. More works have been published in respect of NSW than of any other state. The key ones in

respect of gauge decisions include Rae's report of 1866, Vogel's series in the magazine *NSW Railway & Tramway Budget* (the NSW Railways' staff magazine) over 1913 - 14, Gilder (1931); Rowland (1954); and Birch's review of the operations of the Sydney Railway Company (1957). The work of Lee (1988 and 2000), and Gunn (1989), is substantial. Don Hagarty's unfinished series on the engineers of the Sydney Railway Company and his *Sydney Railway 1848 - 1857* (2005) are very useful original contributions.

The value of these works lies in their descriptive accounts about the who, what and when of decisions about railway gauge. They are relatively light in analysing causal factors. The same is true of works about Victorian railways. Corbett (1857) has already been cited. Serle (1977) provides useful insights into the structure and behaviour of the society in which early Victorian railway developed and Harrigan (1962) is a useful chronology. Beveridge (1952); Beever (1971) and Fogarty (1973) are all helpful analyses of railway policy in Victoria, but none have much original to say about Victoria's choice of 5ft. 3in. gauge, nor its investment forty years later in 2ft. 6in. gauge railways.

There is considerable historical material about social and economic development in South Australia, including the works of Boothby (1876); Marcus (1876); Hirst (1973) and Pike (1957). Well aware that the colonies had already committed to a mix of 5ft. 3in. and 4ft. 8½in., and of the potential (but not yet actual) disabilities associated with breaks of gauge, the South Australian government deliberately introduced a second gauge into South Australia. Granted it was to be another fifty years before the decisions of others introduced the third gauge (4ft. 8½in.) into the state. Nonetheless, the prospect of having three gauges at work in the state may have been apparent. The literature does not make it clear how apparent it was, nor what kind of rationale was used to support introduction of narrow gauge railways into South Australia, other than the need to satisfy the maximum number of electors' thirst for access to railways and to do so by minimising first cost of construction. These sentiments are more apparent in select committee proceedings than they are in the literature.

In Queensland, the motives are clear and so are the reasons why railways developed differently to those in other states. Its capital lies in its south-east corner, far distant from

revenue-generating resources, with prospects for other ports seen by and large as non-competitive with the port of Brisbane. Settled relatively recently, only thirty years before separation, Queensland was sparsely settled, and dependent almost entirely on pastoral income from the Darling Downs. Its pioneer legislators considered it imperative that the Queensland economy be developed as quickly as possible, and saw investment in railways as a prime stimulant of regional economic development. Not without argument, it opted for a railway system built on a gauge of 3ft. 6in. as a means of maximising the value from the very scarce resources available for railway construction. All of these themes are apparent in the key works of Fox (1866 - 7); Phillips (1892); Cole (1945); Lewis (1973); Fitzgerald (1982) and Kerr (1998) and are explored in Chapter 5.5 of this thesis.

### ***Constitutional Historians and the Gladstone Despatch***

Certain aspects of constitutional development of what was to become Australia are relevant to the rationale for gauge decisions in the Australian colonies. This is because railway engineers and the companies (later governments) that employed them did not exist in a vacuum. Rather, they existed within a hierarchy of authority with Britain's Parliament at the top. The British Parliament brought down legislation which, in conjunction with a body of centuries-old common law, applied to its colonies as much as it did to the constituents of the United Kingdom. The British government controlled the colonies of Britain, acting through powers delegated to a cabinet minister, the Secretary of State for the Colonies. His administration was required to consult with UK ministerial colleagues in respect of colonial matters, exactly as he would have done in respect of issues at "home". So for example, the civil servants administering Britain's railways legislation formed a unit within the Board of Trade, and the Secretary of State for the Colonies accessed their advice via his colleague, the President of the Board of Trade. Note that between 1844 and 1867, this unit was designated variously as the Railways Board, the Railway Department and the Commissioners of Railways; see Parris (1965, Chapters 3 - 5).

The powers of government were delegated from the British government to Governors of its colonies. The Secretary of State for the Colonies stewarded Governors' use of their delegated authority, and gave approval or not for initiatives which the Governors referred to him. There are two features of this constitutional structure which could have had a direct bearing on rail gauge decisions in the colonies.



Firstly, the colonies were statutorily separate units of government. Though they existed on, or adjacent to, the Australian continent, there was until Federation no effective machinery to deal with matters-in-common between the colonies, nor of resolving inter-colony disputes, save for reference of matters to the Secretary of State for the Colonies (Ward 1958, Chapter 2). This is notwithstanding British-initiated action to appoint the Governor of NSW contemporaneously Governor General of the Australian colonies, with the intention of using this role for inter-colonial consultation, coordination, and if necessary, decision-making. British legislation of 1850 conferred this role on the then Governor of NSW, Sir Charles Fitzroy (Ward 1956, Chapter 9). Ward claims that Fitzroy was Australia's first Governor General (Ward 1953). This appears to be incorrect. Fitzroy's role extended a concept first introduced in 1825, when the colony of Tasmania was formed by separation from the colony of NSW. Governor Arthur's commission as Governor of Tasmania was as constitutional junior to the Governor of NSW, Sir Charles Darling. The latter retained the roles of Governor-in-Chief to the island of Van Diemen's Land, and Captain-General of both colonies (Brown 2004, p. 14; Wentworth 1956, p. 81.).

The importance of constitutional matters to railways is that it appears that although Fitzroy was constitutionally empowered to compel the governments of both colonies to adopt a common gauge, he chose not to exercise that authority. Moreover, in his joint capacities he had concurred in the NSW legislation to establish 5ft. 3in. as the standard gauge, and subsequent legislation to re-establish 4ft. 8½in. as the standard. Instead of exercising his authority as Governor General, he referred the matter for decision to the British Secretary of State for War and the Colonies. The Secretary's response was to suggest that the NSW government simply "review" the matter. Why Fitzroy chose not to exercise his authority as Governor General is not known, nor do we know why he referred it to the Secretary in the first place. Possibly the referral to the Secretary enabled Fitzroy to avoid the embarrassment of re-considering earlier decisions of his own.

Fitzroy was already aware that Governor LaTrobe of Victoria intended to seek the Secretary's intervention with a plea for the latter to withhold Royal Assent from forthcoming NSW legislation to mandate reversion to 4ft. 8½in. Perhaps he thought that the Secretary was bound to intervene, because in fact, LaTrobe's appeal ignored Fitzroy's status as Governor General. The British government's policy was after all, well known.

Earl Grey had written to the NSW Governor (and others) in 1848, well in advance of any investment in railways in the antipodes, and made it clear that he was strongly in favour of one railway gauge being adopted by the Australian colonies, and that his preference was for a gauge of 4ft. 8½in. (Ward 1958, p. 272; - see also Appendix 3). His successor might have re-stated this preference, or he might even have made a directive to standardise. He did neither. This highlights the second feature, namely the reluctance of the British government to issue *directives* to the colonies (except in relation to trade policy). The British government was deeply committed to foster the growth and development of British colonies to autonomy and self-government, and correspondingly reluctant to push policies which were not known to have local support – see Grey (1853); Melbourne (1963); Shaw (1986) and Ward (1958). Further evidence of this attitude to colonial development may be found in a despatch to colonial Governors by WE Gladstone on 15 January 1846. Gladstone was a member of the British Cabinet and occupied the post of Secretary of State for the Colonies and for War. He wrote:

I find that the impulse which has been given in every other part of the civilized world to plans of Railway communication has been felt in many of the British Colonies. The subject has been pressed on my attention from many different quarters and under circumstances both physical and economical as distinct and as various as are the conditions of those widely extended settlements. To attempt to lay down any one set of Rules or even a single Rule binding inflexibly on the Executive governments of them all, would obviously be futile and impracticable; but the experience of this country has ascertained some general principles on the subject, the application of which is neither transitory nor local, but which it may now be presumed are applicable in various degrees to the legislation of every country in the new field of enquiry. The object of this Despatch is to state, compendiously, what those Rules or principles are.

Gladstone to Gipps *et al* 15 January 1846

This extract exemplifies a policy which accepts that distance from the colonies and their variety constitute circumstances in which one-size-fits-all directives would be unworkable, and adoption of a view that allows and encourages discretion in decision-making within an established policy framework.

This review of the literature pertaining to colonial railways has led to the conclusion that the despatch of Gladstone referred to above may have added significance in the history of rail gauge choice *because it has been widely misquoted*. Many writers have claimed that it

urged the standardisation of colonial railways at a gauge of 4ft. 8½in. This is not so. Gladstone's despatch of 15 January 1846 is silent about both gauge and gauge standardisation. Yet the Commonwealth Year Book (1908, p. 554) states "In 1846 Mr Gladstone, then Colonial Secretary recommended in a despatch to the Governor of NSW that the 4ft. 8½in. gauge should be adopted." The source of this information is not supplied. Archival search revealed that Gladstone's despatch of 15 January 1846 is the only despatch on the subject of railways which he wrote in his tenure of the office of Secretary of State for the Colonies and for War. A copy of this despatch is included as Appendix 2.

Writers who have misquoted Gladstone on this matter include Denniss (1942); Birch (1957); Harding (1958); Harrigan (1962); Fearnside (1970); Paddison (1956) and Ward (1958). Birch (1957, p. 62), noted that "This [4ft. 8½in.] had been recommended by Gladstone in connection with the 1846 South Australian project, when he stressed the need for uniformity in the various colonies". Birch references Coghlan (1969, p. 841). Coghlan there states that "Major Robe, when he received Gladstone's despatch in reference to railways, introduced, among the rules and orders to be observed in the introduction of railway Bills into the Legislative Council of South Australia, a rule that "the gauge of 4ft. 8½in. be the gauge to be used in all public railways hereafter to be constructed in this Province, ..." (Coghlan 1969, p. 841). Earlier, Coghlan had noted that "in January 1846, Gladstone who was at that time Secretary of State for the Colonies, sent a circular despatch to the Governors of the Australian colonies, in which he indicated the principles which should govern local legislation in railway matters" (Coghlan 1969, p. 830). Coghlan's statements are correct but he has been widely misinterpreted. Denniss (1942, p. 54) compounds the felony. He states that "as an outcome of the English Gauge Act, Mr William Gladstone, [Secretary of State for the Colonies and for War] recommended to the Legislative Councils of this [that is NSW] and neighbouring colonies that, in the event of railways being constructed in Australia, a uniform gauge of 4ft. 8½in. should be adopted." However, the Royal Commission appointed to enquire into the Gauge of Railways in 1845 was still sitting in January 1846. The Gauge Act was not passed until August 1846, by which time the government of which Gladstone had been a member was out of office (see Matthew and Harrison 2004, vol. 22). Ward too attributed a role in enunciating gauge policy to Gladstone. "The troubled story of the gauges in England and Ireland led both

Gladstone and Grey to warn the colonies against permitting any variation in gauges” (Ward 1958, p. 272). As his letter shows (Appendix 2), Gladstone’s despatch of 15 January 1846 said nothing about gauge. This matter is considered further in Chapter 5.3 because it appears that one of the first to misinterpret Gladstone’s despatch may have been Governor LaTrobe, Victoria’s first Lieutenant-Governor.

## **2.4 Conclusions**

The secondary sources make it clear that the original break of gauge outcome between NSW and Victoria involved much more than the personalities of two engineers, the most popular “explanation”. The boards of directors of railway companies were involved; colonial governments and governors, and UK government institutions all played parts.

Another major learning from this review of secondary sources is that there were strong drivers at work to achieve colonial autonomy. Studies in this area generally acknowledge that negative sentiments between the colonies played a part. Research carried out in this study suggests strongly that the rise of negative sentiments, in Victoria and Queensland in particular, pre-dated their formation as colonies. In both colonies, misgivings about the calibre of leadership supplied from the NSW administration dated from settlement.

As Chapter 5.3 will demonstrate, previous studies have ignored Governor LaTrobe’s participation in the rail gauge decision-making process in Victoria. In the process, they have ignored important data from the board minutes of a railway company, and even correspondence subsequently published in parliamentary papers. They have given little if any weight to the proceedings of select committees and other parliamentary enquiries, particularly those of the 1870s and 1890s.

Whilst breaks of gauge have been widely, if not universally, criticised for one hundred and sixty years because of the waste, additional cost and inconvenience they incur, this has not prevented their deliberate introduction, or their preservation. The initial break of gauge in Australia was knowingly introduced for reasons which are not yet clear. Queensland’s and South Australia’s introduction of 3ft. 6in., and Victoria’s of 2ft. 6in. were also deliberate. Breaks of gauge persist in Australia despite a succession of moves to standardise, especially post World War II, and continuing to the present. This review of the literature pertaining to

the history of breaks of gauge in the Australian colonies reveals that no formal feasibility studies were ever undertaken prior to an investment resulting in breaks of gauge, nor for that matter, of extensions to standardised systems – or, if they have, their content is unpublished. It is true that cost/benefit calculations occasionally appear, but they have generally been of the most primitive kind. This is because in part of the extreme difficulty of forecasting revenue expectations when introducing a new technology.

Because of the lack of agreed frameworks for evaluating the relative economy of options, political decision-makers relied extensively on engineers' opinions. Often these were in conflict, and where this was so, scope appeared for the use of non-economic or quasi-economic criteria.

Finally, the literature review reveals that a number of writers about the history of gauge choice in Australia who have used Gladstone in support of standardisation at 4ft. 8½in., have misinterpreted his despatch.

### 3 THE ORIGIN OF THE STANDARD GAUGE

#### 3.1 Introduction

The purpose of this chapter is to describe the origin of the gauge of 4ft. 8½in., and to describe why the British Government mandated it as the preferred gauge for railways in its colonies, except for Ireland.

According to Lewis, “In the most basic sense, a railway is a prepared track which so guides the vehicles running on it that they cannot leave the track. That, and no more.” (Lewis 1970, p. 1). This definition, though succinct, is minimal. Even so, it embraces the newer technologies such as magnetic levitation and monorails. This thesis deals with a significant subset of the set which Lewis’ definition covers. It is concerned with railways as large networked systems with three distinguishing features. These are that they use motive power to transport people and/or materials, generally on steel-wheeled conveyances on parallel steel rails in a way which constrains lateral movement. This focus enables attention to be concentrated on steam powered locomotion and rail track gauge.

This latter description is more relevant because it exposes the issue of gauge – that is the distance between the inside of the parallel rails. It also allows for introduction of the notion that two technologies under-pin the system – the technology of the interplay between steel wheels and steel rails on the one hand, and the technology of locomotion on the other. It is also useful because the reference to “people and/or materials” allows for introduction of the notion of market segments, and where appropriate, to highlight the characteristic differences between the demand for moving people and the demand for moving freight. The presentation by Travis at the AREMA Conference entitled *Running High Speed Passenger Trains on Freight Railroad Track, or You Want to do WHAT?* highlights these differences (Travis 2000). It is this expanded concept of railways that is used in this thesis. However, this description does not gainsay that, as Dr Michael Lewis has pointed out in private correspondence with the author, “A railway is still a railway even if small, not a large networked system, or if the rails are of wood or stone; or if the motive power is horse or man or gravity; or if guidance is by pin or by flange on the rails; and whatever the gauge” (Lewis to Mills, 17 Feb 2006).

The remainder of this chapter considers the following issues – the prehistory of track gauge, the significance of mining in railway history, the derivation of the 4ft. 8½in. gauge, and the management of mixed gauges.

### **3.2 Prehistory**

The evolution of wheeled vehicles spans four millennia (Piggott 1983). For most of that period, individual wagons, or conveyances on wheels, were moved by the application of gravity and/or human or animal effort, (generally horses or oxen) over tracks made on undifferentiated ground. The next stage of their evolution occurred with the weatherproofing of such tracks by paved roads. This development is thought to have begun about the second millennium. As early as the second millennium, some paved roadways were improved by cutting channels or grooves into the road surface on which wheels might run with less slippage, especially on inclines, and with less effort required in steering. A gauge of about 1.30 m. has been identified in a wide range of artefacts and locations in Europe from the second millennium. Referring to Grosseibstadt Grave 4 in the West Hallstatt province of what is now Germany, Piggott reports:

The wheels, which were set in a pair of slots in the floor of the grave, giving a gauge of 1.30m, had no tyres and were estimated by Kossack (1970) to be no more than 40 cm in diameter. The provision of pits or slots for the wheels looks back to the mid second-millennium chariot graves in the Urals and forward to La Tène from fifth century BC to be described in the next chapter, and the same wheel-track of c 1.30 is common to all.

Piggott 1983, p. 158

Early examples of the use of trackways include an extensive system of rutways in Malta, which probably date from the second millennium, the Diolkos, a portage for carrying ships on wheeled cradles across the Isthmus of Corinth in Greece (600 B.C. – 67 AD) (Lewis 2001, p. 11) and channels cut into roads at Roman Pompeii. Lewis notes that “One feature common to all these early railways was a remarkably uniform gauge: even in Malta it varied only between 4ft. 5in. and 4ft. 9in.; while in later times it was constant at about 4ft. 8in or 4ft. 9in.” (Lewis 1970, p. 2), recognising even so that the Diolkos gauges were 1.67m. [5ft. 6in.] and 1.57m. [5ft. 1½in.](Lewis 2001, p. 12).

In short, the track of wheeled vehicles was established far back in human history, and it had existed broadly in the range 1.2 – 1.67m. (approximately 4ft. – 5ft. 6in.) as early as the second millennium. Lewis says that:

It is often tempting to suppose that rails were laid to fit a wagon built at random, rather than that wagons were built to fit a deliberately chosen gauge. There is no real mystery, however, about the basic reason why the Tyneside wagonway gauges fall into the range of from 4ft. to 5ft. – Charles E. Lee has pointed out that a figure of this sort is the optimum axle-length for a one-horse vehicle; if the axle is much shorter, the vehicle is small, and the horse does not pull an economic load; if it is much longer, the cart becomes too heavy for the horse. Times change but the horse does not.

Lewis 1970, p. 183

The pre-history of trackways and railways is discussed more extensively in Lee (1962), Lewis (1970) and more recently in Lewis (2001).

### **3.3 Mining Heritage**

The use of wooden rails or plates on which to move a vehicle appears to have originated in the underground coal and metalliferous mines of Medieval and Renaissance Europe (Lee 1962; Lewis 1970, Chapters 1 – 7; see also Agricola 1556, especially pp. 156, 170, 343).

The first underground railways consisted of wooden rails laid on wooden planking (Lewis 1970, p.6). Because space was limited, and because there were low limits to the weight a man could move, the gauge of underground ore/coal tracks seldom exceeded 2ft. 6in., and was more usually about 2ft. The earliest wooden rails known to have been laid down in Britain for transportation on the surface were in collieries at Wollaton and Strelley near Nottingham, Broseley on the Severn River, and Bedlington, Cowper and Bebside on the north east coast (Smith 1960, p. 122; Wood 1838). Of these, Wollaton in 1604 was the earliest (Smith 1957, 1960).

Long before then, coal mining and transportation had a significant role in the Tyneside regional economy:

Evidence of the importance of the Newcastle coal trade at a very early period is widespread. A licence was granted by Edward III in 1351 to



burgesses to work the coal in two portions of the tower lands, the Castle Field and the Frith.

Marshall 1938, p. 10

From the middle of the seventeenth century to well into the nineteenth century in Britain, canals and rivers were the main mode of transporting coal from mines to population centres, and/or to ports for onward transport by sea. Sea transport was used to transport export coal, and coal for consumption in larger and more distant population centres within the United Kingdom, such as London. These early colliery railways used wagons on inclined planes from mine to river, and haulage by horse up the reverse slope. The use of colliery railways obviated the damage done to public roads by heavy horse-drawn wagons carting coal.

It was in north east England that the most extensive development of colliery railways took place because “the valleys of the rivers Tyne and Wear offered the most favourable situation for their use ...” (Flinn, 1984, p. 149). Access to land between colliery mouth and river bank was a major challenge to constructors and operators of wagonways. A precedent for dealing with this issue had been set early in the eighteenth century. Private Acts of Parliament were used to give constructors/operators of turnpikes and canals rights of compulsory purchase of land. This legislation traded off private property rights against creating public rights to the use of canals and turnpikes on compulsorily acquired land (Flinn 1984, p. 159). But colliery wagonways were for private use, not public use. Constructors/operators of wagonways were obliged to negotiate for access to other private owners’ land on which it was proposed to build. This was a particular challenge for colliery owners in the north east, where there was a high density of collieries, and where owners of the required land were often colliery owners themselves, with first hand knowledge of the economics of mining and transport. There was thus significant potential for hold up problems to occur in the bilateral relationship between coal transporters and property owners – who were essentially monopolists in respect of particular pieces of land. This difficulty could generate significant economic negatives.

In 1739, the viewer Thomas Slaker, estimated that most of the fifty to sixty Tyne collieries not being worked at that time were prevented from operating because of denial of wayleaves, and it was believed in London

that agreements to deny wayleaves were responsible for pushing up the price of coal in Newcastle.

Flinn 1984, p. 161

This challenge was resolved in part by the formation of combinations of colliery proprietors. A group of owners, particularly owners of contiguous collieries, were powerfully placed not only to reach agreement between themselves about wayleaves, but to resist competition in regions in which they dominated. A “wayleave” is an authority to transport one’s own property over land owned by someone else. Of several combinations formed, perhaps the most powerful was the “Grand Alliance”, a combination of the Wortley, Liddell and Bowes families dating from 1726. The Grand Alliance is disproportionately important in the development of railway technology – it owned the first wagonway to have been laid down at 4ft. 8in., and the colliery that employed George Stephenson. They supported him in the design and construction of his first locomotives. They also financially supported his engagement by others to survey, design and construct railways, and locomotives. According to Lee:

The agreement of the Grand Allies was dated 27 June, 1726, and was designed “to join some of their collieries and to enter into a friendship and partnership for the purchasing or taking other collieries, and for the winning and working of coals throughout, and to exchange benefits and kindnesses with each, upon a lasting foundation.” This agreement gave the group a virtual monopoly of the most valuable mineral district in the north of England. The collieries specified were to be held in thirds from November 11, 1726, for a term of 99 years, the coals to be worked jointly but led to separate staiths and vended distinctly.

Lee 1950, p. 147

The earlier coal mines in the area had been on or near the river banks. As they became worked out, new pits were opened further away from the river. As implied above, this created demand for a means of transport from the pit to the river – wagonways were the response to this demand. The Grand Allies caused construction of a wagonway from Willington Quay on the northern bank of the River Tyne, to Willington Square, a colliery site some three miles away. Lee has it that this wagonway is the first recorded use of 4ft. 8in. gauge (Lee 1953, p. 211). The first section of this historically important group of wagonways was laid in 1764 - 5 from Willington Square to Willington Quay (Lewis, 1970, p. 114).

Killingworth West Moor Colliery was commissioned in 1804, and George Stephenson went to work there in 1806. Why Killingworth should have chosen 4ft. 8in. remains a mystery. There was a range of gauges in use on Tyneside at that time, ranging from 4ft. to 5ft. The rationale for the selection of 4ft. 8in. remains unclear. For some, it is simply chance.

If Stephenson had found his mission in life at Heaton, our standard gauge would probably be 4ft. 3in.; if at Wylam, about 5ft. It was largely a question of chance.

Lewis 1970, p. 183

and

As appealing as it may be to find an elongated history to path dependence in gauge, the fact remains that early railways in different regions had a substantial variety of gauges, and thus it must be seen as accidental that the modern world has its particular standard.

Puffert 1991, footnote p. 140

Certainly Stephenson's employment at Killingworth *was* a matter of chance – he might just as easily have gained employment where the wagonway's gauge was something other than 4ft. 8in. But the original choice of 4ft. 8in. at Killingworth may have been more deliberate.

Lewis' authoritative *Early Wooden Railways* is thirty-five years old (Lewis 1970). He recently expressed his dissatisfaction with one aspect of the "chance" explanation, as quoted above, in recent correspondence (Lewis to Mills, 1 May 2003). He noted that gauges on Tyneside wagonways varied from 3ft. 10in. to 5ft., at Tanfield and Wylam respectively. He further noted that "the 3ft. 10in. lines (the Tanfield and its predecessors) were the steepest. The 5ft. one (Wylam) was the most level". For horse-drawn wagonways, the factor most limiting system efficiency was the capacity of a horse to draw an empty wagon up hill. In this correspondence Dr. Lewis hypothesises that given standard horse capacity, there may have been a rule of thumb relating gauge and grade. That is, gauges may have been selected broadly according to the steepness of the route being planned – the steeper the gradient profile, the narrower the gauge selected. This seems a plausible hypothesis. However further consideration of it is outside the scope of this thesis.

The period 1805 to 1815 was a period of intense experimentation in locomotive design, and is described in some detail in Guy (2001). His account of activities at that time at Wylam Collieries, at Kenton and Coxslodge, at Heaton and Lambton, at Newbottle and at

Killingworth, makes it plain that a number of colliery owners, viewers and engineers were engaged in locomotive innovation under a major and common sense of urgency. The Napoleonic Wars' demand for horses and horse fodder had driven up prices for both to the extent that it had become imperative to find a more economical way of carrying coal to the staithes (river docking points for colliers). There was also a developing scarcity for timber to form rails.

Much of this experimentation was not immediately fruitful. But as Guy puts it:

Eighteen fifteen was a seminal year. It saw engines at Wylam, Killingworth, Kenton and Coxslodge, Heaton, Lambton, Newbottle and ... Wallsend. By the end of that year, of these seven sites, only at Wylam and Killingworth had it (locomotion by adhesion – author's interpolation) become established. This was due as much to misfortune as to failure. The Blenkinsops had been abused and broken, Heaton Colliery laid off due to flooding, Newbottle had suffered an overloaded boiler, the track at Wallsend proved unsuitable.

Guy 2001, pp. 128 - 9

But George Stephenson was successful – an audit proved that his first engine *My Lord*, halved the cost of transporting coal to the staithes (Guy 2001, p.128). A contemporary observer, Mathias Dunn, singled him out as the only unqualified success of the many locomotive pioneers of 1815. “George Stephenson has completely succeeded in getting 2 Travelling Engines into complete work, which save about 8 horses each” (quoted in Guy 2001, p. 128).

George Stephenson was invited by Edward Pease, a Quaker businessman, to build a railway from Stockton in the south west of county Durham, to Darlington. The primary purpose of this line was to transport coal economically by a combination of horse-haul, stationary engines and locomotive (Kirby 1993, p. 1), a total distance of thirty seven miles (Kirby 1993, p. 37). When opened in 1825, it also provided for passenger carriage by horse-drawn coach. According to Kirby, the relevant parliamentary bill received Royal Assent on 19 April 1821. It authorised the construction of a railway or tramroad from the River Tees to Stockton to Witton Park Colliery with several branches therefrom, all in the County of Durham, with “men and horses” as the whole means of conveyance (Kirby 1993, p. 37).

The shareholders appointed a Management Committee of fourteen to implement the act, and that committee appointed a sub-committee of seven, of which Edward Pease was a senior member. Pease had met with George Stephenson in Darlington at Pease's invitation on the day on which the Stockton and Darlington bill had had its third reading (Kirby 1993, p. 39). Stephenson pleaded the case for edge rail and locomotion, rather than plateway and horses. Pease was impressed enough to accept Stephenson's invitation to inspect the Killingworth operation. Having done so, he became committed to the introduction of the edge rail and locomotion on the Stockton and Darlington. So on 23 July 1821 the Management Committee agreed. It authorised the sub-committee to engage Stephenson to conduct a new survey of the line. Stephenson submitted a revised estimate and was appointed as Engineer to the line following a Management Committee meeting on 18 January 1822 (Kirby, 1993, p. 40). Stephenson laid the Stockton and Darlington at 4ft. 8in., as he had the Hetton Colliery line, his first railway construction project.

Some of the evidence for this arises out of discussions and further investigations following a presentation to the Institution of Mechanical Engineers in 1875 by William Pole FRS. The chief theme of Pole's address was to establish the engineering superiority of wagons with the vehicles' bodies inside the wheels rather than over them. However the discussion which followed referred in part to consideration of gauge superiority.

Mr Joseph Armstrong remarked that the gauge question had already been discussed for more than thirty years, and he thought it would probably be a long time before it was decided whether the narrow or the broad gauge was really the best ... It was a singular fact too that the original gauge on the Stockton and Darlington line was not 4' 8 ½" but 4' 8" . The Liverpool and Manchester Railway was 4' 8 ½", and then the Stockton and Darlington was altered to the same ...

Pole 1875, pp. 80 - 1

Armstrong's statement evoked further discussion.

Sir John Coode thought there was some mistake as to the gauge of the Stockton and Darlington line having been different from that of the Liverpool and Manchester: for he had been told by Mr. George Stephenson himself that the gauge in the Liverpool and Manchester line was, so to speak, a matter of accident; that there was no question raised about what the gauge should be on that line, but that it was taken for granted, and that when the platelayers who had previously been employed

on the Stockton and Darlington line went to lay down the rails, they took with them the gauge that had already been used with the rest of their tools.

Pole 1875, p. 83

Mr Armstrong had been a practising professional railway engineer since at least the late 1830s, and stated that for the previous twenty years, he had worked on the mixed gauge tracks of the Great Western Railway. The discrepancy between the two statements stimulated the Institute to make further enquiries, and two years later, it reported as follows:

The original engine, the ‘Rocket’, that first ran upon the Liverpool and Manchester line at the competition in 1829, for determining whether locomotive or stationary engines were to be adopted for the working, was made 4ft. 8 in gauge, as shown by the evidence preserved at Messrs Robert Stephenson and Co.’s factory, Newcastle. During the progress of the line however, the gauge was settled to be 4ft. 8½in. The following information on this subject has been supplied by Mr. Thomas L. Gooch of Saltwell, Gateshead, who was engaged on the construction of the Liverpool end of the Liverpool and Manchester Railway under Mr. George Stephenson: “There was much discussion during the construction of the line about curves and the self-acting value of the conical tyre in relieving the pressure of the flange against the rail, and the consequent need of a certain amount of play in the gauges of wheels and rails, especially as considerably higher speed was contemplated (even before the ‘Rocket’ was produced) than that on the Stockton and Darlington Railway. I venture to think therefore that the extra half inch was given to meet these considerations *and that this was the true origin of the 4ft. 8½ in gauge.*” [Author’s italics]

Institution of Mechanical Engineers 1877, pp. 160/1

The same report notes that the conversion of the Stockton and Darlington gauge to 4ft. 8½in. “was carried out gradually as the course of repairs and the relaying of the line gave opportunity” (Institution of Mechanical Engineers 1877, p. 160), and was not completed until 1842. In other words, it took twenty years to make the conversion which widened the gauge by half an inch. In the meantime, the Liverpool and Manchester line aside, Stephenson was advising on laying other lines at 4ft. 8½in. These included the Liverpool and Birmingham, the London and Northern, and the London and South Wales (Kirby 1993, p. 45). At the same time, two other important developments were taking place. These were the formation of the Great Western Railway Company, and the introduction of railways to Ireland. These developments are described briefly below; both were challenges to the utility of the 4ft. 8½in. gauge.

### 3.4 Managing Mixed Gauges

The Great Western Railway Company (GWR) was formed to design, construct and operate a railway between London and Bristol. The Board of the GWR appointed Isambard Kingdom Brunel to lead the design and construction processes. He recommended that the GWR be built to a gauge of 7ft. 0¼in. The GWR's revenue was to be derived primarily from passengers. Brunel argued that the gauge he selected provided the optimum in terms of comfort, safety and speed. His Directors accepted this argument, and raised money from the public to build the railway to that specification. Arguably his Directors were supportive of the broad gauge precisely because it promoted speedier communication with London, and thus in turn, supported their mercantilist interests – see Alborn 1998, pp. 179 -80". Construction proceeded and the 7ft. 0¼in. system extended until, on 8 July 1844, it met an adjacent system built to a gauge of 4ft. 8½in., firstly and notably at Gloucester. (See Rolt 1953, Chapters 5 – 7 for a detailed account of GWR and Brunel; see also Buchanon 2003). The cost, discomfort and inconvenience experienced in changing trains eventually prompted the government of the time to appoint a Royal Commission to enquire into rail gauge issues in both England and Ireland. Appointed in July 1845, the Gauge Commission, as it became known, reported in July 1846 in nine volumes. Its report is a seminal document in the gauge debate, and certain aspects of it require consideration in some detail.

In the first place, the Commissioners chose to analyse break of gauge impacts separately for four market segments – fast or express trains, ordinary or mixed trains, goods trains, and conveyance of Her Majesty's Forces. As to the first, it concluded that customers who could afford to travel light and fast would be little inconvenienced. For the other segments, the “narrow” gauge was seen to be serviceable, if not preferable.

The Commissioners concluded, further, that:

there is one point which forcefully presses on our attention, and the truth which must be readily acknowledged, but of which the importance is not at first equally obvious; it is, that the greater part of the inconveniences to which we have alluded, are not inconveniences of rare occurrence, and which would affect only a small number of persons, but, on the contrary, that many of them would occur several times in the course of every day, to a great number of persons, at each point at which a break of gauge might

exist. The cumulative amount of such inconvenience would of necessity be very considerable, and we feel bound to sum up our conclusions, by stating that we consider a break of gauge to be a very serious evil.

Report of the Gauge Commission  
PP. 1846, vol. 16, p. 7

The segmentation adopted by the Commissioners sets a very important precedent. It implicitly recognises that Stephenson's gauge of 4ft. 8½in. came about to meet the needs of the *bulk* carriage of goods, and specifically, coal. There was no premium for speed as there may have been with passengers, but there *was* a premium for carrying loads of much greater weight per axle than the weight of passengers. The Commissioners proceeded to consider how the "evils" they had identified might be obviated or mitigated, and considered the relative merits of alternative technologies including multiple tracks, telescopic axles or "piggybacking", that is, carrying narrow gauge wagons on top of broad gauge wagons. They concluded "that no method has been proposed to us which is calculated to remedy in any important degree the inconveniences attending a break of gauge" (Report of Gauge Commission, PP. 1846, vol. 16, p. 9).

The Commissioners' key recommendations were as follows:

First. That the gauge of four feet eight inches and a half be declared by the Legislature to be the gauge used in all public railways now under construction, or hereafter to be constructed in Great Britain ...

Fourth. That as any junction to be formed with a broad gauge line would involve a break of gauge, provided our first recommendation be adopted, great commercial convenience would be obtained by reducing the gauge of the present broad gauge lines to the narrow gauge, of four feet eight inches and a half; and we therefore, think it desirable that some equitable means should be found of producing such entire uniformity of gauge, or of adopting such other courses as would admit of the narrow gauge carriages passing, without interruption or danger, along the broad gauge lines.

Report of Gauge Commission  
PP. 1846, vol. 16, p.21

Although the Commission took extensive evidence about the economics (though static and partial) and the technologies of the competing rail gauges, its recommendations did not rest on, or even refer to, either:

... if we were dealing with the property of the public, and not of private trading companies, we should merely have to consider whether that uniformity of gauge which we deem to be so desirable, would be too



dearly purchased by the alteration of one gauge to suit the other, or of both to some fresh gauge which might be considered preferable to either, if any such there be.

But our position is different from this, since we have to consider not only the relative length of the different systems, the comparative mechanical efficiency of each, the general superiority of one above the other, their adaptation to the wants of the country, and the possibility as well as the policy of a change, but also the pecuniary means of effecting it. We have further to look at the consequences of an interruption of the traffic through the progress of an alteration.

Report of Gauge Commission  
PP. 1846, vol. 16, p.9

The Commissioners concluded firstly that no decided advantage rested with either gauge in respect of safety, accommodation and convenience of passengers. Secondly they considered that the advantage of faster running offered by the broad gauge was nullified by an increased safety risk. In their view, the narrow gauge was a more convenient carrier of goods, “and to be more suited to the general traffic of the country” (Report of Gauge Commission, PP. 1846, vol. 16, p. 9). Finally, they considered that the broad gauge would carry a greater construction cost but could see no means by which operating margins could be large enough to provide an adequate return on the greater investment. Their decision turned on the costs of conversion:

... we are inclined to consider the narrow gauge as that which should be preferred for general convenience; and therefore, if it were imperative to produce uniformity, we should recommend that uniformity to be produced by an alteration of the broad to the narrow gauge, more especially when we take into consideration that the extent of the former at present in work is only 274 miles, while that of the latter is not less than 1,901 miles, and that the alteration of the former to the latter, even if of equal length, would be less costly as well as the less difficult operation.

Report of Gauge Commission  
PP. 1846, vol. 16, p. 19

Parliament reacted immediately upon receipt of this report, and passed the Gauge Act in August 1846. The provisions of the Act were less stringent than those that had been proposed by the Gauge Commission. For example, it permitted completion of the Great Western scheme although limiting it to south-western England and a connection with Wales. Twenty years later, there were 1,040 miles of 7ft. gauge, and 887 miles of mixed gauge (that is both 7ft. and 4ft. 8½in.), together with 30 points at which breaks of gauge

occurred (Simmons 1978, p. 47). Through running and thus practical uniformity was not achieved until 1892.

It is to be noted that the Gauge Act which made it unlawful to construct a railway in Britain at any gauge other than 4ft. 8½in. save for exceptions specified in the Act, also made it unlawful to construct railways in Ireland at any gauge other than 5ft. 3in. This represented a compromise on a range of gauges which had been installed in Ireland. This is further evidence that the early gauge decisions in the United Kingdom were guided to a significant extent by the pragmatism of politics, and owed little if anything to the economics of railways or the economics of development, save for the economics of sunk costs.

### **3.5 Conclusions**

In summary, the “standard” gauge has a history which identifiably spans four millennia. The track of wheeled wagons had standardised in the range 4ft. to 5ft. 6in. as early as the second millennium. The gauge of 4ft. 8 in. at Killingworth colliery in the north east of England became the platform for railway development because it was the experience base of the man who came to lead the development of railway track and locomotion engineering, George Stephenson. Its choice for Killingworth may have been accidental, or it may have been a function of the local wagonways’ gradient. We do not know.

We do know that the gauge of 4ft. 8in. was employed on the first two public railways that George Stephenson designed (the Stockton and Darlington, the Liverpool and Manchester). Plausible evidence suggests that the gauge was extended by half an inch to provide more “play” for the wheels as they rounded curves. The gauge of 4ft. 8½in. was established as the predominant gauge in use in England by 1845, and its role as a standard for England, Scotland and Wales was mandated in 1846.

The mandating of those gauges followed recommendations delivered by the Gauge Royal Commission. This commission probed the relative technical and economic advantages/disadvantages of the 4ft. 8½in. and 7ft. 0in. gauges. However, its findings on these matters played no part in its recommendation. Its recommendation to adopt 4ft. 8½in. as the British standard was justified purely in terms of its minimisation of changeover costs – it argued that a change from 7ft. 0in. to 4ft. 8½in. would inconvenience fewer people than

the reverse change. This recommendation, and its subsequent adoption by Parliament, was thus motivated by political considerations rather than considerations of railway system economies.

It is significant for economic theory, and especially for the theory of economic development, that the standardisation proposed by the Gauge Act not only ultimately reduced costs of transshipment, it also created opportunities to achieve advantages of scale, and to increase specialisation in support industries.

## **4. THE INTERNATIONAL CONTEXT**

### **4.1 Introduction**

The purpose of this chapter is to describe debate and action about gauge choice as it occurred in Brazil, India and the USA, all geographically large, economically undeveloped and sparsely populated regions, sharing as they did those features with the Australian colonies. The railways of the Australian colonies, Brazil, India and the USA constituted almost 32% of global rail trackage in 1987 (Puffert 1991, pp. 387 – 394).

Following their first commercial application in the UK in the 1820s/30s, railway technologies diffused around the globe. The first railway in the USA became operational in 1830 (Puffert 1991, p. 200). Railways were established in France, Russia and Germany in 1837, 1838 (Lardner 1850 pp. 367, 414, 387), and 1835 (Brophy 1998, p. 24). It took only twenty to twenty-five years for the use of railways to become actively considered in remote and economically undeveloped regions such as Argentina, Brazil, India and the new Australian colonies. Although debates about railway issues were carried on at a local level, many made use of material from around the globe (see for example Fox 1865). Not only this, but some recognised from an early date that railways all over the world would have similar challenges to face. Gladstone and Grey were two important political leaders who understood this – see Appendices 2 and 3.

The key point is that the Australian rail gauge choices were not made in a vacuum, but on a global stage, informed from the very first about railway activities occurring all over the world. It follows that a complete understanding of rail gauge choices in the Australian colonies cannot be realised without an understanding of contemporaneous debate and action elsewhere on the globe.

Railway development in each country is considered to consist of three phases. These are entitled “Establishment”, “Early Railway Development” and “Later Developments”. This analysis notes that the structure of government differs between regions and between those regions and the Australian colonies. As described in Chapter 5, the Australian colonies were autonomous units of government each responsible directly to the British Crown until Federation in 1901. India was also a British Crown possession. However, it had a unitary structure of government embracing territory now consisting of Bangladesh, India, Kashmir

and Pakistan, a territory called India in the nineteenth century. The East India Company (EIC) was the original colonising agent. The EIC's role was taken up by a Governor General (a civil servant) in the 1840s. This structure was superimposed on a "native" structure of Indian principalities.

Brazil, a Portuguese colony from early in the sixteenth century, was given independence from Portugal in 1812. It retained an imperial form of government which was supported by national and provincial legislatures. The empire was abandoned in favour of a republic in 1889. From that time, the national government assumed executive rather than advisory powers. Europeans migrated to North America in numbers from the seventeenth century. In 1789 the American colonies united to defy Britain's sovereignty, and the Republic of the United States of America was formed.

## **4.2 BRAZIL**

### ***Introduction***

The modern railway system of Brazil covers about 40,000 km. and is built predominantly at a gauge of 1 m. (Harris 1998/9, pp. 55 - 61). The first railway was built in 1852 at 5ft. 6in. gauge. This was quickly superseded by the adoption of 5ft. 3in. as the Brazilian "standard" gauge, five of the first six lines having been built at this gauge (da Silva Telles 1987, Chapters 4 – 11). Originally, Brazilian railways were built by private enterprise, but since the late nineteenth century, railway companies have moved from private ownership to ownership by government, both provincial and national. In the past few years, ownership has begun to move back to the private sector in a programme sponsored by the World Bank. Aspects of the transition from private to public sector ownership are described in detail in Duncan (1932, 1937) and Summerhill (1998, 2003).

Although metre gauge now accounts for 89% of Brazilian rail, and 5ft. 3in. the balance, the absolute length of broad gauge track has lengthened from 460 km. in 1912 (Lavis 1915, p. 312) to more than 4,000 km. late in the twentieth century. The rationales for the original choice of 5ft. 3in., the apparent proliferation of narrow gauges (Randall 1977, p. 127), and the process of standardisation of 1 m. remain obscure. It appears that much of the primary source material "has been destroyed in Brazil and the UK since the beginning of the second world war" (Waters in da Silva Telles 1987, p. 6). There appears to be little secondary

material originally published in the English language, and according to Waters, it “was aimed principally at creating a good impression of the relevant company for the shareholders” (Waters, *ibid*, p. 6). There appears to be a body of work in Brazilian Portuguese, but this is not readily accessible in translation. In addition, again according to Waters, “in Brazil most secondary material was written, consciously or otherwise, by nationalists who were only too keen to create the myth of exploitation by foreigners” (Waters, *ibid*, p. 6). The two relevant historiographies mention very few sources. Others focus on individual companies or regions rather than a national policy - see for example Stein (1960). Summerhill (2000), in referring to perceptions about the behaviour of foreign investors in Brazil notes that:

What is striking about these assertions on the part of many scholars is the utter dearth of empirical work that assesses in any systematic or rigorous fashion the benefit and costs of railroad development in Brazil

Summerhill 2000, p. 25f.

Brazil was occupied and then settled by the Portuguese from the middle of the sixteenth century. It achieved independence from the Portuguese empire in 1812, installing a local imperial regime. A republican form of government was established in 1889. Representative government was put in place during the empire. There were two chambers of the national parliament. The lower house consisted of deputies elected for a fixed term of four years; the upper of senators with lifetime tenure. Provincial assemblies also brought down legislation, but these acts required review by the national parliament. Legislation which passed both houses of the national parliament was presented to the emperor for concurrence (Summerhill 2000, p. 35).

The area which Brazil covers (3,218,991 square miles) is larger than that of continental USA (less Alaska 2,980,339 square miles). It makes up 43% of the land mass of the South American continent (Barclay 1917), and occupies its centre and north-eastern corner. It has an array of substantial ports, ranging from Para (near the mouth of the Amazon River) on the north coast, to Rio Grande du Sol in the south-east, embracing major ports such as Recife, Rio de Janeiro and Sao Francisco in between (Barclay 1917, pp. 169 - 80; Lowther 1904). Major rivers form commercial highways on the plateau, but in general, run north/south and do not connect the coastal ports.

The transition from coastal plain to plateau in Brazil differs from that in Australia in that Brazil's is not only more abrupt, but consisted originally of very high rainfall and tropical jungle. That transition is so abrupt that technologies other than straightforward adhesion, which characterised railways almost everywhere else in the world, had to be employed in building lines inland from the capital Rio de Janeiro, and the adjacent port of Santos. The physical feature which dominates Brazil's geography, especially in the south, is the plateau the Serra do Mar. It presents an almost unbroken barrier for 1,600 km. of coastline, commencing 240 km. north of Rio de Janeiro (Barclay 1917). The coastal strip along its whole length varies in width from only 10 km. to 30 km. – any railway seeking the interior quickly enters foothills, and then must climb almost vertically to reach summits up to 3,000 ft. high.

The first line from Santos to the plateau used a cable system to draw its trains to the interior plateau. One of the first lines from Rio de Janeiro used a rack-and-pinion system, and another used a third friction rail. In a distance of 12 kilometres the Santos line climbed 776 metres. In a distance of 6 kilometres one of the lines from Rio de Janeiro climbed 811 metres (Duncan 1932, p. 21).

### ***Establishment of Railways***

The original demand for railways in Brazil was determined by increasing sales of coffee from the 1820s (da Silva Telles 1987, p.8). Until then, gold had been Brazil's main export. Mined in the province of Minas Gerais, on the plateau west of Rio de Janeiro, gold could be transported effectively by mule train because of high intrinsic value and the small tonnage involved (da Silva Telles 1987, p. 8). Coffee demanded more efficient land transport because of the volume involved and the distances from port (Graham 1968, Chapter 2).

Typical of the difficult transport situation was the case of an important coffee farmer of Vassouras in the Province of Rio de Janeiro, in 1850, who said: "we had heavy rains, ..., the animals were frightened because they waded in the mud up to their chests, or fell over the precipice at the side of the road. The unhappy muleteers became covered in mud in attempting to save the sacks of coffee, which in the majority of cases were soaked sufficiently to lose the coffee. Many times four or five of a mule train were lost in the sea of mud."

da Silva Telles 1987, p. 6

The constitutional justification for railway construction was contained in the Law of 29 August 1828 which stipulated that:

Works that had as their object to promote the navigation of rivers, opening of canals, construction of roads and bridges, causeways or aqueducts shall have the right to be carried out by national or foreign contractors, associated or singly.

da Silva Telles 1987, p. 10

This flagged government's recognition that Brazil lacked both the skills and the funds needed to develop the country's infrastructure (Graham 1968, Chapter 1), and would need to import both. The first legal instrument to apply specifically to railways was Decree No. 100 of 31 October 1835 which authorised the national government to:

Concede the privilege, for a term of forty years, to one or more companies which build railways from Rio de Janeiro to Minas Gerais, Rio Grande do Sol and Bahia.

da Silva Telles 1987, p. 10

In return for being awarded a "concession", a party became responsible for the design and construction of a railway between two designated points, *and its funding*. The "concession" commonly incorporated favourable treatment by the government of the contractor in respect of one or more government impositions. For example, government might forego revenue from tariffs imposed on goods imported by the contractor and/or provide for a government guaranteed interest rate on capital subscribed. In return, government required the contractor's adherence to certain conditions. For example the government might stipulate that once built, the railways' prices might be set by government.

The first concession was legislated by the government of Sao Paulo in Provincial Law No. 51 of March 1836. This concession lapsed (da Silva Telles 1987, p. 11). It was not until 1852 that the first effective formula for a national concession was specified. The Law No. 641 of 26 June 1852

... conceded a guarantee of interest of 5% on the capital employed in the construction of railways. The Law established also immunity from import duty on necessary machines, materials and equipment; a zone of privilege of 30 km. on each side of the line where no other competing line would be built; right to appropriate the necessary land and the cession of unoccupied ground; contracts subject to approval by the legislative assembly.



It was also prohibited that the lines should have slaves or that they should take advantage of them in the works.

da Silva Telles 1987, p. 12

The first concession was obtained by a Brazilian, Irineu Evangelista de Souza, afterwards Baron and Viscount Maua. His company raised local capital and built a short line from the coast in Rio de Janeiro to a beach in the municipality of Estela. This is the first point in the story of railway development in Brazil that raises the issue of gauge. The gauge adopted was 1676mm. (5ft. 6in.), the only one in Brazil with this value, and wider than any other gauge (da Silva Telles 1987, p.16). Since da Silva Telles is the source nearest to primary material, he is quoted in full on this point. That quotation is followed by an elaboration from his translator, Paul E. Waters.

It is interesting to observe that that gauge, certainly of the free choice of constructors to best suit their convenience (sic), was not the usual value in England, from whence was provided all material for the line. To attempt to explain that strange gauge, Ademar Benevolo remembered, with reason, that a short time before, the standardisation of a unique gauge of 1.44m. had been decreed in England, making available, at low cost, numerous material of the other gauges until then used. However, that hypothesis has a flaw: the rolling stock sent by the English to Brazil does not seem to have been second-hand, as would be supposed if it was obtained from deactivated railways.

Engineer Leal Burlamarqui says that the gauge of 1.676 was adopted at that time in Ireland, and remained the same after the unification of gauges in England in 1845.

da Silva Telles 1987, p. 6

According to Waters' footnote,

The Irish gauge is 1.600m. not 1.676m. and the largest gauge used in England (apart from Brunel's 7ft. (2.13m.)) was 5ft. (1.52m.): 1.676m. (5ft. 6in.) was the Spanish gauge, said to be 6 Castilian feet, adopted in a report of 1844. However, after some consideration of the problem of the choice of gauge in South America, it no longer seems to me to be necessary to look for a precedent in this way. In the mid-19<sup>th</sup> century, there was much debate about the relative merits of Brunel's 7ft. gauge on the Great Western and the standard gauge of 4ft. 8½in. Many engineers considered that 4ft. 8½in. was too narrow and referred to the British standard gauge as the narrow gauge. On the other hand, 7 foot was proving to be uneconomic. So, when starting to build railways with

a clean sheet of paper, what more appropriate gauge to choose than five and a half feet. This had been done some years before in India.

Waters in da Silva Telles 1987, pp. 16 - 17

The EF Maua railway was inaugurated on 30 April 1854.

The initial phase of railway development in Brazil was driven almost entirely by the need to move product, principally coffee, from the plateau to the port. This pattern of development resembles that of Queensland, with railways striking inland from the widely separated coastal terminuses. From north to south the key ports in the first wave of development were Recife, Bahia, Porto das Caixas, Rio de Janeiro and Santos. Lines from other ports, and connections between these separate ventures came later. Mr HC Lowther was Secretary to the British Legation in Rio de Janeiro in 1904, and was one of the very few near-contemporary observers who wrote in English. In a report presented to the British parliament, he observed that:

The primary object of the various railroads established in Brazil was not to create continuity of overland communication throughout the country so much as to facilitate intercourse between each port, the terminus of an isolated railway system, and a certain extent of a country cut off from adjoining territories and dependent on the local railroad for its supplies.

Each railway system was therefore originally established purely in local interests, without reference to the requirement of the country as a whole, and the absence of facility of communication overland in a country of such vast extent has placed considerable difficulties in the way of centralisation.

Lowther 1904, p. 5

All of the lines referred to above were built at a gauge of 5ft. 3in., the gauge having been specified in the contract. As Waters points out, the fact that the gauge was specified in the contract does not confirm that it was the contractor who chose it (da Silva Telles 1987, p. 20). It does not appear as though the 5ft. 3in. gauge was mandated by the national government, at least earlier in the period. At the inauguration of the first section of the railroad Dom Pedro II (Estrada de Ferro Dom Pedro II) on 29 March 1858, engineer Christiano Ottorri, President of the Company is reported to have said, in the presence of the Head of Government [Emperor] “ ... the necessity of today of our system of communications is, principally, Senhor, to be rationalised ... let all the projects conform to

a general plan, so that the efforts of one cannot be isolated and all aim at a uniform goal” (da Silva Telles 1987, p. 25).

Hence, the forces driving multiple and separate selections of the 5ft. 3in. gauge in the initial stage of railway development remain obscure. Two further quotations illustrate the confusion. Speaking of the construction of the Estrada de Ferro da Bahia Sao Francisco, da Silva Telles says:

The gauge of the line was 1.60m., by the same coincidence or unexplainable reason which had already occurred with the EF Recife au Cabo and with EF Dom Pedro II

da Silva Telles 1987, p. 30

And speaking of the construction of the line from Jundiai to Campinas, completed in 1872, he said:

It is interesting to observe that the gauge adopted for the line of the Companhia Paulista was the same as the Sao Paulo Railway (1.60m.), to permit mutual traffic between the two roads. *The decision to permit mutual traffic was a novelty for us and a great advance, which could only be applauded.* [Italics mine]

da Silva Telles 1987, p. 47

In summary,

Each railway system was therefore originally established purely in local interests, without reference to the requirements of the country as a whole, and the absence of facility of communication overland in a country of such vast extent has placed considerable difficulties in the way of centralisation ... A portion of these systems alone has 1.60metre gauge, a 1 metre gauge having been adopted elsewhere as better suited to the nature of the country.

Lowther 1904, pp. 5 - 6

In the Australian colonies and Brazil, governments encouraged private enterprise to invest in and manage railways. With two exceptions (the Melbourne & Hobson’s Bay Railway Company and the Silverton Tramway Company), Australian companies failed at the earliest stage of their development. Colonial governments decided to take over their assets and operate the railways. In Brazil, the failure rate was lower and slower, and national government acquisition of railway properties did not occur until late in the nineteenth century. This is so notwithstanding that both provincial governments and the national government initiated investments of their own in the interim. Perhaps because of their

British heritage, the Australian colonial governments also saw rail gauge as an issue for legislation from railways' very inception. This was not so in Brazil. Gauge choice was left in the hands of companies whose concessions had distinct local boundaries, and were not seen by governments or enterprises at least initially, as part of a larger regional or national system.

The establishment phase of railways in Brazil can be said to have ended in 1866. In that year, the Imperial Government granted a concession to the Uniao Valenciarria Railway. Gauged at 1.10m, this was the first narrow gauge railway in Brazil. "All subsequent concessions were to narrow gauge" (Wiener 1913, p. 54).

### ***Early Railway Development***

As railways developed from 1866, extensions were made to the original lines of 5ft. 3in., but as indicated above, all new concessions were extended to narrow gauge railways. In the Brazilian context no legislation appears to have specified *which* narrow gauge was to be adopted. A range of gauges, from 2ft. (0.61m.), to 3ft. 10½in. (1.40m.), was employed (Wiener 1913, p. 56). In the case of one particular railway, two gauges were used. The Oeste de Minas (West of Minas) railway was 2,666 km. long; its first 1,538 km. were 1 m. gauge, the remaining 733 km. being 70 cm. (Duncan 1932, p. 162).

Railway construction was not coordinated on either a provincial or a national basis in this early stage of development. Dean (1989) noted that:

By 1889 ... 9000 kilometres of rails had been built, and by 1930 32000 kilometres. The railways were entirely a response to the opportunities of the domestic market, since all of their equipment except the cross-ties, had to be imported and therefore paid for in foreign currency. Designed to drain the interior of exportable commodities, they did not form a national network. Broad and narrow gauges were employed, even within the same regional network ...

... Railways were unquestionably a major instrument of Brazil's escape from economic stagnation, yet it must be noted that their stimulus came late and was limited to a few regions.

Dean 1989, pp. 245 - 6

Consistent with Wiener (1913, p. 56), Waters notes that Brazil's first narrow gauge railway was the EF Uniao Valencia, built at 1.10m. from 1869. Waters adds that by 1883, Brazil

had nineteen different gauges in 6,395 km. of line (Waters 2001, p. 7). The proliferation of gauges is confirmed by Randall (1977):

The rapid building of railroads did not mean that a railroad network was constructed. Although maps at the time indicated that most railroads used narrow gauge tracks, there were, in fact, thirteen different gauges in use in 1880 on Brazil's 3,971 kilometres of track.

Randall 1977, p. 127

Available documentation does not make it clear what motivated those granting concessions to favour the metre gauge over the original 5ft. 3in. The rationale which prompted substantial diversity in choice of narrow gauge is similarly obscure. The factors which prompted the integration of narrow gauge railway into the dominant railway system are also obscure.

This lack of information prompted a request for references from the present author to Professor Maria Teresa Ribeiro de Oliveira of the Department of Economics of the Instituto de Ciencias Humanas at the University of Brazil. Professor de Oliveira enlisted Snr Paulo Roberto Cino Queiroz of the Universidade Federal de Grande Dourados, Brasilia. Snr Queiroz researched the subject and wrote to me in response to my questions. Professor de Oliveira translated his response from Portuguese to English.

Queiroz' correspondence quotes a number of sources in the Portuguese language. He relies principally on Chaves (1942). Chaves noted Brazilian interest in the Festiniog railway in 1863. This interest in turn led to an analysis of the suitability of narrow gauge lines for "regions scarcely inhabited where reduction in the cost of investment was more important than the capacity to transport or the speed of the trains" (Queiroz in private correspondence with the author, 14 March 2006). Queiroz' account of Chaves' argument suggests that Chavez argues in retrospect that the metre gauge may have been a poor choice for Brazil. In particular, lower standards of construction on standard or broad gauge lines may have yielded savings at least as great as those emanating from the narrow gauge choice (Queiroz in private correspondence with the author, 14 March 2006). Whilst this data may provide something of an explanation for the move from 5ft. 3in. to 1 m. gauge, it fails to shed light on either the diversity or standardisation issues.

The Republic succeeded the Empire in 1889, a convenient point to mark the end of the early development phase for railways in Brazil. By then, integration of the narrow gauge lines and their standardisation was well under way.

Randall (1977) reported further that:

The status of Brazil's railroads at the end of the empire (1889) was that of 56 railroad companies; 18 operated under an interest guarantee from the imperial government; 16 operated under interest guarantee from the provincial governments; and 22 operated without guarantee in the hope of future profits "which unhappily were almost always lacking." Track gauges had been adjusted so that 1,345 km. were broad gauge (1.60m), and 7,585 narrow gauge (1 metre). Only 653 km. were of different gauges. All new lines under construction were of 1m. gauge ... The length of railroad lines increased substantially from 745 km. in 1870 to 9,583 km. in 1889.

Randall 1977, p. 144

The early stage also saw proliferation in ownership structures, and in the roles of governments. The national government extended a variety of concessions to private sector operators. Some entailed guarantees of interest payments – others did not. Some specified that interest guarantees would be payable in gold, and some in paper. Other lines were owned by the national government and leased to private operators. One railway was owned by a provincial government and leased to a private operator (the Sorcorbana railway, in part, owned by the State of Sao Paulo – see Wiener 1913, p. 56). Additionally, State governments issued concessions to private operators. Further, the national government had the power to act as guarantor to States' subsidies to private sector operators (Wiener 1913, p. 54). These complexities were addressed in the next phase of railway development in Brazil.

### ***Later Developments***

Initiatives to standardise narrow gauge components of the system proved successful. By 1889, narrow gauge (1 m. and variants) accounted for 86% of the total railway system, and 1 m. gauge alone accounted for almost 80%. This transformation had taken place over a span of 23 years. Whilst effort to reduce variant gauges continued, the metre gauge proportion of the total system at 31 December 1911 had moved from 86% to 89.5% (Wiener 1913, p. 56) – the bulk of the standardisation task had been achieved by 1889.

It is not clear what factors drove the rail gauge standardisation process. We may speculate that the cost of operating a system of fragmented ownership, in which there were many breaks of gauge, became actually or potentially prohibitive. The evidence which supports this is the major changes in railroad policy introduced by the new Republican government from 1889. Wiener (1913, p. 54) explains that:

Upon the creation of the Republic it became urgent to bind the outlying Provinces with Central Districts, and comprehensive schemes of railway construction have been elaborated and slowly carried out, and the Federal government has consistently been bringing into effect the following general policy:

- (a) Commutation of government guarantees, either through payment in rescission bonds, or through granting of other privileges ...
- (b) Formation of systems in the various states, and the construction of connections between them ...
- (c) Gratuitous reversion of the lines to government on expiration of lease.

Wiener 1913, p. 54

These policy measures were driven by the need to reduce the national government's liabilities to pay interest guarantees in gold. By 31 December 1911, national government guarantees applied to 3,147 km. of line only, or 14% of the system (Wiener 1913, p.56) – see Table 4.1 below.

**Table 4.1**  
**Ownership Structure**  
**Brazilian Railways: 1911**

	<b>Length of Track (km.)</b>		
	<b>Open</b>	<b>Under Construction</b>	<b>Under Approved Study</b>
Owned & worked by the Union	3336	455	435
Owned by the Union & leased	7390	2178	2254
Conceded by the Union: Guaranteed	3147	256	833
Conceded by the Union: not guaranteed	1793	199	1260
Owned & worked by the States	416	-	-
Owned by the States & leased	965	432	-
Conceded by the States	5019	433	259
<b>ALL</b>	<b>22066</b>	<b>3953</b>	<b>5041</b>

*Source: Wiener, L 1913, p. 56*

This table also shows that by the end of 1911, the public sector owned 55% of total trackage, and the private sector 45%, or 86% of the trackage owned by the national and state governments combined.

As reported above, few vestiges of the metre gauge variants remained. Wiener (1913, p. 56) notes that:

There are 743 km. of 2ft. 6in. gauge, 689 km. of which are on the West of Minas system ... of the 2ft. gauge, there are 167 km. There are also 12 km. of 1m. 40 gauge (Olinda Railway), 9 of 1m. 36 gauge (Sao Vicente Railway), 25 of 1m. 21 (Caxanga Railway). Other gauges, of which there were previously a number, have been converted to metre gauge.

Wiener 1913, p. 56

As indicated earlier, empirical data about the rationale for moving from 5ft. 3in. to 1 m. gauge as standard is scant. Similarly empirical data rationalising the wide diversification achieved with metre gauge variances by 1866 is lacking. We may surmise that cost pressures brought about standardisation at a gauge of 1 m. from 1866, along with moves to produce integrated structures at regional level and to reduce the potential indebtedness of the national government.

It should be noted that notwithstanding lack of data, Brazilian railways and associated economic issues have received considerable attention from scholars since the end of the present period of study, 1901. These include Duncan (1932); Lewis (1985) and particularly Summerhill (1997, 1998a, 1998b, 2000, 2003). Summerhill concluded that:

Railroad technology had created large gains for the economy. Those gains were a good deal lower than they could have been, however, since many individual railroads produced mediocre outcomes. This was not the result of foreign investment, exploitation, dependency, the export of surplus value, or foreigners conspiring to undercut efficient service. Instead, it stemmed directly from the way in which Brazil's political organization channelled investment subsidies. The polity was neither endogenous to the structure of the international market nor bending to the demands of foreign investors. Indeed, many of its features were common to stable, successful, representative polities at that time. One key difference was the highly centralized character of the political institutions that were empowered to undertake market intervention.

Summerhill 2000, p. 63



However, it remains somewhat puzzling that Summerhill and other scholars did not acknowledge the wide diversity of metre variant gauges between the early/mid 1860s and the end of the nineteenth century, nor their standardisation. It seems possible that many breaks of gauge evolved as the isolated building of railways began connecting into regional and national systems late in the nineteenth century. It seems likely that those breaks of gauge were responsible for operating costs which were greater than those which would have been incurred with through running. Since almost all Brazilian railways were unprofitable, the cost of gauge breaks seems likely to have contributed to that outcome, although not necessarily in uniform ways across the country. Nevertheless, this issue has gone untreated in any of the works about Brazil's economic history used in preparing this thesis.

One of the major differences in the processes used in Brazil and in the Australian colonies was the use of the "concession" as a tool to stimulate private sector investment. Concessions were not used in the Australian colonies. Although private enterprise there sought favoured conditions from government, they were not as easily forthcoming as they were in Brazil. In particular, the NSW government could not deliver a guaranteed rate of interest on companies' funds raised from investors at a level which satisfied colonial Australian company directors.

A further major difference lay in the structure of government. Brazil acquired a national government on its establishment in 1812. Provincial governments were also established. Hence unlike Australia, Brazil had a structure with the power to legislate for a national standard gauge, although it does not appear to have used it in the early stage of railway development in that country.

### **4.3 INDIA**

#### ***Introduction***

Railways of India are of interest for a number of reasons. The Australian colonies and India had British rule in common. Their interest in railway development occurred in the same time-frame, beginning in the early 1850s. Their railways came to be owned and operated by government, and in both cases, railways became a serious drain on government finances. And in both cases, diversification in gauge choice occurred.

On the other hand, India's economic structure differed from those of the Australian colonies, and those of Argentina and Brazil. India had a highly developed village-based economy, predominantly agricultural. Domestic and export trading patterns were long established, if highly constrained by the lack of mechanised transport facilities – (see Hurd (1983) for an account of railway impacts on domestic and export trading patterns). The Australian colonies, Argentina and Brazil on the other hand, had economies based on capitalist agricultural/pastoral activities and were only beginning to emerge from what had been primitive societies.

### ***Establishment of Railways***

By 1850, when investment in railways was first being considered, the Indian sub-continent (consisting of today's Bangladesh, India, Kashmir and Pakistan ) had been under British rule for 250 years. Prior to British rule, and for many centuries, India had consisted of a number of autonomous principalities. In general, those principalities remained under British rule, although the role of the princes had become titular. The agent of British rule was the British East India Company (EIC) which was chartered in 1600. While Australia developed towards representative democracy, and had achieved it by 1859 (the foundation of Queensland as a state), India continued to be directly ruled by Britain until after World War II.

There is some evidence that initiatives were taken in the 1840s to promote railways in India, but that those initiatives were resisted by the EIC – see Headrick (1988, pp. 58 - 60) and Thorner (1955, pp. 80 -1). But by the end of that decade, the EIC's influence was waning, whereas the Governor General of India (1848 to 1856), Lord Dalhousie showed enthusiastic support for railways. According to Headrick (1988, p. 61) “Dalhousie was a brilliant and ambitious politician, a disciple of Jeremy Bentham, and the youngest member of the House of Lords. He had acquired his reputation as head of the Railway Department of the Board of Trade in 1845 – 46 ...”.

In 1849 the EIC agreed to the formation of two railway corporations. The East Indian Railway Company (EIRC) undertook to build and operate a line running a few dozen miles north of Calcutta. The second company was the Great Indian Peninsula Railway Company

(GIP) which undertook to build a line running north from Bombay for thirty-five miles to Kalyan. These were both “experimental” lines. “If the first few years’ experience with them proved successful, then the EIR and GIP hoped to go on to the building of the trunk lines of northern and central India” (Thorner 1955, p. 83).

Indian railway companies came to have considerable influence in British politics because of the number of industry affiliations of their British shareholders, particularly those in the cotton industry. There was no equivalent Australian lobby in London.

Committees for the promotion of railways in India sprang up in London, Liverpool, Calcutta, Bombay and Madras. In the press, in pamphlets, in public gatherings, and in shareholders’ meetings, they carried on a protracted controversy with the East India Company and among themselves regarding the auspices under which railways should be undertaken and the terms that would be necessary to attract British capital ... Finally, in 1849, the promoters, the Cabinet, and the East India Company reached agreement on the terms for the construction of the first two “experimental” railways in India.

Thorner 1951, pp. 389 - 90

The economic model for building and operating railways in India emerged from the discussions referred to in Thorner above. This model had three features: railways were to be constructed and operated by private enterprise; the Indian government indemnified shareholders in those companies against loss by guaranteeing dividends at 5% and a commitment to buy back capital investment in full after a year’s notice to government; and thirdly, and in return for their financial support, the Indian government was to control and supervise policy, direction of line, type of construction, mode of operation and rates and fares policy (Thorner 1951, p. 391).

The gauge of 5ft. 6in. (1.676m.) was decided on by the Governor General in 1851. Dalhousie brought a preference for the broad gauge with him to India.

... now at the very outset of railway works, it (the Government) should not only determine that any uniform gauge shall be established in India, but that such uniform gauge shall be that which science and experience may unite in selecting the best ... The evidence which has been given to the Gauge Commission in 1846 is ... I venture to think, sufficient to show that something intermediate between the narrow gauge of 4ft. 8½in. and the broad gauge of 7 feet will give greater advantage than belong to the

former and substantially command all the benefits which are secured by the latter.

Lord Dalhousie, quoted in  
Royal-Dawson 1921, pp. 16 - 17

The gauge of 5ft. 6in. was recommended by Simms, the then Engineer to the East India Company (Headrick 1988, p. 61). His grounds were that it would allow 9½in. more working space to house the working gear of locomotives, enable their centre of gravity to be lowered, and make them more stable in dealing with “the fearful storms of wind so frequent at certain seasons of the year” (quoted in Royal-Dawson 1921, p. 17). Headrick (1988, p. 62) states that “In 1845 Simms had recommended to Lord Dalhousie that the Indian gauge be set halfway between the British gauges, at 1.676 metres”. Since the halfway point between the two British gauges, 2.134 m and 1.435 m, is 1.784 m, Headrick is obscure on this point.

The body which governed the East India Company (EIC) on behalf of the British Government was its Court of Directors. It decided that all bridges, tunnels and cuttings should be made wide enough to accommodate double tracks (Headrick 1988, p. 62). Simms’ advice was followed by Lord Dalhousie. Thus India adopted 5ft. 6in. as standard.

Progress in building railways was slow, with only 480 km laid up to 1857 (Headrick 1988, p. 65). The Rebellion [Mutiny] of 1857 demonstrated the military value of railways, and this accelerated railway construction.

In the year 1858 – 59 alone, more track was laid than in all the years before 1858. By 1859, eight more companies had contracts for some 8,000 kilometres of railways ... The first of these, from Calcutta to Delhi was completed in 1866, followed in 1870 by the Bombay – Allahabad Line, which connected with the Calcutta – Delhi ... By 1871, 8,000 kilometres of line were open to traffic.

Headrick 1988, pp. 65 - 6

Hurd notes that by 1867, nineteen of India’s largest cities were on railway lines (Hurd 1983, p. 149).

For a number of reasons the first trunk lines proved very costly. The geography of the routes chosen required extensive engineering works to overcome very wide rivers, and

steep mountains; double track capacity was provided (Headrick 1988, p. 71). The broad gauge was chosen as standard. Because they cost more to build than expected, returns were lower than expected. They yielded “an average of 3 per cent up to 1870. Given their guarantee of 5% dividends, the difference had to be made up by government” (Headrick 1988, p. 71).

But geographical and technological factors were not the only determinants of the railways’ lack of profitability. It was the government of India that decided where to place railways, not the private sector constructors, and government’s policy was “to have lines spread widely across the country” (Hurd 1983, p. 151). In doing so, government was seeking to achieve a number of objectives, some at the expense of profitability.

... it approved so-called ‘famine lines’ which were constructed for the purpose of transporting grain to poor famine areas in time of need. And since it viewed the railways as an instrument for aiding the military in controlling the population and for defending the frontier, it authorized lines ... to strategic points on the frontier through regions that could support only light civilian traffic. Again for strategic reasons, lines built through cities normally avoided the central business districts and passed through the outskirts. This allowed the lines to be defended from mobs more easily, but the needs of potential customers were disregarded.

Hurd 1983, p. 152

Railway constructors could not change the geography, and they were locked in to traditional British construction standards. They could not alter the multi-purpose strategy of government authorisation of construction. But, in search of lower costs, it *seemed* possible to reduce the gauge at which railways were constructed.

### ***Early Railway Development***

In search of lower costs, government units began to build and run railway lines from 1869.

Princely states, provinces and even district boards constructed some railways. And between 1869 and 1882, because it felt that it could construct more cheaply, the central government itself built several lines ... In 1879, after the government purchased the East Indian Railway, the largest of the private lines, it initiated a policy of gradually taking over ownership of the large companies when their contracts ran out.

Hurd 1983, p. 148

Sir John Lawrence, Viceroy from 1864 to 1869, decided that narrow gauge lines should be built where possible and that government should build, own and operate them. His successor, Lord Mayo, concurred. These decisions were approved by the Secretary of State for India, who authorised issue of the bonds necessary to finance them (Headrick 1988, p. 72). Lord Mayo chose the gauge of 1 m. for India's narrow gauge railways (Royal-Dawson 1921, p. 19). Lord Mayo's rationalisation for adoption of a second gauge was "when we have an elephant's load, we may use an elephant, but when we have only a donkey's load, we ought to use a donkey" (quoted in Royal-Dawson 1921, p. 19).

It was with respect to a railway needed primarily for military purposes that the "battle of the gauges" went public in the engineering literature which inter alia, contains a devastating critique on the military's stated requirements for a standard gauge railway. It concludes:

The case for the Government of India stands thus: By making the Punjab lines on the metre gauge (and having to connect at both ends with the 5ft. 6in. line – author's note), it will save £530,000 at the lowest computation. To have adopted a light standard, instead of the metre gauge, would have occasioned a waste of like amounts, against which there would not have been the smallest strategical set-off, nor any other compensation of any other kind, except a slightly increased commercial convenience, not exceeding in capitalized value £17,000 at the outside.

Thornton 1873, p. 227

But there were other considerations other than first cost of construction.

If the original decision to adopt the wider gauge was a costly mistake, Lord Lawrence's meter gauge only compounded it. It saddled India with two systems, each with its own kind of rails, locomotives, rolling stock and workshops, and no way to shift equipment from one system to the other. Even transfers between meter-gauge lines was impossible because they were separated by standard-gauge track. Freight going between two lines had to be reloaded from train to train, and at every transfer point it was subject to delays, mishandling and the attention of thieves.

Headrick 1988, p. 72

Thornton (1873) is the first of the series of four papers about rail gauge issues in India referred to in Chapter 2. It attacks the prevailing wisdom that construction costs vary as a function of gauge choice. However, this issue had become almost dead by the time Thornton wrote his paper. Government had built a 4ft. gauge of 27½ miles in 1863

(Waring 1889, p. 107), and the first metre-gauge railway (Rajputana – Malwa) was opened in 1873 (Waring 1889, p. 108).

As the relationship between construction cost and gauge became an issue for sporadic debate only, the main debate in the “battle of the gauges” shifted to the additional cost of managing a system of two gauges, that is 5ft. 6in. and 1 m.. The government view was that such additional cost would be either non-existent or negligible. Thornton’s exposition of government policy had, according to Royal-Dawson, put the following argument:

In India there was no idea of letting the two gauges come into competition. There were not to be any standard-gauge lines and metre-gauge lines running from the same point in the same direction.

Thornton 1873, quoted in  
Royal-Dawson 1921, p. 19

In this scenario, transshipment costs would be nil because there would be no transshipment. There may even be savings in construction and operation of a metre-gauge system, and thus a net saving to the system as a whole.

It was also argued that although there may be inconvenience to passengers and transshipment costs for freight in a two-gauge system, they would be negligible. Royal-Dawson quotes from an unidentified Indian government document of c 1869 as follows:

For goods, changes of vehicles represent a certain additional charge for loading out of one set of wagons into another. This charge will commonly not exceed the cost of transport for 10 miles of railway, and the practical inconvenience is no greater than that which would have been caused by such an addition to the distance over which the goods had to be carried. The advantage obtained from any facilities of construction of locomotives for a broad gauge must be set off against the corresponding facilities of construction of the road and works for a narrow gauge, and where the traffic is likely to be light and the cost of construction high in comparison to the net profits, the balance may readily rest with the narrow gauge line.

Thornton 1873, quoted in  
Royal-Dawson 1921, p. 18

Another issue of debate in the “battle of the gauges” was about the relative savings potential of a reduction in costs via rail gauge reduction vs a reduction in construction standards. The Indian government’s push for reduced construction costs seems not to have

seen these options as alternatives but as complementary, and pursued both (Royal-Dawson 1921, p. 18).

The state railways were unprofitable, and proved unable to satisfy the need to redistribute food throughout the country in the famine of 1874 to 1879. The Famine Commission is reported as having said that a railway system to serve the nation effectively in drought conditions needed to be 20,000 miles long, and 5,000 additional miles were urgently needed (Headrick 1988, p. 74). The building of railways on this scale was beyond the capacity of Government. The Indian Government decided in 1879 to retain the right to build strategic lines to the northern frontier, but otherwise to return to the guarantee system to attract private capital to fund the remainder (Headrick 1988, p. 74). The Indian railway system continued to expand on this basis.

### ***Later Developments***

Adoption of the metre gauge and the (limited) use of narrower gauges did not improve railway profitability. By 1900, 70 per cent of total system mileage, representing 43 per cent of earnings, required subsidy. “Of the earnings of these lines, 81 per cent accrued to units with a profit of less than 3.5 per cent” (Hurd 1983, p. 152). Hurd proceeds to note that:

In the years 1879 to 1900, almost all the lines not requiring a subsidy were located in north India in an area which included much of the Ganges Valley between Bengal and Delhi, extending in the north to a point in the Punjab 105 kilometres south of Lahore, in the south to Bombay, Poona and Nagpur, and returning to meet the Ganges at Allahabad.

Hurd 1983, p. 152

Hurd mentions a few lines outside this region which were also profitable, and noted that of the total lines considered, 70% had an earning rate in excess of 7% p.a. concluding that “Most of these lines probably would have been built even if there had not been a subsidy ...” (Hurd 1983, p. 153).

In an extensive analysis of the impacts of railways on the Indian economy to 1940, Hurd is silent about the gauge controversy. It is therefore not possible to examine rail profitability in India as a function of rail gauge from Hurd’s data. Derbyshire’s more detailed analysis of railways’ impacts on a particular regional economy is similarly silent (Derbyshire 1987). In neither case is the economics of a mixed gauge system given any consideration.



By the time of Waring's paper (Waring 1889), Indian standard gauge mileage (5ft. 6in.) had grown to 8,000, and 5,000 miles of metre gauge had been laid. By the time Sir Frederick Upcott's paper was published (Upcott 1906), the mileage of the two systems was 15,000 and 12,000 respectively.

As to other gauges, some lines were constructed at 2ft. and 2ft. 6in. gauges. Upcott reports that at 1903, they had reached a total of 1,058 miles (Upcott 1903, p. 198). They were built in order to provide railway transportation in very steep country. The first two, the Darjeeling and Barsi lines were built by private companies. Upcott reports that these lines:

... not only drew the attention of the military authorities to the capabilities of a small gauge for serving hilly tracts at a reasonable cost, to act as pioneer lines for the standard gauge, but has also led to other lines being started as tramways which have developed into railways. These small-gauge lines do not, in general, serve metre gauge lines but have been built as continuations of and feeders to, the standard gauge lines.

Upcott 1903, p. 198

Table I in Waring's Appendix provides a line by line analysis of line length and construction cost of railway lines in India. The total track sanctioned in 1889 was 16,600 miles, and 13,385 had actually been built. The small gauges accounted for 260 and 220 miles respectively, or about 1½ % (Waring 1889, p. 132). As stated above, by 1903 the small gauges accounted for a track length of 1,058 miles or 4.3% (Upcott 1903, pp. 209 – 10). By 1921, small gauge rail occupied 3,764 miles of line, or about 10% of total track. Of that 2,926 miles was of 2ft. 6in. gauge, and the remainder 2ft. (Royal-Dawson 1921, p. 23). As Royal-Dawson put it, "These have not been referred to before, because they do not constitute "rival" gauges" (Royal-Dawson 1921, p. 21).

The main development in the later part of the nineteenth century was the proliferation of metre-gauge lines accompanied by dissolution of the original policy of developing separate systems for the two gauges.

... the metre gauge first began to rival the broad gauge between 1889 and 1906, when infringements of the confined area policy were first permitted. This was due to a light-hearted heresy, widely disseminated by metre-gauge enthusiasts in the nineties that all metre-gauge systems should be linked together, and should have direct access to ports.

By 1906, the main issue in the gauge debate in India had become about the costs and benefits of converting metre-gauge lines to broad-gauge lines and vice versa. This appears to be the first issue with respect to rail gauge management in which cost/benefit analysis became routinely employed – see Upcott (1906) and Royal-Dawson (1921).

India and the Australian colonies had little in common save both being British dependencies. Direct British rule was applied in India whilst the Australian colonies worked towards representative government and eventually federation. What these very different forms of government had in common was the view that railway gauge was a proper matter for government regulation. It distinguishes them from the USA and Brazil. It meant that neither India nor the Australian colonies experienced the wide diversification that occurred in the USA and Brazil in the early stage of their development. Government control simply did not permit it.

In both India and Australia, political leaders were working with different visions of their estate; in India the vision was national in scope; in Australia the vision was merely colony-wide. Further, India was working with strategic imperatives of defence and famine relief both in a national perspective; neither were significant to the Australian colonies.

#### **4.4 UNITED STATES OF AMERICA**

##### ***Introduction***

The United States of America is almost unique amongst the markets for railway services. This is because it is one of the very few in the world which has a ubiquitous rail gauge. That gauge is 4ft. 8½in. The USA railway systems have been studied intensively and comprehensively. They are described and analysed in works such as those of Hilton (1990); Stover (1997); Taylor & Neu (1956) and Vance (1995). The processes involved in standardisation have been examined intensively by Puffert (1991, 1996, 2001, 2001a, 2001b and 2003). Their contributions to management science have been chronicled by Chandler (1977), and railroads' role in the growth and development of the US economy has been analysed and chronicled by authors such as Abramovitz (1955); Cootner (1963); David (1969); Fogel (1971) and Jenks (1944).

It is important for the story of gauge choice in the USA to be recounted as it is one of the rare cases in the world where the rail gauge was shaped predominantly by market forces. In most other cases, governments played a key role in determining the outcome. Even in the USA, congressional action was critical with respect to the gauge of transcontinental railways.

In terms of political structure, the United States of America achieved nationhood in 1787. The Constitution of the United States was settled at a constitutional convention in Philadelphia. It was later ratified by special conventions in each of the original thirteen states. It caused creation of a federal union of sovereign states and a federal government to operate that union, with effect from 4 March 1789. Effective union followed two “Wars of Independence”, 1775 – 1783, and 1812 – 1815.

In contrast Australia was *debated* into existence almost one hundred and twenty years after the United States achieved nationhood, and one hundred and twenty years from first settlement.

By 1820, the population of the United States was almost 10 million (Maddison 2001, p. 241), concentrated in the north and east of the country. Significant investments had been and were being made in turnpikes (highways) and canals. The Erie Canal, connecting Albany and Buffalo over 364 miles was completed in 1825, and was the spine of a significant long distance heavy haul transport network. According to Stover (1997):

By 1830, at least 10,000 miles of inland waterways were projected and 1,277 miles had been built ... although in 1840 every state east of the Mississippi, with the exception of Illinois, Michigan, Mississippi and Tennessee, had canals in operation, 70% of the total mileage was to be found in Pennsylvania, Ohio and New York ... several minor types of canals were built. The most important type however, was that intended to draw western business to some eastern city.

Stover 1997, pp. 5 - 6

But canals could not deliver regularity and reliability of supply. The availability of some canals was inhibited by winter freezing, and others were periodically and unpredictably affected by drought and flood. Mountain ranges presented barriers. The development of trade required the railway (Stover 1997, p. 9).

### *Establishment*

New York was North America's first city of commerce. It competed with Philadelphia, Baltimore, Boston and Charleston for exports and to serve the hinterland. These cities all saw investment in rail as a key to their being competitive in the markets for freight, and hence in securing trade. The building of commercial (as distinct from industrial/mining) railways in North America began with the Baltimore and Ohio in Maryland (4ft. 8½in.) and the Charleston and Hamburg of South Carolina (5ft. 0in.) in 1830. In 1831 the Mohawk and Hudson of New York (4ft. 9in.) was commissioned, as was the Camden and Amboy of New Jersey (4ft. 10in.) in 1832 (Puffert 1991, p. 200).

Three gauges – first 4' 8½", second 5' 0" and third 4' 10" appeared almost simultaneously between 1830 and 1832 at the very beginning of inter-city railway service. That these gauges differed from each other by a maximum of only 3½" (about 6%) indicates that there was not a great deal of disagreement amongst engineers about optimal gauge, but the difference was enough to prevent, for the most part, interchange of traffic.

Puffert 1991, p. 197

That there was not greater diversity across a wider range than actually occurred is arguably due to the number of American engineers who sought guidance from English expertise, and most notably from George Stephenson and his associates. Stapleton (1978 –Table Ia) documents visits to England of fifteen emerging American railway specialists by 1836, ten of which visits were made by 1830. They were influential – they were responsible for 77% of North American railway trackage in operation by 1839 (Puffert 1991, p. 204). Stapleton (1978, pp. 65 – 6) notes that:

... the American engineers developed knowledge of railroads in three areas: (1) locomotives and inclined planes, the two "new" elements in railroads, (2) the uses of materials – especially stone, wood and iron – in construction, and (3) the principles of laying out routes feasible for railroad travel.

The American civil engineers who returned with this special knowledge were readily hired by railroad corporations, and they dominated the market for chief engineers in the early years. Many of the early railroads built by the visitors were imitations of the most impressive of the British railroads, the Liverpool and Manchester. The Baltimore and Ohio engineers particularly attempted to copy its solidity of construction, and its use of locomotives and inclined planes. The Columbia and Philadelphia, Boston and Lowell, and Camden and Amboy had similar designs. In order to follow the British pattern most

of the locomotives and all of the rails for American railroads in the first years were imported from Britain. The visiting engineers transferred virtually an entire technological “package” to the United States.

Stapleton 1978, pp 65 - 6

### *Early Railway Development*

The railroad industry grew rapidly. By 1840, twenty two of the twenty six states making up the union had laid at least their first mile of track:

Most of the lines were built to serve coastal cities in the eastern states, for only a twelfth of the 3,000 miles of road bay west of the Appalachians. The New England and Middle Atlantic states accounted for more than 60% of the mileage in 1840, with Pennsylvania first in the nation in mileage (754), New York second (374) and Massachusetts third (301).

Stover 1997, p. 19

By 1830, 41 miles of track had been laid. By 1840 2,200 miles of track were laid; by 1850, 7,500; by 1860, the year before the American Civil War, 29,000; by 1870, 49,000; and by 1880, 93,671 miles of track had been laid. So much track had been laid by 1880 that the North American network was more than twice as large as Australia’s network would ever be. At that time, the trackage of Australia’s colonial railways totalled 5,592 miles (Lalor 1889). Railroad construction proceeded at a rapid rate in the decade of the 1850s, prior to the onset of the American Civil War in 1861. This decade saw the construction of 20,000 miles of line on a base of 29,000 miles. By 1855,

... four rival western lines had completed their original planned construction. The race between Baltimore, Philadelphia, New York City and Boston to tap western trade via the railroad had finally ended in a virtual tie. More important was the fact that the four trans-montane railroads had united the states of the northeast and the northwest well before the crisis of secession.

Stover 1997, p. 39

Those lines were built by corporations chartered by the local (usually state) government for the specific purpose of connecting two designated points by rail, and funded by equity subscriptions or loans or subscriptions from public funds, or sometimes all three. Those charters imposed few constraints on promoters. Their choice of rail gauge in particular may have been constrained, particularly where state governments saw some advantage from

being specific. In consequence, the first railways were built to a variety of gauges, and the choice was made generally to suit the preferences of owners.

Only in the New England states was the Stephenson gauge adopted in the beginning. Others were:

Delaware and Hudson	4'3"
Baltimore and Ohio	4'6"
Mohawk and Hudson	4'9"
Saratoga and Schenectady	4'9"
Philadelphia and Columbia	4'9"
Baltimore and Susquehanna	4'9¼"
Camden and Amboy	4'9¾"
New Jersey	4'10" (or 4'9¾")
Southern roads	5'0"
Louisiana roads	5'6"

Down east in the state of Maine, John A. Poor and his associates decided that the trade of that area would center in the then little city of Portland and that none of it would continue on to its hated rival Boston so they adopted the old Scottish gauge of 5'6". The British North American provinces, which had not yet united to form the Dominion of Canada, were planning a grand trunk inter-colonial railway, which would use the railroads of Maine, temporarily at least, to bridge the gap between the valleys of the St. Lawrence and St. John rivers and, as a result, New Brunswick, Nova Scotia and Canada adopted the Maine gauge. The principal reason was that the line between Montreal and Portland was 5'6" and nearly completed but there were political reasons too although the fact was not stressed at the time. It was government policy to force trade to flow east and west, by artificial means if necessary, and to discourage north and south traffic, and there were still vivid memories of the many attempted Yankee invasions in the War of 1812, so the broad gauge was welcomed as a means of impeding border crossing except on the one line to Portland.

Brown 1952, pp. 82 - 3

The range of gauges in use set out by Brown is such that whilst some were planned, not all were constructed. More detailed empirical research carried out by Puffert (1991 & 2000) indicates almost equally significant variety, but notes the concentration of early gauge choices of 4ft. 8½in., 4ft. 9in., 4ft. 10in. and 5ft. 0in. See in particular Puffert (2000, p. 935 et seq). By 1860, the US rail network consisted of roughly equal thirds – the New England and Middle Atlantic states with 10,000 miles, the Middle West with 11,000 miles and the South of 9,000 miles (Stover 1997, p. 43). Fourteen different gauges were in use in the north, but 4ft. 8½in. had become the most common by 1860 (Westbay 1933, p. 32). Most of the railroads of the South used a gauge of 5ft. (Stover 1997, p. 43).

Most of the money for the early railroads came from private investors who in investing hoped variously for improved land values, more profitable markets and/or a general rise in prosperity, together with a reasonable return on the investment. Initial railroads were designed primarily to meet local needs, so that investors were very familiar with the territory and the economies in which they would operate. Though railroads were generally unconstrained in their choice of gauge, that choice was occasionally determined by the extent to which it conferred or enhanced the railroads' monopoly powers – see for example reference to the adoption of the 5ft. 6in. gauge for the line from Montreal to Portland in Brown (1952, p. 83) above. There were occasions and situations in which competition for monopoly power was intense and prolonged. Kent (1948) gives an account of the “war” between the railroads in the Erie region, “the immediate cause of which was the attempt to eliminate the break or difference in railroad gauges between the two east-west lines which connected at Erie” (Kent 1948, p. 254). Erie was in effect a junction of 6ft. and 4ft. 10in. gauges and difficulties were encountered in finding an optimum way of connecting to the 4ft. 8½in. line to New York. Over a three year period, these difficulties manifested themselves in track destruction, the burning of bridges, riots, fights and kidnappings, as well as extensive litigation. Compromise emerged in 1856, but a solution was not found until standardisation at 4ft. 8½in. was implemented many years later (Kent 1948, p. 274), at which time the 6ft. and 4ft. 10in. gauges disappeared.

In July 1862, Congress passed, and President Lincoln signed, the first Pacific Railway Bill. This legislation stated that the transcontinental railroad was to be built by two companies, one each starting in the east and in the west. The legislation gifted certain public lands to both companies, they received a thirty year government loan, and were authorised to solicit equity investment (Stover 1991, p. 64). This Act was styled as “an Act to aid in the construction of a railroad and telegraph line from the Missouri River to the Pacific coast and to secure to the government the use of the same for postal, military, and other purposes” (Westbay 1933, p. 30). It did not specify the gauge at which the transcontinental railway was to be built but contained the provision that “... the track upon the entire line of railroad and branches shall be of uniform width, to be determined by the President of the United States ...” (Westbay 1933, p. 30). It became known that President Lincoln favoured a gauge of 5ft. Congress repealed that provision of the Act which gave the President the discretion to determine the gauge, and on 3 March 1863 fixed the gauge at 4ft. 8½in.

(Westbay 1933, p. 31). The debate leading to this vote demonstrated considerable support for a 5ft. gauge. Its arguments are of interest.

Particularly interesting in these days of efficient railroad operation, with our present fast trains, both freight and passenger, and through car routes over long distances, were the arguments by those interests which favored the 5-foot gauge and who desired breaking gauge at the eastern terminus of the Union Pacific. It will be sufficient to note in passing that gauge-breaking was argued as a matter of both safety and good business; that goods could not be safely shipped from the Pacific coast to the Missouri River without a change of cars en route, for it would not be safe to run cars for so great a distance in a continuous trip; that such transfer at the middle point (perhaps near Salt Lake City) and again at the gauge-breaking point would stimulate business at those stations; that if the Union Pacific were built to the 4ft. 8½in. gauge its cars would be used by other roads of that gauge and they would get to such distant points as Baltimore, Portland and Boston and carry traffic on lines radiating from those centers, thus getting away from the control of the owning road. Figures were presented which indicated that transfer costs would average 7 cents per ton at gauge-breaking points, and the argument was advanced that the railroads “can better afford to break gauge and pay the expense themselves” than to let their cars get so far away from their own rails.

Westbay 1933, p. 31

Vance (1995, pp. 115 – 6) observes that “Taylor shows that Congress did not determine the gauge of the transcontinental railroad; the predominant structure of the northern rail network in 1861 did. Then there were 20,567 miles of standard gauge to 1199 miles of other gauge in the North and the Middle West” and refers to Taylor & Neu 1956, p. 55. Taylor & Neu themselves note that:

It is sometimes assumed that American railroads have a standard gauge of 4 feet 8½ inches because that gauge was chosen by Congress for the first transcontinental line, and it is thought that this decision forced conformity upon connecting roads and subsequently upon all roads. An examination of the Senate debates on the matter, however, leads to the inescapable conclusion that the gauge of the Union Pacific-Central Pacific was set at 4 feet 8½ inches largely because this measurement already predominated in the country. In other words, standard gauge had been determined for America before Congress acted on the gauge of the Pacific Railroad.

Taylor & Neu 1956, p. 55

Wherever the emphasis is put, this is a clear case of Federal government intervention in a market place for railway services which had, until 1863, been the legislative province of



the States. The proposal for *transcontinental* railways was a clear case for Federal involvement. Until then, railways had been considered intrastate operations.

The significance of the Congress decision which nominated 4ft. 8½in. as the gauge for the transcontinental railway was that it ensured “that the railway system west of the Missouri River would develop as part of the nation’s system, not as a separate system” (Taylor & Neu 1956, p. 53). In their view, this decision was one of three factors which led to substantial advances in building an integrated rail network in America. The other two were the need created by the Civil War for efficiency in moving troops and materiel, and the growth of the grain trade from the west (Taylor & Neu 1956, p. 53).

Throughout the war, efforts to improve the Northern trunkline systems went forward. Built during this period was the Atlantic and Great Western, a road of 6-foot gauge which connected with the Erie at Salamanca, New York, and with the Cincinnati, Hamilton and Dayton at Dayton, Ohio. In 1864 the latter road completed a “straddle track” – a broad-gauge track placed outside its 4-foot 10-inch rails – in order to accommodate the cars of the Erie and the Atlantic and Great Western. At Cincinnati, the Cincinnati, Hamilton and Dayton connected with the 6-foot Ohio and Mississippi, thus completing a broad-gauge line without a single physical obstacle between the eastern seaboard and the Mississippi River opposite St. Louis. By the end of 1865 the 5-foot 6-inch Great Western of Canada, which formed the connecting link between the New York Central and the Michigan Central railroads (both standard-gauge roads), was laying a third rail for the future accommodation of standard-gauge cars.

Taylor & Neu 1956, p. 54

The Civil War experience highlighted the constraints to freight movement caused by breaks of gauge – but “by 1870 the railroads of the United States represented a more or less conglomerate assortment of gauges” (Westbay 1933, p. 32). That assortment is demonstrated in Table 4.2 below.

**Table 4.2**  
**Gauge Diversity USA – late 1860s**  
**Selected Railroads**

<b>Gauge</b>	<b>Railroad</b>	<b>State</b>	<b>Mileage</b>
6ft.	Albany & Susquehanna	NY	103
	Atlantic & Great Western	NY, Pa, Ohio	507
	Delaware, Lackawanna & Western	Pa, NY, NJ	251
	Erie	NY	460
	Hackensack & NY	NJ	13
	Lackawanna & Bloomsburg	Pa	80
5ft. 6in.	Galveston, Houston & Henderson	Texas	50
	Main Central	Maine	110
	North Missouri	Missouri	170
	Pacific & Missouri	Missouri	283
5ft. 4in.	Portsmouth Branch	Ohio	56
5ft.	Albany & Florida	Ala	114
	Kentucky Central	Kentucky	99
	Virginia & Tennessee	Va, Tenn	204
4ft. 10in.	Belvedere & Delaware	NJ, Penn	67
	Bellefontaine	Ohio, Ind	202
	Central Ohio	Ohio	137
	Cincinnati, Hamilton & Dayton	Ohio	60
	Pittsburgh, Ft. Wayne and Chicago	Pa etc.	468
4ft. 9½in.	Sandusky, Mansfield & Newark	Ohio	117
4ft. 9¼in.	Lake Eyrie & Louisville	Ohio, Ind	175
4ft. 8½in.	Illinois Central	Illinois	365
4ft. 8in.	Cumberland Valley	Pa, Md	74
4ft. 7in.	Wilton	NY	15
4ft. 5½in.	Tyrone & Clearfield	Pa	23.5
4ft. 3in.	Delaware & Hudson	Pa	32

*Source: Westbay 1933, p. 32*

Whilst Table 4.2 depicts diversity in gauge choice adequately, it could be misleading as to the relative concentration of particular gauges, especially at regional level. Puffert (2000, p. 936) analyses concentration of gauges by region in a way which, unlike the table above, highlights the regional and national predominance of the choice of 4ft. 8½in.

### ***Later Developments***

Even before the Civil War, shippers strove for improved access to railways, and lower costs in using them. This continued postwar (Stover 1997, Chapters 3 – 4). There were a number of responses to the continuous search for improved access and reduced costs to shippers. These included the increasing cooperation and combination of freight forwarders

in the search for fast freight lines - lines where time was gained by through running since goods did not need to be transhipped en route. They also included the railroads' adoption of technological solutions including "compromise cars", movable axles, and transferable bogies. ("Compromise" cars were rollingstock with five inch treads. At this tread width, "compromise" cars could run on any gauge between 4ft. 8½in. and 4ft. 10in.). But they also included the "voluntary" moves towards gauge standardisation by individual railroads, including the use of double gauge lines (Taylor & Neu 1956, pp. 59 – 61). According to Taylor & Neu (1956):

By 1880 there were perhaps 2,800 miles of double gauge railroad in the United States. "A large proportion of the double gauges", the census of the year said "are formed by means of a third rail". Most roads of double gauge represented efforts to accommodate broad-gauge lines to standard-gauge equipment, or vice versa. But perhaps 400 miles of such road made possible the interchange of traffic between lines of standard gauge and of 3ft. or narrow gauge, *of which approximately 5,000 miles had been constructed during the "narrow gauge fever" of the 1879s* [italics mine].

Taylor & Neu 1956, p. 63

Puffert (2000, p. 238) argues that "The emergence of diversity of gauge was conditioned by two sorts of incentives for each local railway line: preference for specific gauges and an interest in adopting a common gauge in order to exchange traffic." The balance between these two sets of incentives also produced movement towards standardisation where the preference for through traffic capability came to dominate. As noted above, Taylor & Neu (1956, p. 53) considered that the third factor (after Civil War demands and the need for a common transcontinental gauge) was "the growth of the grains trade from the West," and in particular, the demand for transport to shift grain from the West to the rapidly industrialising East (Taylor & Neu 1956, p. 57).

The demand for better service at lower cost stimulated the birth and growth of fast freight lines. These organisations were independent of railroad companies, owned their own rollingstock with diverse "compromise" capabilities, and were able to travel over a variety of roads. As Taylor & Neu explain, "Their service was "fast" in that the cars of the line went through from their point of pick-up to their destination without breaking gauge, thus eliminating delays at transfer points" (Taylor & Neu 1956, p. 68).

The fast freight lines helped the economies of railroading because they owned and supplied their own cars, railroad companies avoided having to invest in the same capacity; and were thus able to ship volume they would not otherwise have been able to shift. But fast freight lines imposed another layer of cost and administration. In time, this led to the formation of “cooperative” freight lines. Such lines were not separate corporate entities but administrative structures which coordinated the activity of a number of companies over a length of line. Taylor & Neu report that “within a very short time after their first appearance the fast freight lines became remarkably efficient. By 1874 they blanketed the nation and were carrying “substantially all” through freight moved by rail” (Taylor & Neu 1956, p. 72).

The drive to substitute cooperative lines for independent fast freight lines was a move adopted by railroad companies to capture additional revenue and profit. Cooperative and company lines proliferated and became increasingly competitive. In 1886 one observer questioned whether any other single cause was more responsible for the demoralisation of freight rates than the competitive bidding of the freight lines for traffic (Taylor & Neu 1956, p. 76). But it was these competitive pressures which over time, caused railroad companies to move from compromise solutions to gauge standardisation.

As described in the accounts of railway development in the Australian colonies in Chapter 5, the “battle of the gauges” was conducted on a global scale, and no less vigorously in the USA than anywhere else. The second phase concerned the relative merits of standard and narrow gauge railways, and represented a regression to differentiation whilst standardisation was in progress.

The Denver and Rio Grade Railroad Company is the most famous of the narrow gauge lines built in the USA in the 1870s/80s. It was owned in part and directed by General William Palmer, referred to previously in connection with transcontinental railroad proposals. Taylor & Neu (1956) note that:

By January 1, 1878, the nation had 2862 miles of narrow-gauge railroad. About half of it was to be found in the lightly settled area west of the Mississippi, 350 miles of it in Colorado alone. East of the Mississippi, the greatest narrow-gauge mileages were in Ohio, which had 271 miles, Pennsylvania, which had 261 miles, and Illinois, which had 202 miles. By 1889 the narrow-gauge trackage figure for the United States had

climbed to the neighbourhood of 5,200, representing about 5 per cent of the total railroad trackage of the country. In the single year 1882 some 2000 miles of narrow gauge track were laid. This was the high point. ... By the spring of 1884 the pioneer narrow-gauge line, the Denver and Rio Grande, had laid a third rail over the oldest part of its road, the section between Denver and Pueblo, for the accommodation of the standard-gauge equipment of its eastern connections.

Taylor & Neu 1956, p. 65

The partial diversion of resources to narrow gauge railways occurred on cost benefit grounds which were found in short order to be specious. In the meantime, the movement towards standardisation at 4ft. 8½in. proceeded in the rest of the country. In the north, moves to the standard gauge were made and implemented by individual railroad companies:

A few roads, representing a little less than three per cent of total United States mileage, by 1880 had accomplished the change by using a third rail. But a number of railroads of once divergent gauge had made an abrupt change to the standard gauge. This course was taken, for instance, by the 5 foot 6-inch Grand Trunk of Canada in 1874 and by the 6-foot Delaware, Lackawanna and Western in 1876. By 1880 practically all Canadian roads had shifted from the 5 foot 6-inch gauge to standard. In the United States this same broad gauge, which had been common in Missouri and other states south of Missouri and west of the Mississippi River, had also virtually disappeared. Similarly, the 4 foot 10-inch gauge, previously so common in New Jersey and Ohio, had, except for 52 miles, been changed to standard gauge. *By 1880 nearly 81 per cent of all the railroad mileage in the United States was equipped to accommodate rolling stock of standard gauge [italics mine].* Of this, 11 per cent of total mileage was of 4 foot 9-inch, which for practical purposes was also standard, since equipment was usually exchanged between roads of these two gauges “without objection”.

Taylor & Neu 1956, p. 77

Representatives of the major railroad companies of the South met on 2 February 1886 to consider the future for their 13,000 miles of track. They decided to change to the standard gauge, and to adopt a synchronized process with all lines changing from 5ft. to 4ft. 9in. over Monday and Tuesday, 31 May and 1 June 1886. This was accomplished, 4ft. 9in. having been preferred because most of the lines connected with the Pennsylvania road of that gauge; 4ft. 8½in. gradually replaced 4ft. 9in. as 4ft. 9in. equipment aged and was replaced. It is not clear when this process was completed but it is thought to have been in about 1900.

Taylor & Neu (1956) concluded that:

... in the age of limited markets before the Civil War the forces of competition had led to the building of railroads designed to serve the exclusive needs of each of the great market cities. The result was an uncoordinated railroad patchwork. The later chapters show how this patchwork was converted into a well integrated network. Under the leadership of financiers and promoters whose interests transcended local loyalties, there emerged a national economy which, on the one hand, was made possible by the railroads, and which, on the other, moulded the railroads themselves into a unified transportation system.

Taylor & Neu 1956, p. 83

The differences between the US railway development context and that of the Australian colonies seem in retrospect to be greater than the matters they had in common. In the first place, the US had achieved a national identity from early in the nineteenth century, whilst Australia's was not achieved until one hundred years later. Secondly, nationhood in the US entailed adoption of a structure of federal and state governments, which again Australia did not achieve until 1901. Representative government was in place in the US forty years before rail gauge decisions became critical. In Australia at the same time, (1855 say), representative government had barely emerged from embryo.

The net result seems to have been that in the US, critical decisions were made earlier. For example, railroad construction in the US abandoned the British practices of double tracks and masonry civil structures at least forty years before the colony of Victoria did. Moreover, the existence of a federal structure led to some decisions that could not have been made in Australia at all because the requisite machinery was lacking. For example, it was the Federal Government in the US which mandated a gauge of 4ft. 8½in. for transcontinental railways, and it did so as early as 1863. It took the act of federation and the passage of a further fifteen years before the same decision was taken in Australia.

Further, it can be argued that the US developed internal, as distinct from export markets, on a scale and at a rate of development far in excess of the capability of the small and widespread Australian population. In particular, the end of the Civil War permitted and facilitated trade between the two relatively large (in world terms) economies of the North and South. Comparable market structures did not emerge in Australia until around the time of Federation.

It was pressure from markets in the US which, above all, appears to have led to gradual adoption of the standard gauge. The lack of national markets in Australia meant that there was no such pressure from the private sector on colonial governments to standardise.

#### 4.5 Synthesis

British practice provided the precedents for railway development all over the globe (Robbins 1998, Chapter 2). But British precedents were not unambiguous – hence different precedents were taken up in different parts of the world. The British Gauge Act of 1846 mandated 4ft. 8½in. as the standard gauge for England Scotland and Wales, *but* simultaneously, 5ft. 3in. as the standard gauge for Ireland. Countries looking to the United Kingdom for technical leadership in the matter of rail gauge could follow one of two paths in comfort – the “broad” gauge path (5ft. 3in. and above) and the “narrow” gauge (the later “standard” gauge) path of 4ft. 8½in. It was the debate about the relative merit of “broad” and “narrow” gauges that constituted the first “battle of the gauges” in the nineteenth century.

Brazil’s first railway was laid at 5ft. 6in., but it was very short, and was rejected as a precedent by the British engineers who designed and constructed Brazil’s early railways at 5ft. 3in. The widespread adoption of this gauge appears to have been by consensus rather than by fiat, and it was legalised in the form of individual railway contracts (da Silva Telles 1987, p. 6).

In India, the gauge used in establishing railways was 5ft. 6in. This was chosen by the Governor General. It was a well-informed choice. As noted earlier Dalhousie had served for two years as head of the Railway Department in the British Board of Trade, at a time when the Gauge Commission was in progress (Headrick 1988, p. 61). He also received professional engineering advice which confirmed one of the main messages which Dalhousie himself took from the Gauge Commission – that the “broad” gauge offered superiority over the “narrow” gauge in terms of stability, safety and speed (Headrick 1988, p. 61). Note that the argument was conducted in terms of functional performance, not value obtained for money spent.

In the USA, where railway construction and operation was initially governed by state law, gauge choice was in the hands of corporations created to design and run railways (Stover 1997, Chapter 2). Gauge choice was made at the corporation level, that is without either federal or state direction. The evidence suggests that early American railroad engineers turned primarily to George and Robert Stephenson and their works for information (Stapleton 1978). With railways perceived by their promoters as investments aimed at regional or local economic development, gauge choice permitted design engineers some latitude in the exercise of personal preference; but it was latitude about a narrow gauge model, rather than about a broad gauge model. Thus as previously reported, the first three gauges used clustered around 4ft. 8½in., not the “broad” gauges of 5ft. 3in. or 5ft. 6in. (Puffert 1991, p. 197).

It appears as though the debates about the relative merits of various gauges at railways’ establishment, judging from evidence from India, the UK and the USA, were not about the economics of the gauge options. Rather, they focussed on their technical and functional characteristics, particularly in respect of locomotive design. Specifically they focussed on locomotives’ relative potential for delivering stability and security with speed. The British precedent in particular also argued strongly that railway system design should avoid the “evils” of breaks of gauge. To the extent that original differences in view about the relative merits of different gauges were resolved, they were resolved not on economic grounds, but primarily on political grounds – (see in particular, Report of the Gauge Commission, PP vol. 16, 1846).

The single distinguishing feature about the early phase of railway development, *wherever it occurred*, was that the cost of constructing and operating railways exceeded both entrepreneurial and official expectations. In hindsight this is not surprising; entrepreneurs and officials were involved in supplying and regulating a range of technologies which had no precedent and which were changing rapidly, and with which they were therefore unfamiliar. In order to do so, they had to produce argument which would persuade individuals and governments to finance railway objectives; and they did so, generally in good faith. But they had scant knowledge about the system they were promoting.



In both India and Brazil, it had become apparent by the early 1860s that railways were likely to lose government large amounts of money both in real terms and as a proportion of GDP. In both cases, government had promoted investment in railways by subsidising rates of return to investors and operators. It became clear early that they had created a potential debt of unwanted magnitude (see for example, Headrick 1988, p. 71). In the USA railroads were not only privately owned but substantially unregulated. Shippers, especially shippers of grain from inland to the east coast, were experiencing difficulties of access to rail, and were objecting to freight rates. In all of those circumstances it became necessary to find ways to reduce costs. Various efforts were made to analyse and improve understanding of cost structures.

In India, the key causes of costs were analysed post hoc. The gauge of 5ft. 6in. itself was one of the key causes of high construction cost. But so was the adoption of British standards of construction. Those entailed building double-line tracks (where a single line might have served anticipated volume for thirty years), over-engineered bridges, embankments and station houses. In retrospect, analysts referred to the severe nature of the terrain to be crossed, and the ways in which it was impacted by monsoons as a key determinant of costs (Headrick 1988, p. 71). Many also referred to the government's multiple objectives for railways (see for example, Hurd 1983, p. 152). Achieving two of them (defence capability and famine relief capacity) could be incompatible with the private railway company's search for profit, and trigger substantial payment of government subsidy. The easiest factors to control were rail gauge and construction standard. In the early stages of railways' development, the Indian government opted for both a narrow gauge and lower standards of construction. The government decided in 1863 to build a system of 1 m. gauge railways which was to be independent of and non-competitive with the 5ft. 6in. system.

The government of Brazil decided at almost exactly the same time (1863) to limit the provision of concessions only to railway companies with narrow gauge lines, although not to any particular narrow gauge (Wiener 1913, p. 54). As a consequence, Brazil came to employ nineteen different narrow gauge lines by 1883 in the range 2ft. (0.61m.) to 3ft. 10½in. (1.40m.) (Waters 2001, p. 7). It appears that Brazil's sponsorship of narrow gauge

lines was an initiative to contain cost, and followed awareness of the performance of the Festiniog railway (private correspondence with Queiroz, 2006).

Rail gauges proliferated in the USA also in the early stages of railroad development (Westbay 1933, p. 32). By the late 1860s, gauges ranging from 4ft. 3in. to 6ft. were in use in the USA. Railroad operators and shippers were continually under pressure to reduce costs, and reducing transshipment cost was an obvious tactic. This led to the adoption of “compromise” mechanics to promote through running between railroad companies using different gauges (Taylor & Neu 1956, p. 59 – 61). This phase also saw the rise of fast freight companies. These were companies, initially independent of railroad companies, which came to own their own rolling stock because of its capacity to be used for through running. One development occurred in this phase and which signalled its end; the passage by Congress of a Bill mandating a gauge of 4ft. 8½in. for transcontinental railroads. Like the 1846 British gauge decision, this decision was essentially political; it was made for those who owned lines of the predominant gauge, or 4ft. 8½in. (Taylor & Neu 1956, p. 55)

In the later development stage, independent fast freight operators gave way to cooperative fast freight operators who were gradually absorbed by the railroad companies. From the end of the Civil War in 1865, railroad companies increased the effort put into modifying non-standard lines to standard at 4ft. 8½in. With one exception, this effort continued and by 1886, Northern and Southern USA were essentially working as a single system at 4ft. 8½in./4ft. 9in. (Taylor & Neu 1956, p. 77).

That exception was the introduction of narrow gauge railways. It will be noted that the range of variation in gauge choice in the US was a range about the broad or standard gauge favourites – by 1882 preference for the standard gauge predominated; but unlike in Brazil or India, there had been no large scale attempt to reduce costs by using a *narrow* gauge until the Denver and Rio Grande railway was built in the early 1870s as the first of a number of narrow gauge (3ft.) railroads. Eventually railroads of this gauge took up 5% of the total railroad system. However their popularity waned quickly and by the mid-eighties about a third of the narrow gauge capacity had become compatible with standard gauge by either compromise (third rail) or conversion (Taylor & Neu 1956, p. 65).

In both Brazil and India railways continued to be unprofitable and governments became more and more concerned about the impact of railway diseconomies on the national economy. In Brazil, considerable effort was put into rationalising the narrow gauge network, so much so that by 1910 the length of track occupied by variants to 1 m. was miniscule (Wiener 1913, p. 56). Not only that, but government became convinced that it could operate railways more cheaply than could the private sector. It set about acquiring ownership of railways, especially those with respect to which there was a continuing obligation to pay interest subsidy in gold.

The last part of the nineteenth century saw the Indian government assume responsibility for construction of “strategic” railways, that is those built for defence or famine relief purposes. It also saw extension of the metre gauge system, and increasing interaction and competition with the broad gauge system. Outside the time-scale of this thesis, this was eventually to lead to government assuming ownership of railways. By the turn of the century the debates which made up the “battle of the gauges” in Brazil, India and the USA had moved past the simplistic beliefs that construction costs were an adequate proxy for assessing operating costs, and that construction costs were proportionate to gauge. In India, the debate moved to the search for an economic rationale for converting narrow gauge lines to broad gauge lines or not. In Brazil and the USA, the battle was over; standard gauge had won in the US, and the metre gauge in Brazil.

## 5. RAIL GAUGE CHOICE IN THE COLONIES

### 5.1 Introduction

This chapter examines how rail gauge choice decisions were made in NSW, Victoria, South Australia and Queensland. Railways of the Commonwealth, Western Australia and Tasmania are outside the boundaries of this thesis for reasons explained in Chapter 1. This enquiry considers the nature of the economic decision-making models used by participants in the decision-making processes – their presence or absence, their content, structure and relevant features. The prime purpose is to understand how Australian rail gauge choice decisions resulted in a multiplicity of gauge over the period 1850 to 1901, a period in which railway gauges tended to standardise in most other regions of the world.

It might be thought that choosing a particular rail gauge for the building of a railway system is a one-time decision – not so in the Australian colonies. Rail gauge choices were continually under review by colonial governments throughout the entire half-century, and fresh decisions were made as late as the last decade of the nineteenth century. For example, the Victorian Government introduced the gauge of 2ft. 6in. to the Victorian railway system in 1899 (Harrigan 1962, p. 97). Having legislated for adoption of 4ft. 8½in. in 1848, South Australia introduced a gauge of 5ft. 3in. in October 1851 (although the first railway was not commissioned until 1856) (Alexander 1936, pp. 212 – 213), and superimposed railways of gauge 3ft. 6in. in its main line system starting in 1868 (Hambley 1972, p. 51). In 1872 a committee of Queensland’s Parliament recommended adoption of a gauge of 2ft. 9in. for an extension of the “Northern” line west of Rockhampton when the State’s main line gauge was 3ft. 6in. (Kerr 1998, p. 29).

It is not widely recognised that three main line gauges were operating inside the colony of NSW from 1888 – see Chapter 5.2. For example, the Australian Heritage Commission’s history of transport and communication in Australia states that “By contrast, there was only ever one system in Victoria (except for suburban lines) and never more than two in NSW” (Australian Heritage Commission, 2004, Chapter 3). This last statement is incorrect. The NSW main line system was built at 4ft. 8½in., but NSW legislated for a 5ft. 3in. line from Moama to Deniliquin in 1873 (Gunn 1989, p. 119), and a 3ft. 6in. line from Broken Hill to Cockburn (the South Australian border) in 1886 (Roberts 1995, p. 29)..

First choice decisions made by NSW, Victoria and Queensland resulted in a system built around three gauges, but in the 35 years following Queensland's adoption of a gauge of 3ft. 6in., all jurisdictions were under pressure to diversify further. Note that Queensland introduced a system of 2ft. gauge to transport sugar cane, and although this system eventually extended 4,150 km. (ARA 2003), it is not considered to be a main line railway and is therefore outside the scope of this thesis.

A feature of the railways system in all Australian colonies is that they were, in all four cases, conceived by private enterprise, but were in general taken over by government before they produced any revenue. The exceptions are the Melbourne & Hobson's Bay Railway Company which led a profitable existence from 1855 to 1878 until purchased by the Victorian Government, and the Silverton Tramway Company. Founded in 1889, it remains profitable (Roberts 1995, p.32). The history of rail gauge choices in each of NSW, Victoria, South Australia and Queensland is recounted in the following sections of this chapter.

The corner-stones of Australian railways are two despatches to colonial governors from the British Government. The author of the first, dated 16 January 1846, is WE Gladstone, then Secretary of State for the Colonies and for War. The second was produced by Earl Grey, a successor to Gladstone in that role, and is dated 30 June 1848. A copy of each is included as Appendix 2 and 3 respectively. Save for Canada, no British colony had laid railways at the time of those memos (Canada's first railway was commissioned on 21 July 1836 – see Vance 1995, p. 242). The British Government had already experienced difficulties with breaks of gauge in both England and Ireland. The British Government had appointed a Royal Commission to enquire into railway gauge issues. This Commission (the "Gauge" Commission) had not long begun its work when Gladstone wrote, and had reported 23 months before Earl Grey wrote.

## **5.2 NEW SOUTH WALES**

### ***The Sydney Railway Company 1848 - 1853***

The Sydney Railway Company (SRC) became the agent which led the instigation and early development of the first railway in NSW. It may be noted that there are several authoritative references on the formation and brief life of the SRC. These include Birch

(1957); Hagarty (2005); Gunn (1989); Lee (1988); and Vogel (1913/14). Their accounts are generally consistent. Any one of these can be quoted on most issues. For simplicity, this brief account relies mainly on Gunn (1989).

The SRC was formed following a public meeting in Sydney on 29 January 1846 to consider the construction of railways (Gunn 1989, p. 3). The meeting was chaired by James Macarthur, son of the merino wool industry pioneer in NSW, John Macarthur. One of its most active participants was Charles Cowper, who in fact became the champion of railways in NSW in a career in public office which spanned 40 years (Gunn 1989, p. 3). He had been elected to the Legislative Council in 1843, and became the Chairman of the Legislative Council's first Select Committee on Railways of 1848. The close relations between the corporation-elect and the government were evident. "Two of the seven members of the Select Committee were subsequently directors of the railway company. Cowper, who chaired the Committee, became the company's first President" (Lee 1988, p. 13). It was this Select Committee which recommended that the colony should legislate for the introduction of railways into the colony, and which laid down the terms and conditions under which a company might be incorporated to do so (see report from the Select Committee on Railways, V&P NSW LC 6 June 1848).

The public meeting of 29 January 1846 appointed a committee of twenty eight men to lead the process of introducing railways to the colony. There are accounts in the references above of the process that followed, culminating in the legislation referred to above. This account relies mainly on the *Report and the Minutes and Proceedings of the Select Committee* referred to above. The Minutes of Evidence of 3 April 1846 note that a survey was to be conducted involving respondents "in different parts of the interior, requesting local information from them on the subject of railroads, and of the traffic between those districts and Sydney" (Minutes & Proceedings op cit).

A further public meeting was held on 6 August. This meeting received the traffic projections, appointed a so-called Provisional Committee of fifteen, authorised a search for the funds necessary to carry out a survey of potential lines, and the commissioning of such a survey (Minutes and Proceedings, op cit). The Provisional Committee appointed three "sub-committees", one for each of the potential northern, western and southern railway

lines from Sydney (Minutes and Proceedings, op cit). A tender was called for conduct of a survey. “All cost more than the Provisional Committee could afford. Lieutenant Thomas Woore (RN. Retd.) undertook to make the survey and to take the chance of getting his expenses paid” (Minutes and Proceedings, op cit).

The three sub-committees appointed by the Provisional Committee met as a single sub-committee, and decided that survey attention should be focused on the Sydney – Goulburn line only.

The first matter which engaged our attention was to decide upon a line of road having the greatest traffic, free from the competition of water communication, and opening the most fertile and populous district. With these objects in view, Goulburn appeared to us to present the most eligible terminus; and it is therefore to the southern line of road that this report alludes; without intending however in the slightest degree to insinuate that this line alone possesses the requisites for profitable railway investment.

Appendix D, Report, op cit  
V&P NSW LC 6 June 1848

The sub-committees in respect of the northern and western lines were not activated.

By reference to costs incurred in building railways in England, France, Germany and the USA, the sub-committee estimated that the Sydney – Goulburn line could be built for £6,000 per mile and that it would be necessary to invest a total of £750,000 (Appendix D *ibid*). The sub-committee projected revenue of £100,000 in the first year of operation – its survey findings led to an estimate of £66,500 but the sub-committee was confident that the balance would be made up by new traffic generated by the presence of the railway. Its confidence was based on observations about traffic/revenue rates of growth experienced by newly-introduced railways – the Stockton and Darlington in England and the Eastern Railway of the USA – see footnote to Appendix D *ibid*.

The sub-committee’s report concludes as follows:

With these facts before us, therefore, we hesitate not to express our conviction that the time has now arrived when railways would be a source of profitable investment in this colony; and we doubt not a portion of the capital would be subscribed by the colonists.

Appendix D, *ibid*

The sub-committee reported back in August, the intervening time being used by Woore to carry out his preliminary and voluntary survey of the Sydney – Goulburn line. The sub-committee’s report is incorporated as Appendix B in the Report from the Select Committee on Railways (op cit). This report supplies feedback on Woore’s work – Woore’s report also is incorporated in the *Minutes and Proceedings of the Report from the Select Committee for Railways*, *ibid*.

The sub-committee faced severe difficulties in estimating potential operating performance. None of the members were experienced railwaymen, and it is doubtful whether any had designed, constructed or managed major civil works, let alone managed an enterprise as large and as complex as a railway. The forecasting and financial tools which they used were inadequate to the task. There was no attempt to forecast revenues and margins beyond a stylised year, and certainly not for a period of anything like the life of the capital involved. The concept of margin did not recognise the presence of overhead costs, and there was no attempt to forecast cash flow. There was no analysis of the sensitivity of the one year forecast to variances in key forecasting parameters. While care must be taken not to judge entirely by the technical standards of today, the project’s financial evaluation process was crude.

Over and above the recognition of the need for private capital, two other themes emerged in the 1846 report which are often repeated by railway promoters and which for many became articles of faith in future years. These are firstly that “however coarse present projections may be, the reality of the future will greatly exceed them”, and secondly, “investment in railways will accelerate economic development of the province/region/country”.

It appears that Woore did a competent professional job, notwithstanding subsequent criticism by the Surveyor General, Sir Thomas Mitchell (Hagarty 1992, p. 141). The sub-committee’s report is significant because it makes clear that the sub-committee members, and therefore their audience, recognised that a railway in the colony had stakeholders other than shareholders. The following extract from the report is particularly relevant.

Of the vast importance of such an undertaking [that is the Sydney-Goulburn railway], to the Government as well as to the colonists, and in some sense to the mother country as well as to NSW, it would, indeed, be superfluous for your Committee to speak at any length. In developing the



resources of the colony, and multiplying its facilities for the production of wealth, railways would of course subserve the interests of the Colonial Treasury, and extend our commercial intercourse with Great Britain.

It is therefore not too much to expect, that with reference to its own financial policy ... the Government should look upon this enterprise with a favourable eye, and extend to its conductors whatever assistance they can reasonably derive.

Appendix B Report, op cit 1848

The report referred to above was presented verbally to the Governor of NSW on 10 August by a deputation of the Provisional Committee, and the proceedings of that meeting were documented in a letter to the Colonial Secretary by the Provisional Committee's Chairman, Charles Nicholson, on 19 August. This letter states that whilst Nicholson and his colleagues had initially taken the view that any investment in railways in NSW would generate an adequate return, they also considered that there were strong grounds for government support and assistance. Nicholson's letter sets out his case as follows:

2. The lines referred to are the main trunks of communication between the Metropolis and the southern, western, and northern parts of the colony, respectively.
3. The establishment of railways on these lines, whilst it could not fail to confer immense advantages on the colony at large, would at the same time be the means of enhancing the value and promoting the sale of the waste lands of the Crown, and of therefore affording an ample return for any sums of money advanced out of the Land Fund, in aid of their formation.
4. The importance of railways to the general interests of the colony, must be obvious to all who are aware of the following facts: -
  1. That nearly the whole of our exportable commodities are produced in distant parts of the interior.
  2. That, with exceptions scarcely worth mentioning, the colony is destitute of navigable rivers.
  3. That the existing roads and bridges are in a state of great and increasing dilapidation.
  4. That in those seasons of drought to which the colony is periodically subject, even the best of roads would be insufficient for the required traffic

Appendix C Report, ibid 1848

Thus, in today's language, the Provisional Committee recognised that the construction and operation of railways generated externalities or benefits to parties in addition to direct stakeholders in the corporation. The seeds were therefore sown to justify active support by government in compensation for the provision of public benefit.

To sum up this review, the Minutes and Proceedings of the Select Committee on Railways, and the material submitted and appended thereto, suggest that the economic model of the early private sector pioneers of railways in NSW had the following features:

1. Railways had the potential to provide investors with adequate rates of return on capital.
2. Railways are a proper field for private capital investment.
3. Investment in railways would generate benefits for others apart from direct stakeholders.
4. The benefits to the community generated should be paid for by government on behalf of the community.
5. Government should provide financial support to fund initial design and construction, at least in part.

The public meeting of 6 August 1846 decided to establish the Provisional Committee of the Great Southern and Western Railway Company. It had sixteen members and was chaired by Dr. Charles Nicholson. Nicholson was also Speaker of the NSW Legislative Council. Three other committee members, and the Mayor of Sydney were members of the Legislative Council (Lee 1988, p. 12). The Legislative Council members included Charles Cowper. Further to data about Cowper presented earlier, he subsequently served as President and/or Manager of what became the Sydney Railway Company. During a long career in the Legislative Council he became Colonial Secretary, and later Premier of NSW on a number of occasions from August 1856 – December 1870. Thus close and strong connections between government and railways promoters in NSW were forged well before the railway became a reality.

The meeting of 6 August 1846 resolved to commission a full survey, subsequent to Woore's preliminary survey, of the line from Sydney to Goulburn, and engaged Woore to carry it out. Woore's detailed survey was completed early in 1848. It recommended a preferred route from Sydney to Goulburn and confirmed that construction would not meet insurmountable obstacles. The Provisional Committee on 11 September 1848 resolved to seek formation of a company to raise capital, and to ascertain what help the new venture could expect from government (SRC Minute Book, p. 2).

The Sydney Tramroad & Railway Company was then incorporated and issued a prospectus on 24 November 1848. The prospectus called for subscription of capital of £100,000 in shares of £5 each. The company's authorised capital was £1,000,000. The company's one-

page prospectus held out no incentives to prospective shareholders other than the government's conditional undertaking to guarantee a five per cent dividend on subscriptions, and to reassure them "that the traffic must be amply remunerative". Otherwise, it simply described the proposed works, and told prospective shareholders where to bring their money. The company's Provisional Committee of thirty members was to be chaired by Charles Cowper, and in keeping with the precedents already established, nine of the thirty nominees were members of the Legislative Council (Lee 1988, p. 14). Potential investors were advised that the government had agreed to guarantee a return of 5% for twenty five years. In point of fact, the availability and extent of a government guarantee on capital subscribed by the public was a serious point of contention between company and government. It was not resolved for another five years. This dissension created a major uncertainty for potential investors over that period.

Organisation proceeded apace. A Board of Directors was elected. The first six were all Sydney businessmen, four of whom were also members of the Legislative Council (Lee 1988, p. 15). Initially Charles Cowper was appointed both President and Manager. A role for Engineer to the Company was created and filled, and Francis Webb Sheilds was appointed.

The Minute Book of the SRC records that following the advertisement in the press of a vacancy for the position of Engineer to the company, seven local applications were received, including one from Sheilds. His credentials were impressive. Prior to his appointment with the SRC, he worked as the City Surveyor with the Sydney City Council. In evidence before the Select Committee of the NSW Legislative Council on 20 June 1849 on the Sydney Railway Bill, the following exchanges about his qualifications and experience took place:

**Chairman**

**Francis Webb Sheilds**

- |    |   |                     |
|----|---|---------------------|
| 1. | You are a Civil Engineer?   | I am                |
| 2. | And are at present engaged as<br>Engineer to the Sydney Railway<br>Company? | Yes                 |
| 3. | How long is it since you commenced<br>your labours?                         | Since last February |

**Colonial Secretary**

47. What experience have you had of the construction and working of railways? I was bred to the profession of Railway Engineer, and was engaged in it for several years with one of the most eminent engineers in England, Mr. Vignolles.
48. Were you practically employed in any of the surveys?. I was
49. Will you state upon what Railways you were so engaged? I was engaged on Railway Surveys between Sheffield and Manchester, London and Chatham, and from the Dover Railway to Tunbridge Wells during their entire performance, and upon various others for short periods.
50. How many years were you employed in this way? About six years in England. I have had considerable experience in conducting public improvements in Sydney also.
51. What were the particular branches of the profession to which your attention was more particularly directed? In England, principally to the laying out and construction of railways.
52. Did that include all the varieties of work which are necessary in the construction of railways, such as bridges, aqueducts, tunnels, viaducts, filling up ravines, making embankments and laying rails? It did; it is the business of the Civil Engineer to design and carry out such works, as well as those of harbours and hydraulic construction; his practice is different from that of Mechanical Engineer or of the Land Surveyor.”

Minutes – Select Committee Report  
V&P NSW LC 1849

The evidence from the exchange above is inconsistent with some authors’ understanding of Shields’ background. Fearnside for example states that not only was Shields not a civil engineer, he was a city surveyor-turned-railwayman (Fearnside 1970, p. 21). It is more correct to consider Shields as a railway engineer, with experience in surveying – Shields’ career is described in detail in Hagarty (1999) – see also Hagarty (2005).

Throughout 1849 and 1850, during which the turning of the first sod on railway construction took place in July 1850, the company's main preoccupations were negotiating the purchase of land to form the route of the permanent way, negotiating with government to secure the terms and conditions of the government's financing, and supervising the design, and later in the period and beyond, construction of the new railway. Negotiation for land and government financing are subjects which themselves entail considerable research and analysis, and they will not be pursued here because they throw little light on the gauge controversy.

The first indication that there may be a case for selecting a gauge other than 4ft. 8½in., as originally recommended by Earl Grey, came in Shields' evidence to the Select Committee on 20 June 1849, referred to above. In his evidence, Shields argued his preference for a broader gauge, and confirmed that his design of the route was based on adoption of a gauge of 5ft. 6in. There is no record that Shields' option for 5ft. 6in. occasioned any debate by members of the Select Committee, two of whom were Directors of the SRC. The issue of gauge was not canvassed by the other four experts who gave evidence. There was no reference to gauge in any of the appendices to the Select Committee's Report, nor its Supplementary Report of 17 August 1849. Consider the following exchange before the Committee:

**Colonial Secretary**

110. Upon what gauge are your calculations based?
111. Is that the ordinary narrow gauge of England?
112. Are there any local circumstances that would render it objectionable to adopt the gauge mentioned in the Despatch of the Secretary for State upon the subject of Railroads which is the ordinary narrow gauge of England?
113. Upon what ground do you consider the gauge such as you have described preferable to that described in the Despatch of the Secretary for State?

**Francis Webb Shields**

- Upon the gauge of five and half feet between the rails.
- It is wider than the ordinary narrow gauge of England – that is four feet eight and a half inches.
- The regulation for adopting the same gauge in all the Australian Colonies is I think, a most proper and wise one, but I do not concur in the propriety of fixing that gauge at four feet eight and a half inches.
- In these Colonies, where railways are yet uncommenced, I cannot think that we should be tied to any particular gauge but should adopt the

one which experience and a consideration of our circumstances may lead us to consider the best.

Minutes – op cit  
V&P NSW LC 1849

Without at this point recommending a specific gauge, Shields argued for a gauge greater than 4ft. 8½in. on the grounds that travel would be easier, there would be less wear and tear upon the lines and fewer carriages and wagons would require lower investment per unit load because on the broader gauge they would have greater carrying capacity.

The above exchanges are significant because, at the time of these hearings, Shields had not, at least on the face of it, stated his preference for 5ft. 3in. - it appears to have taken some months from his appointment for this to have happened. Secondly, Shields' cost estimates were based on an earthworks width of 55ft. on average. This figure in turn was based on the use of a gauge of five and half feet. Coming so soon after his appointment, this opinion suggests that he brought a preference for the broad gauge with him to the SRC. Given that his previous employer, Charles Vignoles, was an advocate of the broad gauge (see for example Vignoles' advice to the Irish Rail Royal Commission of 1838), this would not occasion surprise. Thirdly, it follows that given structures designed to accommodate a gauge of five and a half feet, the cost of converting to 4ft. 8½in. was in Shields' view, miniscule. It was limited only to modifying the running gear of locomotives and rolling stock. Fourthly, Shields accepted the value of a uniform gauge for all Australian colonies – but was not prepared to support selection of 4ft. 8½in. on this account. He would have supported a uniform gauge across colonies of 5ft. 6in. Nonetheless, the position which argued that the Colony should have the freedom to select a gauge which best suited its own circumstances set the precedent by which multiple colonies could put the same argument in justification of their own gauge choice – as indeed Victoria, South Australia and Queensland subsequently did.

Later that year, Shields presented a formal report entitled *Report of the Proposed Lines of Railway from the City of Sydney to the Towns of Parramatta and Liverpool, in the Colony of New South Wales*. It was addressed to the Provisional Committee of the Sydney Railway Company and presented to a General Meeting of the Company on 13 November 1849. This report not only describes the lines proposed and the rationale for their choice; it also

includes fresh estimates of construction cost, together with assumptions about the materials to be used, and argument in justification. Sheilds submits that the average cost per mile of the main trunk line and its branches to Liverpool and Parramatta is estimated at £2,348.

In reviewing these estimates, it is scarcely necessary to state, that they provide for a single line of rail only, constructed on the American model, and on the most economical principles consistent with safety and strength.

It will be seen that the prices detailed in them are much above what are now current in the colony, or which the work will probably cost ... The wooden framework bridges, which are the only description of arching proposed to be used, will be formed of the round timber, which grows in abundance, and of the best quality, along the line of the Railway; and the durability of our hardwood will render it peculiarly suitable for this purpose. Even in laying the rails, which will be formed of wood, with a light iron plate laid upon them for the wheels to roll over, the structure will not only be lasting, but cheap, in this country – while the iron plate will save the timber upon which it is laid from splitting from the action of the wheels, the hard wood will afford it a firm and unyielding support; and I anticipate that from the dryness of the soil, the structure may be laid upon the ground without requiring a foundation of broken stone or ballast to drain the surface beneath it, which entails a considerable cost, both on the English and American lines.

#### SRC Report op cit 1849

This very succinct specification of the proposed lines' standard of construction, and its consequent cost estimate, is notable for a number of reasons. The first is that nowhere in this report is there reference to the rail gauge that is to be adopted, nor to any cost item which might vary with gauge. This is not withstanding that five months earlier, Sheilds had expressed a strong preference for a broad gauge, rather than the 4ft. 8½in. which had been mandated in the Colony. The second is that Sheilds' estimates of cost per mile are considerably lower than those initially used to justify formation of the Sydney Railway Company. The third is that it would seem that neither Sheilds nor his employer considered that his role should include accountability for profit projections, as distinct from cost estimates alone, because his statement does not explore the implications for profitability of this reduction.

On 10 May 1850, and after 16 months in his job, Sheilds advised his Directors "... that a gauge wider than 4'8½" would be desirable for the railway now about to be constructed ...". The Directors responded on 14 May, requesting Sheilds "... to lay before them the grounds

of my opinion ...” Sheilds supplied that letter on 21 May (both of the fragments quoted above are to be found in this letter). It is not clear from available records what catalysed the expression of this view by Sheilds, or why such a variance from the mandated gauge should have taken sixteen months to surface. But it can be surmised that the Sydney to Liverpool/Parramatta railway was a year closer to construction and time was getting away; in fact the first turf was officially turned on 3 July 1850. Sheilds or his Directors had perhaps realised that changing the gauge from 4ft. 8½in. to 5ft. 3in. required amendment to legislation. This in turn required the consent of the Governor General, and acquiring that consent required a case to be put to the Legislative Council by his Directors, all of which would take time.

On 22 May 1850, Cowper wrote to the Colonial Secretary in the following terms:

... the Directors of the Sydney Railway Company beg now to transmit for the information of His Excellency the Governor a communication which has been received from the Engineer of the company, strongly recommending that the gauge of 5 feet three inches should be selected in preference to any narrower width.

The Directors having for some time had their attention turned to this important question, and having bestowed upon it very grave consideration feel so fully the force of what is urged by Mr. Sheilds that they are prepared to act upon the view taken by that gentlemen, a course which they venture to hope will be approved by the Colonial Government.

As the projected line from Sydney to Goulburn will be the first line of railway commenced in the Australian colonies, no inconvenience need arise from any want of uniformity, provided timely notice be given to the neighbouring colonies of the gauge adopted in its construction.

Cowper to Colonial Secretary 22/05/1850  
SRC Correspondence

With no more than one day elapsing between receipt of Shield’s recommendations and their endorsement to the Colonial Secretary, little time was used by the Directors to scrutinise and debate Shield’s opinion though it is possible and perhaps even likely that informal discussions between Sheilds and the directors had taken place. Design and construction proceeded on the assumption of colonial and UK governments’ approval of Sheilds’ recommendation.



Sheilds' letter contains the key professional judgment on which the Governor and Legislative Council of NSW based their decision to abandon 4ft. 8½in. in favour of 5ft. 3in., and it is therefore worth some attention. Sheilds says that his letter would review the practical experience gained in respect of rail gauge in England in recent years, consider the implications of that review for the proposed railway to Goulburn and draw relevant conclusions.

His letter first refers to the break of gauge between 4ft. 8½in. and 7ft. 0in. at Gloucester in England. He observes that:

...the originators of both of these widths ... have uniformly maintained the superiority of their own to the rival system: but upon extended experience of both, the narrow, or 4ft. 8½in. gauge, appears to be considered more suitable for the general purposes of traffic – this gauge however has been long complained of by practical persons, both from its rendering the manufacture and repair of locomotive engines more difficult, by crowding their machinery within too narrow a space; and from its causing an unsteady motion of the engines and carriages upon the rails, which increased the wear and tear of the line.

Sheilds to Cowper  
SRC Correspondence 21/05/1850

Sheilds does not elaborate on what he means by “appears to be considered more suitable for the general purposes of traffic”. He refers to the investigations of the Gauge Royal Commission of 1846, though not by name. He then discusses the Irish experience:

At the same period also, there were railways of considerable length in the course of formation in Ireland; and as the gauge question was still open in that country, from its railways having yet been completed to a very small extent only, the authorities accepted the principle, that such a width should be chosen upon them, as the experience afforded by the working of other lines should prove to be the best.

Sheilds to Cowper  
SRC Correspondence 21/05/1850

Sheilds concludes:

From these concurrent causes, as appears from various Parliamentary Papers, the Gauge question has lately undergone the most thorough investigation in England, both by the Board of Trade, and by a body of Commissioners appointed by Royal Authority ... Of the mass of information thus obtained from the most eminent Engineers and others best acquainted with the working of railways, it would be much beyond the limits of this report to attempt an analysis – it is sufficient to state, that upon the close of the enquiry, an Act for regulating the Gauge of Railways

(9 and 10 Victoria C.37) was passed which enacted that upon the Irish lines already reverted to, a width of five feet three inches should be uniformly adopted.

Sheilds to Cowper  
SRC Correspondence 21/05/1850

It may be noted that Sheilds argues that it is beyond the scope of his letter to analyse the arguments presented for and against each gauge. One could be forgiven for thinking that this is precisely what he had been asked to do. Further, whilst referring specifically in his letter to the British legislation mandating 5ft. 3in. for Ireland, he omits reference to the same legislation's mandating 4ft. 8½in. for England. He overlooks that much more English 4ft. 8½in. had been laid than Irish 5ft. 3in. and therefore that "practical" persons he referred to must have had more experience with the former than with the latter. This is not to say that experience of 5ft. 3in. was insufficient to judge its practicality.

Turning his attention to the implications for the railway to Goulburn, Sheilds argues that the gradients through Camden will be "exceedingly heavy and severe". Even though they were not expected to be steeper than some English lines, it would be judicious, argued Sheilds, to take every measure which would increase motive efficiency. The broader gauge should be adopted on these grounds; the more so because:

The expense of forming a single track of 4ft. 8½ and on a 5ft. 3in. gauge in this Colony, so far as regards their works of construction, would in practise be equal – the cost of each vehicle on the larger gauge would be slightly increased, though from their greater steadiness in travelling, they may be constructed of larger capacity, and be fewer in number – the cost of maintenance and repairs would be less on the gauge of five feet three inches.

Sheilds to Cowper  
SRC Correspondence 21/05/1850

There is a lack of detailed argument and a lack of evidence provided in support of Sheilds' professional judgment. In supporting Sheilds' recommendation to the Colonial Secretary, the SRC Manager, Charles Cowper, noted, quite rightly, that no investments had yet been made in rail, and plenty of time was available for other colonies to shift to 5ft. 3in.

In the meantime, a meeting of SRC Directors took place over 19, 20, 21, 22 and 25 November 1850. This meeting was considerably occupied with land purchase issues. But on 18 November, Shields had submitted an estimate of the cost of bridges and works on the line to Newtown. On 19 November, the Directors requested a personal explanation. On 20 November, the Board resolved that a Special Meeting of the Board be called for the following Tuesday “for the purpose of considering the financial condition of the company” (SRC Minute Book p. 310).

At the Special Meeting,

... it was resolved that until the works are sufficiently advanced to justify the present rates of salary paid to the officers of the Sydney Railway Company, salaries would be reduced ...

SRC Minute Book pp. 318 - 19

Shields’ salary was reduced from £400 p.a. to £300 p.a. and corresponding reductions were made to the salaries of his team. The payment of fees to Directors was discontinued. Shields resigned, as did his subordinates, Croudace, Brady and Higham – there is a hint in the SRC Minutes that Shields may have mobilised his subordinates’ resignations in an attempt to persuade the Board to back off for fear of losing all of its engineering expertise at once. The Board did not back off. It accepted the tendered resignations, and on 10 December resolved to advertise for applicants to Shields’ position. Eight local applications were received for the position of Engineer to the SRC. The company recruited Henry Mais as Acting Engineer, on a salary of £250 p.a. “until he is confirmed in his office” (SRC Minute Book Jan 1851, p. 347). Shields’ association with the SRC ended graciously – the Board meeting of 28 January 1851 resolved:

that in accepting the resignation of Mr. Shields as Engineer to the company, the Directors beg to express their sense of the zeal and ability which he has evinced while holding that appointment, and they require him to accept their best wishes for his success in his future career ...

SRC Minute Book 28 January 1851, p. 379

Mais’ tenure of office was not happy. Under his direction, the main contractor consistently failed to deliver, and Mais’ competences in supervising the employees of his department were not strong. He was reprimanded by the Board for providing inadequate supervision in June 1851, and tendered and then withdrew his resignation, promising to “exercise more efficient control over the subordinates in the department ...” and “cause no further dissatisfaction with his performance” (SRC Minute Book 17 June 1851, p. 439). The

Board must have considered this solution as less than adequate to the Company's needs. It recorded:

The consideration of the measures to be adopted for obtaining from England or America an Engineer duly qualified in all respects to be head of his department was again resumed – it was agreed that Mr. PH Flower of the firm PH Flower & Co (the SRC's London agent – author's interpolation) be requested to look out for, and if he should be perfectly satisfied with, an Engineer, to engage him on behalf of the Company, that the salary be £600 per annum – to be increased if the Directors approve of his character and qualifications, at the rate of £100 per annum for the first two years ...

SRC Minute Book 29 July 1851

He was, in addition, to be paid £100 passage money.

Flower selected James Wallace. Wallace arrived in Sydney on 9 July 1852 and began work immediately. On 8 September 1852, two months after arriving in the colony, he recommended to the SRC Board that the gauge of 5ft. 3in. be abandoned in favour of 4ft. 8½in.

According to Hagarty, "This letter is the beginning of the gauge problem that has dogged Australian Railways ever since" (Hagarty 2005, p. 141). Wallace advanced three arguments. These were:

1. "Narrow gauge" locomotives were no longer inferior to "broad gauge" locomotives in terms of their power generation capacity,
2. The market for disposing of 5ft 3in. rolling stock had narrowed; supply exceeded demand, and disposal incurred a negative premium of 20 – 30%,
3. 4ft. 8½in. had become the de facto standard.

The first rationale had become valid for passenger engines, though not necessarily for freight. There was a considerable market for broad gauge equipment in the early 1850s. Ireland as reported above, was standardising on 5ft. 3in. The new Brazilian lines were planned from the early 1850s at 5ft. 3in. (Duncan 1932, Chapter 1). At this remove, we cannot be certain about the balance between demand and supply in the 1850s but know enough about the emerging variety of sources demanding broad gauge equipment, with Britain the sole source of supply, to be wary of taking Wallace's argument at face value.

We also know that there was an established market for used equipment in the late 1850s (Robbins 1953, p. 37).

Wallace's third argument warrants very careful consideration, and to facilitate that, it is quoted verbatim as follows:

The narrow gauge has been found to combine in a higher degree than any other, the great commercial requisites for a railway, namely speed, safety, convenience and economy. For these reasons it has been adopted with little exception throughout Europe and America. And in India and in Egypt where the highest engineering talent has been employed, had a wider gauge been considered an improvement it would no doubt have been adopted, but such has not been the case. In both these countries the narrow gauge has been determined on.

Wallace to SRC Directors,  
SRC Correspondence, 8 September 1852

To examine these claims – it is quite true that 4ft. 8½in. had been adopted in the UK, France and Germany. It is *not* true that 4ft. 8½in. had been adopted in the USA “with little exception”. At the date of Wallace's letter, a diversity of gauges existed in the USA ranging from 3ft. to 6ft., with 4ft. 8½in. predominating in the north-east but not in the south (Puffert 1991). In India, a gauge of 5ft. 6in. was adopted for main trunk lines, and a gauge of 1m. for other lines, the latter not until 1869. The first Indian trunk line of 5ft. 6in. opened for business in 1853 (Kerr 2001, p. 1). To be kind about it, Wallace's knowledge of overseas practice appears to have been inadequate and/or out of date.

Despite these concerns, this letter makes a significant contribution, because it draws attention to the parameters by which the performance of a railway system might be assessed, namely “speed, safety, convenience and economy” and is one of the earliest such statements. However Wallace himself made no explicit use of these criteria in any of a system, functional, or operational analysis.

Hagarty (2005, p. 140) notes that Wallace had raised the gauge issue at the SRC Board Meeting of 9 August. He further states that the Board deferred consideration of the matter to its meeting of 10 September, based on Wallace's written report of 8 September, referred to above.

Taking into account that Wallace had been in the colony for only four weeks when he made his recommendation, and that only one further month had elapsed between the two Board Meetings and the day on which Cowper's letter was written, there seems to have been little time or opportunity for the Board of the SRC to debate Wallace's recommendation. Further, the Directors do not seem to have been as well informed about emerging practices overseas in regard to gauge as Wallace professed to be; nor did they take any action to find a third party from whom to seek confirmation or otherwise. Whether or not they would have found it locally is questionable. Not having done so, it was necessary to rely on Wallace's views.

Reversion to 4ft. 8½in. was not the only significant change recommended by Wallace at this time. He also proposed that British construction standards be adopted, namely that the line to Parramatta should be double track, rather than single track, rails should be of iron, rather than of iron-tipped wood and bridges, viaducts etc should be made of brick and/or stone rather than timber (Gunn 1989, p. 27). All three of these proposals represented major changes in what had been the business model to date: collectively they represent a major shift away from the US-type "light" railway model which had been adopted originally in NSW. Wallace produced new estimates of cost - £188,420 for a single line from Sydney to Parramatta or £218,420 for a double line. Sheilds' estimate for a line reaching to Liverpool and Parramatta had been £56,356/9/9. Not all of the difference between the Sheilds and Wallace estimates was accounted for by the shifts in strategy referred to above. It was also in part caused by under-estimates on Sheilds' part and by the very considerable increases in the cost of both wages and materials which occurred when the discovery of gold in 1851 led to a severe labour supply shortage on the coast. The key point to be made here is that the Board's response to Wallace's estimates was not to debate or argue them, nor to enquire as to whether more efficient and economic standards of both construction and operation might be available, but to accept the new standards and the new cost estimates as recommended. No attempt was made to assess whether or not added benefits might flow from the added cost, and whether or not established ratios might change. Note that engineering expertise was not a pre-requisite for probing such issues – they could have been pursued by an intelligent layman.

Faced with the need to spend a minimum of £188,420, and possibly £218,420, with funds available of only £5,000, the company recognised that it faced a cash flow crisis of major proportions. Its solution was to seek a loan of £150,000 from the NSW Government, which it would marry with £100,000 it expected to elicit from subscription to shares, giving it an on-going fund of £250,000 to complete the lines to Liverpool and Parramatta (see Cowper's letters to the Colonial Secretary dated 1 September 1852, and 14 October 1852). The Governor gave his consent to an Act on 27 December 1852 which empowered the Government to lend £150,000 to the Sydney Railway Company, in return for which it acquired the right to appoint three of the seven SRC Directors. When this was implemented early in 1853, the SRC had effectively become controlled by Government.

***The Early Days of Government Control 1853 - 1857***

The letter of 10 September, with Wallace's report attached to it, was circulated to Legislative Council members on 24 September 1852, and formally considered by the Legislative Council on 12 January 1853. Cowper found it necessary to prompt the Colonial Secretary to act on his letter, and wrote to the latter on 19 January 1853. On 27 January, the Government advised the Board that Act 16 Vic No. 5, authorising the gauge at 5ft. 3in. would be repealed (Hagarty 2005, p. 148). On 21 February 1853, the Attorney General provided the Colonial Secretary with a draft Bill to legislate for a gauge of 4ft. 8½in. The Legislative Council of NSW passed this Bill, and it was assented to on 4 August 1853 (Gunn 1989, p. 29).

The NSW Colonial Secretary's letter to his counterpart in Victoria of 2 February 1853 advised the latter that the Legislative Council had advised the Governor General to repeal 16 Vic, No.5, the Act which had authorised the adoption of the 5ft. 3in. gauge. His letter enclosed relevant excerpts from the letter of advice which Wallace had addressed to his Board on 8 September 1852 and which his Board had forwarded to the Colonial Secretary. Victoria's receipt of this advice was acknowledged to NSW in a letter dated 8 March 1853. Lieutenant-Governor LaTrobe advised that Victoria declined to cause its privately owned railways to shift from its commitment to 5ft. 3in. in favour of 4ft. 8½in. but LaTrobe supplied no specific grounds for this. His reply to Fitzroy, dated 28 July 1853 was as follows:

Sir,

In reference to your letter of the 3<sup>rd</sup> February (sic) last No. 10,983, to which I did myself the honor briefly to reply on the 11<sup>th</sup> March, I am now commanded by His Excellency the Lieutenant Governor to inform you that the subject of the width of guage [*sic*] for Railways, therein adverted to, was brought under the notice of the several Railway Companies incorporated in the Colony.

2. His Excellency having given his particular attention to the reports elicited from these and other sources, has directed me to state to you for the information of His Excellency the Governor General, that he cannot feel himself at liberty to advocate the adoption of the narrow guage.

3. This opinion Mr LaTrobe will feel it necessary to communicate to the Secretary of State for the Colonies, and in order to afford to His Excellency Sir Charles Fitz Roy some information as to the reasons which have led the Lieutenant Governor to this conclusion, as well as in accordance with a promise to that effect made to the Chairman of the Geelong and Melbourne Railway Company in his reply to the notification to him of the tenor of your letter above alluded to, His Excellency has instructed me to furnish you with a copy of the Report of the Engineer of that Company on the subject.

John Foster,  
V&P LC V 28 July 1853

It was at this point in the decision-making process that the initial break of gauge was confirmed. The rationale for Victorian action, then and subsequently, is considered in detail in the next section of this chapter. But it is also at this point that governments' behaviour in the colonial decision-making process becomes finally critical. That behaviour requires examination of the roles played by the Governor General, the colonies' Governors, the British Secretary of State for War and the Colonies and the Railway Board in the British Board of Trade. That examination entails a digression to explore certain developments in the Australian colonies' constitutional history.

It will be recalled that until 1851, the colony of NSW incorporated the Port Phillip District, later the State of Victoria. At that time, South Australia and Van Diemen's Land existed as separate colonies. Responding to petitions for separation, the British Parliament brought down legislation (13 & 14 Vic, c. 59), in August 1850 which provided for the separation of Victoria from NSW with effect from 1 July 1851 (Melbourne 1963, p. 376). The bill upon which this Act was based had also contained provisions for the appointment of a Governor General of the Australian colonies and of a "General Assembly of Australia". This was to consist of the Governor General and a House of Delegates the members of which were to



be elected by the colonies' Legislative Councils to the formula of two per colony, plus a further one for every 15,000 inhabitants (Melbourne 1963, p. 370). According to Ward, these provisions were strongly supported by Earl Grey, the Secretary of State for the Colonies and for War. His intent was to provide constitutional mechanisms by which differences between colonies could be managed locally (Ward 1958, Chapter 1).

The provision to create a "General Assembly of Australia" was deleted from the Act, but the provision to create a role for a Governor General was not. Melbourne explains that :

... although Lord Grey had not succeeded in persuading Parliament to create a general legislature for the Australian colonies, he invoked the royal prerogative in order to obtain for the Governor of New South Wales an executive supremacy throughout Australia ...

In addition to the Commission by which he was appointed Governor of New South Wales, Fitzroy received another which made him Governor General of Her Majesty's Australian possessions ...

Fitzroy also received Commissions by which he was appointed Governor of Van Diemen's Land, of South Australia, and Victoria, while the immediate representatives of the of the Crown in these three colonies became Lieutenant Governors.

Melbourne 1963, p. 381

To return now to the main theme, Ward argues that Fitzroy used his authority as Governor General in an "attempt to coerce" Lieutenant-Governor LaTrobe in the matter of railway gauge (Ward 1958, p. 278). Fitzroy's message about NSW intention to revert to 4ft. 8½in. was transmitted in a memorandum from the NSW Colonial Secretary, Deas Thompson to his counterpart in Victoria, John Foster, dated 2 February 1853. That memorandum said:

His Excellency the Governor General has, under the advice of the Executive Council, directed that the proper steps be taken for a repeal of the Act in question (mandating 5ft. 3in.), and I have therefore to request that you will intimate his intention to His Excellency the Lieutenant Governor of Victoria.

Thomson to Foster, 2 Feb  
V&P LC V, 1853

Since this memorandum lacks any suggestion about what subsequent action LaTrobe should take, much less anything like a direction, there appears to be a failure to provide leadership rather than an intent to "coerce". Rather, it is argued that Fitzroy, for whatever

reason, *declined* to use the office of Governor General to induce compliant behaviour from LaTrobe.

When the Colonial Office became aware of the NSW proposal for gauge change, and thus of the prospects for inter-colonial inconsistency, it referred the matter to the Railway Board (Ward 1958, p. 274). The Railway Board, a unit of the Board of Trade, was the repository of knowledge about railways in the UK civil service (Parris 1965). The Railway Board recommended that NSW retain the gauge of 5ft. 3in. because this gauge permitted more powerful locomotives than those on a 4ft. 8½in. gauge, and they were easier to maintain than those of the narrower gauge. The Colonial Office rejected the Board's advice, and the new Secretary of State, Sir George Grey instructed Fitzroy in November 1854 merely to have his legislature review the supposed superiority of the 5ft. 3in. gauge, "for the sake of the neighbouring colonies" (Ward 1958, p. 276). On 4 August 1853, waiting no longer for comment from Britain, Fitzroy proclaimed the Act mandating 4ft. 8½in. as the gauge for NSW railways.

The NSW Legislative Council duly conducted such a review and repealed the statute mandating 4ft. 8½in. as its rail gauge on 14 August 1855 (Hagarty, 2005, p. 196). But since laying the Sydney – Parramatta line at a gauge of 4ft. 8½in. was well advanced, it saw no merit in re-establishing its gauge at 5ft. 3in. and did not so prescribe. Instead, according to Ward:

The Colonial Secretary, Deas Thomson, justified the repealing legislation on the ground that because the government itself had become the only railway proprietor, statutory regulation of gauges was no longer necessary.

Ward 1958, p. 277

This was not the end of the gauge war in NSW. It was taken up by others, including John Whitton. John Whitton was an English-born and –trained engineer who was appointed as Engineer-in-Chief of railways in NSW in March 1856, his appointment having been confirmed on 18 January 1857 following his arrival in the colony in the previous December (Burke 1995, p. 49). Whitton had already become eminent in the UK's engineering profession. He came second to the appointee to the top job in one of the UK's greatest railways (Lee 2000, p. 64). He had served an apprenticeship begun at the age of 15 (Lee

2000, p. 38), and worked as an engineer on the construction of the Manchester and Leeds Railway, tunnels in Venezuela, the East Lincolnshire Railway and for five years, on the Oxford Worcester and Wolverhampton Railway (Gunn 1989, p. 57). During his formative professional years, he enjoyed the patronage of two of the most eminent railway construction engineers of that era, Sir John Hawkshaw and Sir John Fowler, and married one of Fowler's sisters (Lee 2000, p. 64). He also enjoyed a very close relationship with the principals and staff of Peto Brassey & Betts, the largest and most prestigious British engineering contractor of the mid nineteenth century (Lee 2000, p. 48).

Whitton arrived in the colony on 14 December 1856. He attended his first Board Meeting on Christmas Eve, and took up his appointment as Engineer-in-Chief of NSW Railways on 15 January 1857 (Hagarty 2005, pp. 350 – 1). The next day he took his seat in the witness box before the Legislative Committee's Select Committee on the Sole Commissioner of Railways Bill (V&P LA NSW 1857, vol. III, p. 527). Giving evidence on 27 February, Whitton introduced the subject of railway gauge, and the following exchange took place.

<b>Committee</b>	<b>Whitton</b>
83. You know we have sappers and miners here.	I do. While on the subject of railways I think there is one thing that should be mentioned, namely, the question of gauge.
84. That is a most important question - what suggestions have you to offer?	I only wish to mention the differences in gauges in South Australia, Victoria and New South Wales.
85. There is a great difference in these gauges?	Yes. I have heard that in South Australia It is five feet six; in Victoria it is five feet three; and in New South Wales, four feet eight and a half. The Oxford and Worcester is a mixed gauge line, and I know the difficulties and the cost. If you should ever send passengers from here to South Australia, you will be forced to have two changes of carriages. But this would be trifling compared with the expense and trouble attending the changing of goods from one gauge to another.
86. What gauge do you recommend?	I recommend the five foot three inches gauge. That is the best gauge; the most

comfortable for passenger traffic is the broad or seven foot gauge; but I think it unnecessarily large.

87. What gauge this? The Irish gauge is five foot three inches. It is not used in England at all; the seven foot gauge is the English broad gauge.
88. What gauge is the Canadian? Five feet six.
89. What would become of the stock if you altered the gauge? You might work it all up. You could lay down a mixed gauge between Parramatta and Sydney and work it up.
90. Could you alter the rolling stock? Yes, you might. It would be difficult to alter it here; in England it is a matter that would be easily accomplished.

Minutes of Evidence Select Committee of  
Sole Commissioner of Railways Incorporation Bill  
V&P LA NSW 1857, vol. III, p. 576

A further attempt to have the government reconsider its commitment to 4ft. 8½in. was authored by Capt. Gother K. Mann, a military engineer who had retired to Sydney from India on health grounds (Hagarty 2005, p. 196). He had taken up the appointment of Chief Commissioner of Railways on 27 July 1855. At the conclusion of the Chief Commissioner of Railways Annual Report for 1856 (tabled on 13 March 1857), Mann stated:

25. In concluding this report I am desirous of alluding to the fact that a diversity of gauge exists between this and that of neighbouring colonies, New South Wales being 4' 8", Victoria 5' 3", and South Australia 5' 6" the magnitude of the evils that must ultimately arise at no distant period, and be entailed on the future inhabitants of the Colonies, from this circumstance, can hardly be overrated, and I would submit therefore, that it is a question deserving the attention of the different governments.

Mann, V&P LA NSW, vol III 1857, p. 393

The NSW Government took no action in response to either Mann's or Whitton's recommendations. Perhaps this is because they were made *en passant* in the course of consideration of broader matters. Perhaps the audience was unimpressed by their reference to South Australia's five foot six gauge, an option that was never in prospect (see Chapter 5.4). Whilst there is no evidence the prevailing view is that the politicians considered the gauge issue tiresome and dead. Referring to the report of the Select Committee before

which Whitton had appeared, Lee (2000, p. 117) noted that its report made no allusion to gauge, “the politicians not considering that any benefit could be obtained from the expense.”

### ***Railway Development to 1901***

The development of railways in NSW from 1857 to 1901 is described comprehensively in Burke (1995); Gunn (1989) and Lee (1988 and 2000). This was a period in which expenditure on railways became the biggest single tool used by governments to develop the colony’s resources (Butlin 1964, Chapter 5 Pts. 1 – 4)

It was a period characterised by meeting and overcoming major engineering challenges (for example the rail crossing of the Blue Mountains, the Hawkesbury River Bridge); interpersonal differences centring on John Whitton, the railways’ Engineer-in-Chief; inter-regional competition for railway funds; and unrelenting pressure from politicians to attain maximum development of railways at least possible construction cost.

This account focuses on the latter two features. In 1860, Whitton presented a plan for the development of railways in NSW to his superior, Commissioner Martindale (Lee 2000, p. 140). By then, commitments had already been made to build railways to Picton in the south, Penrith in the west, and Singleton in the north, and construction was under way. Whitton’s plan was to extend from Picton to Goulburn (80 miles at £18,765 per mile), Penrith to Bathurst (103 miles at £25,728 per miles) and Singleton to Muswellbrook (31½ miles at £16,910 per mile) (Lee 2000, p. 140). According to Lee:

Whitton’s plan was incorporated in Martindale’s official report of 1 October 1860 and was widely reported in the press thereafter. Martindale also included it in an alternative proposal to build 1,218 miles of horse tramway for roughly four million pounds, an average cost of £3,284 per mile.

Lee 2000, p. 142

There was already a substantial body of public opinion that favoured horse-drawn tramways over locomotive powered railways, led by Governor Denison (see Denison 1858), views which persisted through the Governor’s final address to the Philosophical

(later Royal) Society of NSW (Lee 2000, p. 143). Whitton's plans were not voted on until the end of 1861, according to the Sydney Morning Herald of 14 December 1861, and the bulk of the legislators supported Whitton's vision of building the three main lines to high standards, and not building horse railways at all (Lee 2000, p. 149). But it was not until mid-1863 that the legislature approved the estimates which would provide funds for the expansions.

In the meantime, the New South Welshmen had become aware that Victoria was building steam-powered railways to higher engineering standards than those in place in NSW. Moreover, they became aware of the interest the Victorian parliament had shown in extending its lines to Echuca on the Murray (156 miles from Melbourne), and thus commanding trade with the Murray River basin, including the Riverina (Lee 2000, p. 150)

Whitton had apparently made some enemies in the legislature. On 6 October 1863, the Legislative Assembly established a select committee to "enquire into and report on the disorganised state of the Public Works Department" (Lee 2000, p. 152), of which Railways was a component. The enquiry became a venue for personal attacks on Whitton, and the Press (the "Empire" vs. "The Sydney Morning Herald") took sides (Lee 2000, p. 153). The prime mover on the Committee, Daniel Dalgleish MLA, sued John Fairfax, publisher of the SMH for libel. This action put his veracity on trial in public rather than that of Whitton and Fairfax. Dalgleish's action was dismissed by a magistrate in December 1864 (Lee 2000, p. 155).

Whitton apparently also aroused strong feelings in his subordinates, for example, JH Thomas. Thomas had been appointed Engineer for Existing Lines in 1867. "Relations between Whitton and Thomas had rapidly soured, and no policy or detail matter was too trivial for them to turn into a public brawl" (Lee 2000, p. 186). In order to put some distance between them, the Minister of the day transferred Thomas to the role of Inspecting Engineer of Rollingstock in June 1869. Whitton took over Thomas' previous role, thus separating the management of civil engineering from the management of mechanical engineering matters (Lee 2000, p. 187). The antipathy between the two continued over a number of years, some of it occasioned because Thomas was an advocate of narrow gauges and of Robert Fairlie's double-ended articulated locomotives to run on them. Whitton detested both and their well-publicised enmity kept the gauge issue alive. Thomas went so

far as to order a Fairlie locomotive from England without Whitton's concurrence – when it arrived in Sydney, Whitton caused it to be shipped directly back to source (Lee 2000, p. 204).

The push for horse trams, light, and narrow gauge railways revived when the Legislature appointed a select committee in October 1869 “to report on the best mode of facilitating inland traffic and upon the subject of railway extension generally” (Lee 2000, p. 208). The committee was chaired by WJ Macleay, a holder of much pastoral property in the Riverina (whose wool could have been shipped via Melbourne), an advocate of cheap, lightly-built railways (Lee 2000, p. 207). JH Thomas was a key witness, and his evidence contradicted Whitton's at every point.

The Macleay Committee's report was presented to the Assembly on 25 March 1870. It claimed that “the only realistic choice for future railways was between a narrow gauge light locomotive railway or an even lighter horse tramway” (Lee 2000, p. 212). It outlined plans for a horse tramway network consisting of all of those extensions planned for the next fifteen years. Whitton rebutted this by preparing costed plans for the Goulburn-Yass extension built to three different gauges – standard, three feet and two feet.

He claimed the two narrow-gauge lines would only be marginally cheaper, as the only savings were in the width of cuttings and embankments and in allowing slightly large curvature. Certainly grades would not be any steeper, since narrow-gauge locomotives on light lines were not as powerful as larger standard-gauge locomotives. This meant, to carry the same traffic gradients on a narrow gauge line had to be easier, not steeper than on a narrow gauge line.

Lee 2000, pp. 212 - 13

Whitton's proposals for extensions to Yass, Orange and Tamworth at a cost of £7,000 per mile were approved in October 1870 for inclusion in the Estimates. Thomas continued to argue against their proposals in favour of horse tramways and light narrow gauge railways (Lee 2000, p. 216). A new Premier, Symes, delayed implementing Whitton's proposals. Whitton re-submitted them in February 1871 – Symes continued to take no action.

Henry Parkes first became Premier in 1872. Although Parkes as a journalist (through his newspaper “Empire”) had been critical of the early Whitton, he had come to see railways as

the principal tool available to him to transform the social and political landscape of NSW (Lee 2000, p. 217). Whitton now found himself the “ally of the progressives”.

Even so, the politicians continued to be concerned about railways’ construction cost. The opinion group supporting horse railways and light narrow-gauge railways was still active. In order to resolve the conflict between them and the standard gauge proponents, the then Minister for Works asked Whitton to prepare plans for an even cheaper (than £7,000 per mile) standard gauge line, and a 3ft. 6in. gauge line from Goulburn to Yass. As Lee recounts, the provision of this data led to a well-informed debate in the Legislative Assembly. This in turn led to reinforcement that NSW policy would continue to be retention of the standard gauge (Lee 2000, p. 218).

There were two deviations from this before the end of the century. Both occurred on NSW borders at long distances from Sydney, without connection with the NSW system. One of these was the construction of a line from Moama on the Murray River (and Victorian border) to Deniliquin in the Riverina District from NSW. The Riverina consisted of a state-wide belt of rich sheep/wheat country between the Murrumbidgee and Murray Rivers. This line was built at a gauge of 5ft. 3in. so that it might connect smoothly with the Victorian system. This in turn meant that pastoralists from the Riverina, once their wool had been transported to Deniliquin, could get their product to port speedily and reliably over a link 150 miles long. The alternative to shipping via rail ex Melbourne was infinitely better than shipping ex Sydney via road to Yass, and thence by rail, a distance of more than 400 miles.

A petition seeking construction of a railway from Echuca in Victoria to Deniliquin in the Riverina district of NSW was presented to the NSW Legislative Assembly in 1866, and a select committee was appointed to consider it. At that time, the Riverina was isolated from the railway system of both colonies (Gunn 1989, p. 119), and the *raison d’être* for a railway was to provide producers of the Riverina with direct access to the markets of Victoria for stock and produce. In 1872, a group of promoters undertook to bear the cost of constructing this rail link, provided that the NSW government supplied the land. The fact that government would be spared the cost of construction and operation appeared to outweigh any anxiety in NSW about the loss of trade from NSW to Victoria. More



fundamentally, there was some concern that NSW opposition to the proposed railway may have encouraged separation of the Riverina from NSW in favour of Victoria. (The Riverina was briefly a part of the Port Phillip District in 1841 – 2.)

The Legislative Assembly passed the Moama and Deniliquin Railway Bill in April 1873. The 5ft. 3in. line was formally opened in July 1876. Moama is on the northern bank of the Murray River opposite Echuca. Transshipment of goods from trains to steamers/barges, and later a railway bridge, gave producers within reach of Deniliquin access to either Melbourne by rail or Port Adelaide via the Murray River.

Charles Rasp found galena (lead sulphide) deposits at the “broken hill” in 1883 (Roberts 1995, p. 11). By 1885, the original seven mining leases granted there were amalgamated and controlled by the newly-formed Broken Hill Proprietary Company Limited. Located in far western NSW, Broken Hill was isolated from Sydney, and from every where else in the colony. It was almost 700 miles from the State capital, Sydney, though only 320 miles from Adelaide, the capital of South Australia. This State’s border with NSW was only 35 miles away. The nearest NSW railheads to Broken Hill were at Bourke and Hay, both hundreds of miles to the north east and east respectively. It was possible to get from Wilcannia to Broken Hill by coach in a day and a half, provided one had travelled by coach from Bourke to Wilcannia (1½ days) or from Hay to Wilcannia (2½ days) (Roberts 1995, p. 23).

Terowrie, the end of the broad gauge line from Adelaide had already (1882) been designated by the South Australian Government as the jumping off point for a line to Petersburg (later Peterborough, 14 miles north), and a narrow gauge (3ft. 6in.) line to the border with NSW was planned. But how was the gap from Broken Hill to the border to be filled?

The South Australian Government’s Silverton Tramway Bill passed the legislature in November 1884, and construction on a north east line proceeded apace. The South Australian Government was refused permission in September 1885 by its NSW counterpart to extend its line into NSW: nor was the NSW Government interested in building an isolated line for South Australia’s benefit. This impasse led to the formation of a syndicate

of local pastoralists and businessmen, the formation of the Silverton Tramway Company as a corporate entity, and the issue of a prospectus aimed at raising £225,000 to fund construction of the railway from Broken Hill to Burns on the South Australian border, via Silverton. A syndicate of Melbourne-based businessmen with strong connections to Silverton and Broken Hill was also formed. The two syndicates merged and sought enabling legislation by the NSW government. This was completed in October 1886 (Roberts 1995, p. 30) and specified a gauge of 3ft. 6in. The new Silverton Tramway Company was formed with authorised capital of £250,000. The line was opened officially in January 1888. NSW now had three gauges of railways operating within its borders. Its main line system remained at 4ft. 8½in., and it had two isolated outliers, each of less than 50 miles in length, one of 5ft. 3in., and one of 3ft. 6in.

Although this placated the Riverina pastoralists, and possibly staved off a movement for separation of the Riverina from NSW, it annoyed Henry Parkes and other politicians, and the rail link to Sydney was pushed as far as Hay in order to regain Riverina trade for NSW. But this took another twelve years. However, it ranks as a duplication in rail investment, and in the eyes of some, an unnecessary one (Butlin 1964, p. 369).

### *Conclusions*

Earl Grey's despatch of June 1848 gave NSW railway regulators a firm direction to take with respect to rail gauge. Initially, it appeared that his lead in nominating 4 ft. 8½in. as the standard gauge for all British colonies might be followed in the Australian colonies. But it was not. The first engineer of the Sydney Railway Company recommended a change to 5ft. 3in. The grounds for his recommendation might have been found to be flimsy had his Board of Directors decided to question his judgement. But they did not. They in turn were not questioned by the NSW rail regulators, the Governor and the Legislative Assembly, who referred the recommendation to the Secretary of State for the Colonies.

The Secretary's technical advisers in the Board of Trade, and the Secretary himself took the view that there was little to choose between 4ft. 8½in. and 5ft. 3in., and that standardisation between the colonies was more important than the choice of gauge. Since no investment in rail had yet been committed to, he acceded to the NSW choice of 5ft. 3in.

This decision automatically embraced the Port Phillip District, and to promote connection with Victoria, was concurred in by the independent colony of South Australia. Australia may then have standardised on a gauge of 5ft. 3in. However, a new engineer to the Sydney Railway Company expressed a strong preference for the adoption of 4 ft. 8½in. by NSW. Again, his grounds for this preference were not based upon either strong empirical evidence or sound theoretical/analytical reasoning, and again, they were not subject to analytical questioning by either his Board of Directors or the local legislature. The Governor General failed to assert his seniority over the Lieutenant-Governor of Victoria before and after the latter's decision to retain 5ft. 3in. for Victoria, a colony in its own right from 1 July 1851.

Thus the first railways in NSW and Victoria were built at 4 ft. 8½in. and 5ft. 3in. respectively, with South Australia opting for 5ft. 3in. because of proximity to Victoria. In NSW, no technical or economic evaluations of the engineer's recommendations were undertaken. As will be seen in further chapters, rigorous analysis of gauge options was lacking in other colonies too.

For the next forty-five years, capital expenditure on railways was the largest single object of investment in the colony of NSW. Whilst committed to the development of railways as the key instrument in the development of the colony, legislators were constantly concerned to minimise the cost of railways, and in particular, the cost of first construction. The options perceived to be available were the substitution of horse-drawn railways, and/or narrow gauge railways, and/or "light" railways. From time to time groups promoting one or more of these came to the fore. The NSW legislature maintained its commitment to a gauge of 4 ft. 8½in., whilst over time insisting on less costly construction standards.

Whilst two short lines of 5ft. 3in. and 3ft. 6in. were built in NSW before Federation, they were both outside the then periphery of the NSW system and were not connected to it. One connected Deniliquin in NSW and Echuca in Victoria. The other connected Broken Hill and Burns in South Australia. They were built to connect with the systems of Victoria and South Australia, to which they were adjacent.

### 5.3 VICTORIA

#### *Introduction*

Whilst the genesis of railways in Victoria had much in common with that in NSW, there were many significant differences. They had in common that the initial demand for the railway product came from the private sector, as well as the first attempts to supply that demand. The processes necessary to make this happen were similar. In particular, private railway corporations drew their legitimacy from legislation authorising the terms and conditions under which railway companies were to be established. In both colonies, government took over ownership and control of railways from the private sector initiators. But there were differences. In NSW this process was complete by 1855 – in Victoria it was not complete until 1878, and in the interim, a privately-owned railway and government-owned railways coexisted (Harrigan 1962, pp. 58 - 64). A further difference lay in terms of markets served. The original Victorian corporations operated railways which were urban or inter-urban in terms of markets served, whereas in NSW, the prime market beyond Parramatta was freight. The inter-urban passenger demand in Victoria was critically determined by the discovery of profitable goldfields around Ballarat and Bendigo from 1851, both with much easier access to the metropolitan area than their NSW counterparts, such as Bathurst.

The major difference to emerge proved to be in the selection of railway gauge. NSW decision to move from 4ft.8½in. to 5ft. 3in. has already been described, together with NSW reversion to 4ft.8½in. It will be recalled that the adoption of 5ft. 3in. in NSW took place in 1851. Until this time, what was to become the colony of Victoria, or the Port Phillip District as it was then known, was part of the colony of NSW. Victoria achieved separation with effect from 1 July 1851. Planning and design work in respect of railways prior to that date had adopted the then mandated gauge of 5ft. 3in. This section describes and analyses the processes by which Victoria itself opted for 5ft. 3in. in spite of the NSW reversion to 4ft. 8½in., and other deliberations about rail gauge choice in the second half of the nineteenth century.

The early development of the private sector-based railway industry in Victoria is described, and its eventual acquisition by the colony's government. An analysis of the sequence of events leading to Victoria's own choice of a gauge of 5ft. 3in. follows. The on-going

debate about railway gauge is summarised by reference to enquiries by the Legislature. Description and analysis of the arguments leading to construction of railways at the 2ft. 6in gauge in the closing years of the nineteenth century concludes this section.

### ***The Private Sector 1852 - 1878***

Eight companies were granted licenses to incorporate and to operate railway companies in Victoria before the end of the 1850s (Harrigan 1962, p. 2). Only three eventually did so. All were driven predominantly by the vision of railways as an inherently profitable activity. All were to encounter severe difficulty in raising private investment either in Australia or the UK, or both. Those three which were to become operative were (dates of incorporation indicated in brackets) the Melbourne & Hobson's Bay Railway Company (20 January 1853), the Geelong & Melbourne Railway Company (8 February 1853), the Melbourne, Mt Alexander & Murray River Company (8 February 1853) (Harrigan 1962, p. 2). Brief accounts of their rise and fall are set out below. Further details and accounts of the formation of the other companies can be found in Harrigan (1962) and Murray (1918).

The Melbourne & Hobson's Bay Railway Company had its origins in a public meeting held on 7 September 1851 in Melbourne. It supported the notion of a railway from the beach at Sandringham to the city, but no immediate action resulted (Harrigan 1962, p. 1).

A subsequent meeting resolved to appoint a Provisional Committee, and that the authorised capital should be £100,000. On 20 August 1852, the Provisional Committee appointed a solicitor, ratified the company's name, and resolved to adopt a draft prospectus which had been placed before it. On the following day, the Provisional Committee debated the prospectus clause by clause, agreed to seek an enabling Act from the legislature, appointed a bank, and a pro-tem Secretary/Treasurer. The Provisional Committee continued work and the first General Meeting of the company's proprietors took place on 13 January 1853. By 15 February, the proprietors had agreed to the Act incorporating the company, and elected six directors. The Provisional Committee immediately engaged an Engineer and directed the execution of surveys of the proposed line. As the work proceeded, actual costs proved significantly in excess of estimate, due at least in part to the increased cost of labour following the wholesale loss of the metropolitan workforce to the newly discovered goldfields. Authorised capital was doubled to £200,000, and later increased to £500,000. The 2½ mile long line was opened officially on 12 September 1854, the continent's first

locomotive-powered railway. The Melbourne & Hobson's Bay Railway Company was profitable from inception (Harrigan 1962, p. 41). This is largely because it specialised in the transfer of freight to and from the port and the city over only two and a half miles of line.

Other companies were formed to run adjacent parts of the suburban railway system, and country lines. For example, the Melbourne & Suburban Railway Company was formed in 1857 to build lines from Melbourne to Hawthorn and Brighton (Harrigan 1962, pp. 51 – 7). The challenge of raising funds to finance expansion and pay dividends created significant cash flow difficulties for this and other companies. A number of them were acquired by the Melbourne & Hobson's Bay Company, so that by 1865, what had been re-named the Melbourne & Hobson's Bay United Railway Company, controlled the lines from Melbourne to Sandridge (Port Melbourne) and to St. Kilda, Hawthorn, Windsor and Brighton, a total of 16½ miles, together with the heart of the emerging colony-wide network, Flinders Street Station (Harrigan 1962, pp. 57 - 64).

The Geelong & Melbourne Railway Company had formally opened its line on 25 June 1857 (Murray 1918). It had promised its investors a return of 25% on equity: in fact, it forecast a profit of £90,800 on investment of £350,000. But the company had been over optimistic in projecting revenue. Actual revenue was less than half of that forecast, and in fact, proved to be less than working expenses (Harrigan 1962, p. 33). The most influential shareholders concluded early that the company was not likely to be profitable in the foreseeable future, and urged its sale to the Victorian Government. The Geelong & Melbourne Railway Company's assets were approved for acquisition by Government on 8 June 1860, and transfer to Board of Land & Works, the agency then responsible for Victorian railways, took place on 3 September 1860 (Harrigan 1962, p. 37). By 1865 the Melbourne & Hobson's Bay United Railway Company was the only railway company in private hands.

The first railway company to be acquired by the Government was the Melbourne, Mt Alexander & Murray River Railway Company. Its professed *raison d'être* was to build and then operate lines from Melbourne to Mt Alexander and thence to the River Murray at Echuca, together with a branch line to Williamstown, that is to operate into the Victorian

country (Murray 1918, p. 108). Capital was fixed at £750,000, and later increased to £1 million. It quickly became obvious that the company would be unable to raise equity funds sufficient to finance such construction.

The imminent collapse of this company led to debate in the Council about the relative roles of the private sector in the design, construction and operation of railways (Harrigan 1962, p. 8). Since this debate was not easy to resolve, a commission was appointed in early 1854 to enquire into the “best means of communication to the country areas of the colony.” Presented to the Legislative Assembly in September 1854, this commission’s report recommended that Government undertake responsibility for construction of country railway lines. The legislation to do so was passed on 19 March 1856. The only lines to be built were those lines “that had prospects of paying working expenses and defraying interest charges” (Harrigan, 1962, p. 11., quoting Lieutenant-Governor Hotham’s admonitions to his parliamentarians). Priority was given to building lines from Melbourne to Castlemaine, Sandhurst and Echuca, Geelong to Ballarat, Melbourne to Ballarat and Ballarat to Castlemaine. See also Corbett’s pamphlet “Railway Economy in Victoria” for a contribution to the ownership debate (Corbett 1857).

Government ownership and control of railways was thus established, although the Melbourne & Hobson’s Bay United Railway Company remained in private hands until 1878. Government then purchased the Company in order to give its near-completed line to Sale in the east of Victoria direct access to the city. It thus became sole proprietor/operator of Victorian railways (Murray 1918, p. 101). It might be noted that negotiations for this purchase were neither short nor straight forward. Readers interested in pursuing what transpired in negotiations may refer to *Correspondence and Returns Relative to the Proposed Lines of Railway and the Purchase of the Melbourne & Hobson’s Bay United Company* V&P LC V 1873, p. 1183 – 9.

Separation from NSW provided the Government of Victoria the discretion to select a gauge for its railways without reference to NSW, but Victoria did not exercise that discretion in favour of a change. Its private sector rail corporations continued to plan and design their railways at a gauge of 5ft. 3in, with the support of the new colony’s government. They proceeded until Lieutenant-Governor LaTrobe circulated the memorandum referred to in p.

111 above dated 2 February, advising him of NSW's intention to revert to 4ft. 8½in., and seeking his conformance in respect of Victoria.”

The Minutes of the meeting of the Board of Directors of the Melbourne & Hobson's Bay Railway Company on 14 March 1853 record receipt of a letter from Lieutenant-Governor LaTrobe. This letter advised them of NSW's intention to revert to 4ft. 8½in. and sought a response from the Board. The Minutes note that “consideration of the subject was deferred and the Engineer desired to report upon it.” The Company acted quickly. The Minutes of a Board Meeting held only one week later, 21 March 1853, record:

The Manager was instructed to write to the Colonial Secretary and include a copy of Mr Chauncy's report upon the change of gauge: to state that the Directors of this company are prepared to adopt any gauge that may be decided upon as most eligible for general use in Australia: to request an intimation of the course intended to be pursued relative to this subject, and to press for an immediate answer that orders for machinery may be despatched by the “*Chusan*”.

Melbourne & Hobson's Bay Railway Company  
Minute Book 21 March 1853

Two further Board Meetings of this Company are relevant. The Minutes of 4 April 1853 record that “A letter from the Colonial Secretary's Office was read, which stated that His Excellency, the Lieutenant-Governor intends to recommend an adherence to the gauge of five feet three inches.” On 18 April 1853, the Minutes record that the Manager advised that the Engineer had already despatched duplicate sets of orders for locomotives and rolling stock to the UK on board the vessel *Chusan*. The *Chusan* sailed on 7 April. Presumably the Board decided to commit its investment in plant and equipment on receipt of notice of LaTrobe's intention minuted on 4 April.

The Geelong and Melbourne Railway Company also reacted with despatch, and supplied their Engineer's response on 20 March, (V&P LC V, 1853). He, Mr Snell, had served an apprenticeship at a locomotive building works in Britain and in the locomotive design function of the Great Western Railway Company. He was extensively engaged in the locomotive trials conducted during the UK Gauge Commission's proceedings in 1846. LaTrobe had incorporated an extract from Wallace's letter to the Board of the Sydney Railway Company in which he had been critical of the 5ft. 3in. gauge. Snell commented that “... these objections appear to me somewhat absurd, and are, in fact, merely assertions



unsupported by truth.” Snell communicated a distinct preference for a gauge of 5ft. 3in. His arguments in support were exclusively technical. They entailed no consideration of costs and benefits of the gauge options; he made no attempt to differentiate between Victorian conditions and conditions elsewhere, and his technical comments were restricted to issues of locomotion, as distinct from the broader considerations involved in designing, constructing and operating railway systems. In evidence to the Legislative Council’s Select Committee on the Gauge for Railways, the company’s Chairman confirmed on 20 October 1853, that his company had followed the Melbourne & Hobson’s Bay Company by sending orders for rolling stock to the UK on the vessel *Ambrosine*. This ship had sailed from Melbourne on 17 August prior.

The Chairman of the Melbourne, Mt Alexander & Murray River Railway Company forwarded his Engineer’s advice to the Lieutenant-Governor’s office on 29 June 1853 (Ebdon to the Colonial Secretary, V&P LC V, 1853). Giving evidence to the Select Committee on an amendment Bill in respect of his company on 13 September 1853, the Chairman stated that his company had withheld placing orders for locomotives and rolling stock pending advice from government on the rail gauge to be used in Victoria. He implied a preference for a gauge of 5ft. 3in., but in reply to the following question “The Sydney people having commenced their line on the four feet eight and a half inches gauge, we, I presume, must follow them?” replied “We must, I conclude of necessity, do so” (Report of Select Committee Melbourne, Mt Alexander & Murray River Railway Company’s Act Amendment Bill Proceedings V&P LC V 1853, p. 1015).

In short, as at the end of March 1853, one company professed itself indifferent as to the choice of gauge, and a second had a distinct preference for 5ft. 3in., but only on grounds of locomotive management. A third had a preference for 5ft. 3in., but expected 4ft.8½in. to be selected to secure compatibility with NSW, but did not report a view until June. Thus the Victorian industry’s position was neither unanimous nor clear-cut, although, at that date (31 March 1853), none had ordered machinery from the UK.

As pointed out, the Minutes of the Melbourne & Hobson’s Bay Company of 4 April noted receipt of a letter from the Colonial Secretary stating that LaTrobe intended to recommend adherence to a gauge of 5ft. 3in. The argument put by some historians (for example,

Blainey 2001, p. 250, Gunn 1989, pp. 28 – 9) that Victoria’s election of 5ft. 3in. reflected commitment to orders placed for locomotives and rolling stock at that gauge is at variance with the evidence presented above. It is clear that the directors of the Melbourne & Hobson’s Bay Railway Company and the Geelong and Melbourne Railway Company did not order railway equipment until *after* being advised by Governor LaTrobe that he favoured a gauge of 5ft. 3in. These historians also ignore the less than unanimous support for the gauge of 5ft. 3in. by the companies themselves.

The timing is such that we can be almost certain that this decision was nothing more nor less than an expression of LaTrobe’s personal opinion, based on the opinions received from two companies. There is no evidence that any kind of disciplined analysis of the various gauge options available to Victoria was carried out or that any attempt had been made to consider any difference there may have been in NSW/Victorian conditions. On 28 July 1853, some *three months after* his decision had been made, LaTrobe advised the Governor General that he declined to cooperate in the choice of 4ft. 8½in.

This response, incorporating LaTrobe’s intention to seek the intervention of the Secretary of State for the Colonies, caused Fitzroy to advise the Secretary of State that LaTrobe’s decision had created “an inter-Colonial question of great importance”, and to request him to procure royal assent for the NSW bill to mandate 4ft.8½in. LaTrobe may have felt that, now in dispute with the colonies’ Governor General, his opting for a gauge of 5ft. 3in. on personal preference alone left him somewhat exposed. In any event, he considered it necessary to demonstrate that he had the support of the Victorian Legislative Council for his position. To procure that, he caused the establishment of the Select Committee of the Legislative Council on the Gauge for Railways on 28 September 1853, but six months after his election of the 5ft. 3in. gauge. The Committee was to “take evidence and report on the best gauge for railways in the colony.” The Select Committee sat on three occasions and reported in part, as follows:

After an attentive perusal of the various letters included in that correspondence, your Committee are unanimously of opinion, that the Government of New South Wales was not warranted in abruptly changing the Gauge from the uniform width of five feet three inches, (which had been generally adopted throughout the Australian Colonies,) to the Narrow Gauge of four feet eight and a half inches, without first having obtained the concurrence of the Governments of the adjoining Colonies, to a

measure fraught with so much importance to the general interests of the whole of them.

Your Committee therefore suggest to your Honorable [sic] House, the propriety of presenting an Address to His Excellency the Lieutenant Governor, praying His Excellency to call the attention of the Secretary of State for the Colonies, to the enactment passed by the Legislature of New South Wales, for altering the Gauge of Railways from five feet three inches, to four feet eight and a half inches, and to respectfully request that the Royal Assent may be withheld from that Act.

Your Committee, in the exercise of their discretion, have called before them competent persons to give evidence on the relative merits of the various Gauges, from whose united testimony it appears to your Committee that a Medium Gauge of five feet three inches is the most suitable Gauge for the general purposes of railway transit, that can possibly be adopted that there will be no difficulty in procuring the necessary stock and machinery, as compared with the adapted for the Narrow Gauge; that the expense will be no more; and that the safety, at equal rates of speed, will be much greater.

Your Committee therefore, taking into consideration that the Gauge of five feet three inches had already been agreed to by the Governments of the Australian Colonies; that it had received the sanction of the Home Government; that the railways in course of construction in this Colony are of that Gauge, and that the balance of the evidence given before your Committee greatly preponderates in favour of the adoption of a uniform Gauge of five feet three inches, your Committee feel no hesitation in recommending to your Honorable House, that in all future enactments authorizing the construction of Lines of Railway in this Colony, a strict adherence to the Gauge of five feet three inches should in every case be insisted on.

Your Committee bearing in mind that the best Railway Gauge for the Australian Colonies, had previously been decided to be five feet three inches, and that that Gauge would not be departed from, except in deference to the opinion of the Government of New South Wales, or unless it could be shewn to be inferior to the Gauge of four feet eight and half inches, did not feel it necessary to prolong their sittings for the purpose of hearing other witnesses than those whose evidence is appended to this Report, and which, in the opinion of your Committee, is sufficiently conclusive in favour of an adherence to the Gauge already adopted in these Colonies.

In closing their Report, your Committee feel that they cannot too strongly deprecate the making of railways with various Gauges, when the Governments of these Colonies, by a unanimity of action, might establish and perpetuate a uniformity of Gauge, and thereby entirely obviate the

numerous evils incident to a want of uniformity in the railway communications of a country.

John Hodgson, Chairman, 20<sup>th</sup> October  
Report of Select Committee Gauge of Railways Proceedings  
V&P LC V, 1853

On the face of it, the Committee purports to be taking a view representative of national interest. But the nation in question did not yet exist. Moreover, its argument to reach the point seems to misrepresent the facts about gauge choice decisions to date.

LaTrobe wrote to the new Secretary of State for the Colonies (now the Duke of Newcastle) on 19 November, providing a comprehensive background to the dispute between Victoria and NSW and requesting “the establishment of the medium (gauge) as a uniform gauge with the older colony ...” and that “Her Majesty’s assent may be withheld from the Act in question, until the subject has been more fully, and I must add, more fairly, discussed” (LaTrobe to Newcastle, 19 November 1853).

The sequence of events outlined above has some curiosities. The first curiosity is that the Select Committee appears to have ignored advice supplied some months before it met by Alfred Harrison, Engineer to the Melbourne, Mt Alexander & Murray River Railway Company (Fearnside 1970, p. 24). Harrison’s letter stated a personal preference for 5ft. 3in. but that in his view, circumstances were acting in favour of the adoption of 4ft. 8½in. He wrote:

My reasons are – first, I understand that some miles of line in Sydney have been completed, with the exception of the permanent way, which it is intended to lay down with a width of 4ft.8½ in. This, of itself, is sufficient to decide upon the adoption of the same gauge here, for it is impossible to give any idea of the mischief and expense consequent on a break-of-gauge and which, though it may be years to come, will sooner or later be felt should a different gauge be introduced here to that in Sydney.

Harrison, quoted in  
Fearnside 1970, p. 24

Harrison was not the only one who considered the need for uniformity with NSW to be the paramount factor in Victoria’s gauge selection – see Ebdon’s comment to the Melbourne, Mt Alexander & Murray River Company Select Committee of 13 September 1853 referred

to above. The second point is rather more subtle and concerns Fitzroy's roles as Governor General and Governor of NSW. Fitzroy assumed the role of Governor General, to whom Lieutenant-Governor LaTrobe was subordinate, in his letter to the latter of 2 February 1853 (see above). LaTrobe chose to ignore the fact that he was responsible to Fitzroy as Governor General, and took his argument direct to the Secretary of State for the Colonies, to whom Fitzroy reported. On the face of it, this was an act of insubordination.

Further to discussion of the Governor General's role in the preceding section, it appears that the Governor General's authority to act was not unambiguous, and that the resources made available to the Governor of NSW to play this role may have been inadequate. Earl Grey had made it clear to Fitzroy that "the officer appointed to govern the largest and oldest of the colonies should be provided with a general authority to superintend the initiation and the completion of such measures as those communities may deem calculated to promote their common welfare and prosperity" (Ward 1958, p. 232). Yet, while he was endorsed with considerable discretion to advise Lieutenant-Governors as their superior officer, "and to take over the government of their colonies from them", the Governor General was specifically prohibited from assuming a Lieutenant-Governor's office unless he were physically present in the latter's colony (this did not apply in the case of Western Australia) (Ward 1958, p. 231 – 2). In practical terms, this requirement represented a severe limitation to the Governor General's authority, and one which he did not attempt to remove in the case of the inter-colonial difference with respect to rail gauge.

The British Government's failure to provide Fitzroy with Governor General-specific resources led Fitzroy to use the counsel of the Executive Council of NSW, and there emerged "strong complaints that the Governor General was over-influenced by NSW points of view and ignorant of what was going on in the other colonies" (Ward 1958, p. 234). LaTrobe may well have felt ill-used; Fitzroy had not visited Victoria on the rail gauge issue, nor did he seek Victorian advice.

Ward notes that the gauge issue was not the only issue with respect to which Fitzroy failed to act in his capacity as Governor General (see Ward 1958, pp. 277 – 82). Even so, observed Ward:

It cannot be concluded, however, that whole of Fitzroy's inactivity is to be attributed to obstacles beyond his control. In the matter of the railway gauges, the case is so clear that one may say simply that he was recreant to his responsibilities. His duty had been lain down for him by the Colonial Office ... when he did use his authority as Governor General in the matter of the railway gauges, it was in a futile attempt to coerce the Governor of Victoria and not in a judicious exercise of his authority and discretion. The fact that the Colonial Office made no complaint to Fitzroy concerning his management of the affair is no exoneration of his leading part in producing the problem of the gauges.

Ward 1958, p. 278

Issue has already been taken with Ward's judgment that Fitzroy's treatment of this matter represents an "attempt to coerce". Ward makes the additional point that following Earl Grey's departure from the Office of Secretary of State for the Colonies, support from the Colonial Office for the role of a Governor General in the antipodes appeared to wane (Ward 1958, p. 278).

Notwithstanding, the Secretary of State requested NSW to reconsider its choice of gauge (see Chapter 5.2). The NSW legislature did so, declined to change from 4ft. 8½in., and legislated accordingly (see Chapter 5.2 above). Victoria (and South Australia – see Chapter 5.4) declined to change from 5ft. 3in. Thus the mixed gauge system emerged, and became fact on the day the first train ran from Melbourne to Hobson's Bay.

The question that remains concerns LaTrobe's motivation in deciding on a gauge of 5ft. 3in. Why did he elect a seemingly personal preference without expert, or indeed apparently any, analysis of the options, and with mixed and incomplete receipt of the written feedback he had himself sought from Victorian railway companies? It is possible that after fourteen years of dealing with the Sydney-based administration of what had been the Port Phillip District, and what was now Victoria, he was simply exasperated. He may have decided that Victoria should stay on the established course, and in doing so, demonstrate its capacity for autonomy after so many years of subjugation to the far-off NSW administration of the Port Phillip District.

In order to understand the significance of this possible motivation, it is necessary to briefly review the history of the relations between NSW and Victoria's predecessor, the Port

Phillip District. Many Victorians had actively sought separation from NSW for many years. For them, separation was not simply a structural issue, but one which attracted very strong emotions. Moreover, it was a long time coming. In a despatch dated 31 July 1847, Earl Grey advised the residents of Port Phillip that he would request Parliament to pass an act for the separation of the Port Phillip District from NSW (Shaw 1997, p. 11) – but getting to that point had taken almost 10 years, and separation was not to become effective until 1 July 1851.

The strength of emotional involvement in the issue may be gauged from a petition drawn up following a meeting of six hundred Port Phillip residents on 8 June 1840 (Shaw 1997, p. 7). Addressed to the House of Commons, this petition sought “responsible government, entirely separate from and independent of NSW” (Shaw 1997, p. 7). In support, it stated:

... they had been made to feel that they were governed by aliens, strangers and competitors (p. 262).

It is very confidently submitted to your Lordship that the succession of injustices thus heaped upon Port Phillip is quite unexampled in the history of British colonies (p. 263).

The revenue we have lost is not a mere pecuniary loss; it is the loss of schools and churches, of public worship and education, of effective police, of social and political advancement of a population of 20,000 souls, and of a good and effective government in all its branches. We have been arbitrarily deprived of all of these advantages, and have paid the price of obtaining them for aliens and strangers (p. 270).

Memorial to Earl Grey n.d.  
Printed in Clark 1952, pp. 261-71

This very strong language appears to be a product of prolonged poor relations between the parties. Shaw argues that those poor relations are a product of bad communications, incompetence of personnel, and Governor Gipps’ perennial desire for economy (Shaw 1997, pp. 8 – 9). Ritchie puts an alternative view which attributes Port Phillip resentment of NSW administration to being treated like a penal colony at NSW hands, which was not how it perceived itself, and having suffered economic neglect and political injustice (Ritchie 1974, p. 161).

According to Shaw “bad communications” between the parties, meaning simply their lack of frequency in the 1830s, caused “confusion and delay” (Shaw 1997, p.6). He says, for example:

Lonsdale’s request for authority to allow either William Hodgson and Thomas Watt to operate a punt across the Yarra was held up because the Sydney authorities insisted on discussing the operation of a government-owned ferry. Inefficiency caused other delays. In December 1836, Sydney had sent down some drays that Lonsdale had asked for but neglected to send either horses or bullocks to pull them, and there were not many of either in Melbourne. In September 1839 the government sent down a four-oared gig that the customs people wanted to help to prevent smuggling, particularly of grog, but it sent no oars, and in 1840 it sent down a set of buoys to mark the shipping channel through the Bay but failed to send any mooring tackle – and when this was obtained from Launceston in 1842, no money was granted for a ship to lay it until 1846 (apart from the inadequate and overworked customs’ cutter, *Ranger*).

Shaw 1997, p.6

The petition provoked by such poor administration did not move the Commons but it stimulated a visit to Port Phillip by Governor Gipps in November 1841 (Shaw 1997, p. 7). The residents presented another petition “full of wants – proper government buildings, a police office, a health officer, a proper wharf and sheds, a bridge, a dam above the basin, a Court House, a hospital, barracks,” etc. (Shaw 1997, p. 7). Some initiatives were taken as a result but they proved incompetent in their execution – the dam failed, the Court House had acoustic problems, the light-house was too feeble, and in any event, the sandstone of which it was made began to crumble. The wharf was built but washed away in the floods (Shaw 1997, pp 7 – 8). “Melbourne’s streets were still full of stumps and remained unpaved, unlit, undrained and prone to flooding” (Shaw 1997, p. 9).

Issues such as these continued throughout the 1840s and fuelled continuing Victorian efforts to achieve separation of the two colonies, until its delivery was promised in 1847 and achieved in 1851 (Shaw 1997, pp. 10 – 11). It is not difficult to imagine LaTrobe seeking to separate Victoria from yet another case of NSW confusion in direction, nor of using the gauge decision as a vehicle for asserting Victorian autonomy.

It is now appropriate to return to a matter first raised in Chapter 2, namely the mistaken attribution to Gladstone of advice to standardise in choice of railway gauge, and to choose



4ft. 8½in. As we have seen, Gladstone is silent on both counts. In his letter of 19 November 1853 referred to above, LaTrobe sketches the background to the NSW/Victorian dispute over railway gauge, and notes:

3. In the year 1846 Mr Gladstone, then Secretary of State for the Colonies, by a Circular Despatch dated 15<sup>th</sup> Jan<sup>ry</sup>, drew the attention of the Legislature of the Colony of New South Wales, through His Excellency the Governor, to the Standing Orders respecting Railways.

LaTrobe to Newcastle  
19 November 1853

In doing so it appears that he was seeking to enlist Gladstone's authority in support of the decision he, LaTrobe, had already made to select a gauge of 5ft. 3in. for Victoria. By reference to Appendix 2 of this thesis, it can be seen that the essential purpose of Gladstone's despatch was to *avoid* giving instructions on matters of railway design. Its purpose was to give local administrators discretion in making such decisions. It suggested adherence to nine principles, *none of which related to gauge*. The Standing Orders to which LaTrobe refers were an attachment to the Despatch. Together with four other attachments, they were included by Gladstone in order to pass on to local administrators a collection of experience on which to help make local decisions. It seems unlikely that LaTrobe misunderstood Gladstone's intent. It is more likely that he had realised that he had made an avoidable decision which he now knew could have negative consequences, the responsibility for which he was seeking to avoid. His appeal to Gladstone's authority could be seen as a smoke screen.

### ***Railway Development under Government Ownership***

For the rest of the nineteenth century, the Victorian Government was preoccupied by the challenges involved in railway development and management. The Legislative Assembly in particular became an agent for the micro-management of railway affairs – see particularly accounts of railway management and organisation practices contained in Beveridge (1952); Eggleston (1932); Jenks (1891) and to a lesser extent Serle (1977). For example, a Select Committee of 1859/60 was appointed to report upon the importation of railway plant – it recommended that in future, tenders be called for the importation of such plant (Borchardt 1958 - 78). A Select Committee was appointed in the same year to examine the Chief Engineer's section of Victorian Railways. It recommended that legal

action be taken to investigate the mismanagement and extravagant use of public funds (Borchardt 1970, p. 20).

In 1871, a Select Committee was appointed to investigate various “alleged systems of economical railways”. The report also dealt with the Railway’s financial difficulties and “recommended that future contracts for railway construction should not exceed £5,000 per mile including stations and rolling stock ... (Borchardt 1970, p. 69). A Board was appointed to enquire into the working and management of Victorian Railways on the Legislative Assembly’s behalf. Its tasks were to find ways and means of reducing the Railway’s annual deficit. At the same time it was required to find ways of “giving relief” to consumers, and to “enquire into the administration of the Department in general” (Borchardt 1970, p. 127).

For Eggleston, the Legislature’s continued focus on administrative and operational detail as displayed above, amounted to “political interference”, and in Chapter 5 of his book he catalogues instances of “interference” in policy, administration, rates and charges, finance and staff matters (Eggleston 1972, pp. 134 – 47). There is no purpose in pursuing them here, except to reinforce the point that because Railways took such a large share of both capital expenditure by the Government and operating expenditure, the Legislature felt compelled to maintain close control, and to seek every possible way of reducing expenditure. It could not be expected that the question of gauge would escape public scrutiny, and it did not.

So extensive and expert were the reports gathered in the course of such enquiries as those referred to above, that they may be thought to have provided a sound basis for putting an end to the gauge issue in Victoria for ever. Indeed, a Victorian Select Committee reported that Victoria had been in error in electing a gauge of 5ft. 3in. and made that view widely known. This admission reached South Australia, where it was referred to in the final report of the South Australian Commission on Railway Construction as follows:

11. The Commission observe that the Victorian Select Committee on Railways in 1871 state, in the fourth paragraph of their report, “It appears from the evidence submitted that a narrower gauge than the one adopted in Victoria (viz., 5ft. 3in.) would be more economical, both in the construction of the permanent way and rolling stock; but

as to the expediency of constructing any new line on a narrower gauge, in view of the mileage already constructed on the present gauge, the value of the rolling stock now in use, and the inconvenience and risk which would result from a break of gauge, the balance of evidence taken is opposed to any immediate change on main trunk lines.”

SAPP No. 2 of 1875

Further, Molesworth’s demolition of any argument for using the Festiniog Railway as an exemplar for (very) narrow gauge railways, even in mountainous countries, is classic (Molesworth to Secretary of State for the Colonies, 24 March 1871, V&P LA V 1872). The Molesworth report is considered in more detail below. And yet, less than twenty five years later, when the break of gauge at Albury-Wodonga had become a reality, the same Parliament instituted an enquiry into the merits of building and operating 2ft. gauge railways in Victoria.

Some debates were protracted and much administration was preoccupied with minutiae, as previously discussed. For example, the debate leading to agreement that the Government should buy the Melbourne & Hobson’s Bay United Railway Company lasted more than eight years. And in 1892, Governor-in-Council instituted a “Board of Enquiry into Certain Matters Connected with the Locomotive Branch of the Victorian Railway Department”, an affair of operational trivia of many years standing which could have been dealt with by an auditor.

The scope and depth of other enquiries, for example, that of 1869 – 1873, is impressive, and much material about the relative merits of different railways gauges was brought to light. Because of its professionalism, it is important to note certain highlights of this enquiry.

Because gauge reduction appeared to be a potential source of large savings in construction, lively debate ensued in the Parliament. In November 1869, the Commissioner of Railways engaged William Elsdon, a consulting engineer, to visit England, Belgium, France, Germany, Austria, Italy, Russia and the United States to make a first hand examination of their “modes of construction, equipment and general management” – see Elsdon’s Report to Commissioner of Railways, 29 April 1871 in V&P LA V 1871. This was one of the first attempts by any of the colonies to carry out an independent and objective fact-gathering and

analysis of railways on a global scale. Elsdon's report was supplemented by a report from Higinbotham, Engineer-in-Chief of the Victorian Railways (Higinbotham to Secretary for Railways, 27 April 1871 *ibid*). Elsdon's report is notable because it recommended that Victoria revert to a gauge of 4ft.8½in. at lighter standards of construction than had so far been used in Victoria. Because Victoria had adopted heavier standards of construction (for example, double lines of track, stonework instead of timber for bridges etc.), as well as opting for a gauge of 5ft. 3in., Elsdon's report fed the controversy. Higinbotham's report is notable because it analysed and compared construction costs for three different models of railway construction, it placed such analyses on the public record for the first time in Australia, and because it made intensive use of engineering analysis of gauge proposals with respect to Indian railways. This last had been outside the scope of Elsdon's report.

Higinbotham compared the cost of constructing 5ft. 3in. lines on conventional and "light" standards of construction with that of constructing a 3ft. 6in. gauge within Victoria at "light" standards. Higinbotham's report concludes:

It has been proposed that, as the railways in New South Wales are laid to the four feet eight and a half inches gauge, and as the North-Eastern railway will communicate with them, it should therefore be laid to the same gauge; but this proposal, which at first sight is plausible, will not bear examination. It will be evident that whether the change from the standard gauge be to three feet six inches, or four feet eight and a half inches, all the evils of a break of gauge must follow; but if the break be made at the junction with the New South Wales lines at Albury, it can affect the traffic passing to and from New South Wales only; whereas if the break of gauge be made at Essendon, all the traffic both to and from the North-Eastern districts of Victoria, *as well as* all that to and from New South Wales, must suffer the evils of a break of gauge. The simplest, and in the end the cheapest, way of meeting the difficulty of break of gauge at Albury, will be to lay a third rail to such a distance into New South Wales as will allow Victorian wagons to be carried to the furthest point from which traffic is drawn. It may be many years however before it will become necessary to adopt this expedient.

Higinbotham to Secretary for Railways  
27 April V&P LA V 1871

This is an example of engineering opinion, unsupported by either theory or practice, being used to sway the argument. In point of fact, the Gauge Commission of 1846, some twenty five years earlier, had already dismissed the third rail option as uneconomical.

The arrival within two days of such disparate opinions from two senior professional railway engineers in Victoria would probably have attracted some interest. The Legislative Assembly decided to institute an enquiry focussed specifically on assessing the merits of building all new lines in Victoria at 3ft. 6in. and to do so by eliciting opinion and information from experts in different countries. Higinbotham prepared a brief for those carrying out enquiries on the Victorian Government's behalf (Correspondence on Light Railways and Narrow Gauge, V&P LA V 1872, pp. 397 – 8). He also prepared data for a briefing document authorised by Commissioner of Railways and Main Roads. Because these documents are critical examples of the way in which officials, both elected and employed in the bureaucracy of Victoria conceptualised the issues and arguments, these documents are reproduced below.

*Memorandum of further information on the Gauge Question which the Government of Victoria desires to obtain.*

1. What countries have adopted either the 3ft. 6in., or a still narrower gauge in the construction of railways?
2. For what description of traffic have these narrow-gauge lines been adopted, and what length and kind of railway has been made in each country on each gauge which has been used?
3. What has been the average cost per mile of the railways which have been made either on the 3ft. 6in. or a narrower gauge in each country?
4. What is the average saving per mile in first cost, in each country, which has resulted from adopting either the 3ft. 6in., or other narrower gauge than that which had been used previously?
5. Is there reason to believe, other things being the same, that the working expenses and maintenance of a line of railway on the 3ft. 6in. gauge would be less than on the 5ft. 3in. gauge?
6. Is there reason to believe, having regard to all classes of traffic on a railway, that wagons and carriages can be built on the 3ft. 6in. gauge, having a smaller proportion of weight to the load carried than on the 5ft. 3in. gauge?
7. Has a break of gauge been found to be a serious evil in those countries where it has occurred?
8. What means have been adopted to diminish the inconveniences which arise from a break of gauge, and what is the cost of transferring goods from one gauge to another per ton?
9. Are the damage to and loss of goods arising from a break of gauge found to be serious?
10. Is a mixed gauge on a line of railway, or at stations, objectionable; and are there any grounds for thinking a mixed gauge dangerous?

11. What are the ordinary speeds for passengers and goods trains on lines made on a gauge of 3ft. 6in. or less, and what is the greatest speed which can be attained on such lines with safety?

T Higinbotham, Engineer-in-Chief,  
Railway Department, 8 December 1871

Department of Railways,  
Melbourne, 29 December 1871

Ibid, p. 398

Sir,

I do myself the honor to inform you that considerable discussion has taken place in Parliament during its past session, relative to the question of the gauge to be adopted in the construction of future railways in this colony.

You are, of course, aware that the gauge hitherto in use on the Government lines is 5ft. 3in.; the alternative one suggested and strongly supported is 3ft. 6in.

In support of the latter it is urged –

1. That the lesser gauge, or one approximating thereto, was being adopted in most countries of the world, viz Russia, Sweden, India, Canada, Queensland and America.
2. That the evils attendant upon a break of gauge were not at all so serious as had been represented.
3. That the quantities of goods which would have to be transferred from the new to the existing lines would not be great.
4. That the difficulty of a break of gauge could be met either by a small expenditure in transferring goods from one to the other, or ultimately, as the length of the narrow-gauge lines was extended, by either altering the existing to the narrower gauge, or by using a mixed one.

On the other hand, it was contended –

1. That the economy to be effected by using a narrower than the existing gauge was exaggerated.
2. That the calculations made by direction of the Minister of the department showed a difference in cost, between the wider and the narrower gauges named, of £261 per mile only, while the Engineer-in-Chief pledged himself that the saving to be effected by using the latter in the proposed lines would not exceed £350 per mile.
3. It was denied (other things being equal) that a line on the narrower gauge could be worked more cheaply than one on the standard gauge, and that the weight of the carriages and wagons on this gauge must bear a greater proportion to the paying load than on the narrower one.
4. It was urged that, though, in consequence of their weight, the engines on the existing lines and that (North-Eastern) now in course of construction could not be used on the projected ones, the carriages and wagons could be, if the gauge were not broken; and that uniformity in

rolling stock is one great source of economy in working a system of railways.

5. That experience had shown a break of guage [*sic*] entailed expense in transferring goods.
6. That a mixed guage was expensive, inconvenient, and dangerous; and that either it or a changing station must be adopted at every point where a break of gauge took place.

I have now given you the general tenor of the arguments used on both sides in support of the several projects. The Government of Victoria, without pledging itself to either, has promised Parliament to use its best efforts to obtain the most valuable opinions which older countries and their most valued engineers can afford as to the most advisable guage to adopt, both in relation to the projected and (possibly) the existing lines.

With this view I beg to forward herewith a statement of facts compiled from the records of the department and other documents, also maps of the colony showing the existing and (possibly) future lines; and have to request you will be good enough, with the utmost possible expedition, to seek the opinions of those who in your judgment are most competent by experience, freed from strong prejudices, to advise in the matter.

It is proposed that Parliament should re-assemble in April next, and doubtless this question will furnish an early topic for discussion; I would, therefore, ask that the subject may receive your very prompt attention, and that the information you are enabled to obtain may be communicated with the utmost despatch.

My desire is that you should communicate with the leading engineers connected with both broad and narrow gauge lines in the several countries I have named, Queensland excepted, asking to be favored [*sic*] with their opinions.

Longmore ( Commissioner of Railways)  
to Childers (Agent-General in UK of Victoria)  
29 December *ibid* p. 396

Evidence was supplied by a number of eminent persons. These included Mr. Carl Pihl of Norway, Mr Guilford Molesworth of Ceylon and Mr Walter W Evans of New York. Pihl was the Government Engineer-in-Chief of the Norwegian Railways. Victoria's Agent-General noted that "The railway system in Norway, into which the narrow gauge (3ft. 6in.) has been more extensively introduced, and has been longer in operation than in any other country in Europe, naturally presented a valuable ground for enquiry" (*ibid*, p. 402). Molesworth was a Chartered Engineer who served as Director-General of the Ceylon Railway, who was shortly to become Director-General of Indian Railways and who at the

Victorian Agent-General's request, produced a report on the Festiniog Railway in Wales (gauge 1ft. 11½in.). Evans was an "American engineer of considerable experience" (ibid, p 1173).

Pihl reported that Norway had built two 3ft. 6in. lines commissioned in 1862 and 1864, and further that:

"After these lines, thus finished, had been practically and thoroughly tested, and certainly with the most satisfactory results, the system has been ... recognised as standard throughout the country. We [Norwegian Government railways] have at the present time 146 miles completed, and 47 miles in course of construction ... Moreover, further extensive schemes are in contemplation" (Pihl to Victorian Agent-General, 8 April 1872, "Further Correspondence, V&P LA V 1872 p. 403).

Pihl made some pertinent points:

... careful investigation and ample experience have confirmed my belief that this system affords the greatest efficiency at the smallest cost ...

... it has been too often represented that the cost of a railway depends on and is in proportional to the width of gauge (sic); such a fallacy I need do scarcely more than allude to ...

... the gauge alone cannot of course make a cheap railway ...

... there is nothing to hinder the application on a broad gauge of ... those principles belonging to the now called "light system of railways" ... but this is not a harmonious whole in construction ... (and) can only ... be justified by special circumstances.

Pihl, ibid p. 407

To conclude, I state as my firm conviction:-

1. That a gauge of 3ft. 6in. is not only sufficient to satisfy a fully developed colonial traffic, but it is peculiarly adapted for the requirements of the very smallest traffic deserving railway accommodation.
2. That the inconveniences from break of gauge by the plan proposed will be of no material importance compared to the advantages accruing from the greater and more rapid extension of the railway net which the new and cheaper system is capable of producing.

Pihl, ibid, p. 407

Having argued that 3ft. 6in. represents better value for money in construction *and* operation than broader gauges, Pihl then deals with the relative merits of narrower gauges. He argues



that narrower gauges are inferior to 3ft. 6in. in terms of stability, space and carrying capacity, and afford no significant benefit in construction cost (Pihl, *ibid*, p. 404).

The Victorian Agent-General procured via the Secretary of State for the Colonies, a report prepared by Mr Guilford Molesworth on the Festiniog Railway. It reported that the railway was 14½ miles in length, reached a height of 800 feet above the sea, had an average gradient of 1 in 90, and carried 140,000 tons of freight annually, 90% of which was slate (Molesworth to Secretary of State for the Colonies, Correspondence on Light Railways and Narrow Gauge, V&P LA V 1872, pp. 384 – 9). Molesworth notes that “An attempt has been made by the publication of a series of plausible letters in the *Times*, about the beginning of last year, to give lines of this character an undue importance ... as [their] influence has been widespread, the true facts of the case should be known” (Molesworth, *ibid*, p. 385).

Molesworth noted that this railway yielded a rate of return of 29.5%, and proceeded to analyse its cost structure and pricing. He concluded that its freight rate for slate was twice that of other English railways. He argued that because its business was so specialised, so the variety of rolling stock it used was low compared to other railways. He argued that the difference in construction cost between the 2ft. gauge and the 4ft. 8½in. gauge were negligible, and he claimed that rolling stock design had reached the point where a “steam carriage, 43 feet long, has been exhibited near London running round curves of only 50 feet radius at a speed of twenty five miles per hour on the ordinary gauge of 4ft. 8½in., so that the greatest element of economy claimed for the exceptionally narrow gauge, is to some extent, illusive, inasmuch as with the ordinary gauge curves can be used which are twice as sharp as the sharpest curves in the Festiniog railway.” In summary, he argues that the special features of Festiniog’s geography and design are so exceptional as to make it useless as an exemplar of very narrow gauge railways (Molesworth, *ibid*, p. 389).

Evans is a strong advocate of the “standard” gauge, and of using light standards of construction in the interest of economy. He writes having participated in the design and construction of

... a 3½ft. railway gauge in Costa Rica, one of 3ft. in Peru, and one of 3½ft. in Chile ... these railways (two of which are Government works)

are in mountain regions, where grades of 1 in 20 and 1 in 25 are a necessity, also many curves of 200 to 300 feet radius; all three start from the sea coast, and are not intersected by railways of another gauge; and, I might imagine that, all three are not likely to be over burthened by heavy traffic. They are light railways, and will not be affected with the evils resulting from “break of gauge”.

WW Evans to Agent-General of Victoria,  
Further Correspondence on Broad and Narrow Gauge Railways  
V&P LA V 1872, pp. 441 – 5)

Hence his views are based on extensive practical experience as well as his professional training. His letter is something of a polemic but he provides forty four questions about design criteria to be applied when contemplating a choice between two different gauges for a new railway system, thus dealing with gauge choice at a greater level of technical detail than other writers up to that time – see Evans, *ibid*, p. 443 (see also Hilton 1990, p. 61).

In addition, four reports by different people were contributed with respect to India’s choice of a 1 m. railway as a second railway to its 5ft. 6in. main line system. Their views about the relative merits of different gauges were not unanimous, nor were their views in respect of break of gauge. Some considered it a tolerable inconvenience – other saw it as a major impediment to system efficiency. Three separate reports were submitted with respect to Queensland’s relatively recent choice of 3ft. 6in., and reports were received about the mixed gauge outcome in eastern Canada (5ft. 6in., 4ft. 8½in. and 3ft. 6in.). Information was acquired from the Engineer of the Denver and Rio Grande Railway Company in the USA. As discussed earlier, it laid a 3ft. gauge railway when almost every other US railroad company was collaborating to reach a standard of 4ft. 8½in.

The prevailing preference in the Assembly for a 3ft. 6in. gauge for new lines in Victoria gave way to a preference for “light” lines laid at 5ft. 3in. The vote for extending Victorian Railways on “light” lines at 5ft. 3in. was 42 in favour and 10 against. While it was acknowledged that some saving might accrue in first cost of construction in favour of 3ft. 6in. lines over 5ft. 3in., it was considered that any such savings were likely to be swamped by the costs associated with operating a break of gauge within the State, even though not a single witness attempted to quantify what these might be, and even though some eminent witnesses were inclined to dismiss break of gauge management costs as relatively unimportant.

The economic model used by the Legislative Assembly was very basic. The Assembly, and most of the contributors, worked largely in terms of the economy of first cost of construction. Few recognised that investing in a railway incorporated operating as well as capital cost considerations (Evans and Molesworth are exceptions). The Assembly did not recognise that high capital costs could lead to low operating costs, or the reverse. There was no standard template for analysing and comparing even the construction cost of different technical models; the “benefits” of economic development were accepted, but not the underlying reality of different stakeholders being affected by different externalities. Having said that, Higinbotham’s models and Evans’ questions about design criteria are significant steps forward in achieving more useful economic decision-making tools.

### *The Very Narrow Gauge*

Just over twenty years later from reaffirmation of 5ft. 3in. as the appropriate rail gauge for Victoria, the Standing Committee [of both Houses] on Railways initiated an enquiry into the potential for narrow gauge railways in Victoria – see Report from The Parliamentary Standing Committee on Railways on the Question of Narrow-Gauge Railways, V&P LA V 1895 vol. 2.

This enquiry was provoked by continuing concern about the construction cost of certain lines, and their apparent inability to generate an operating surplus. There were

... seven branches in different parts of the colony – three in Gippsland, three in the south-western district, and one in the north-east. These seven lines have a total length of 134.22 miles, and have cost £879,671, or an average of £6,553 per mile. During the year 1893 – 4 the total traffic amounted to 58,341 tons of goods, and 62,818 passengers; the average load per train being about 14 tons of goods and 15 passengers. The total revenue obtained amounted to £10,993, while the working expenses were £16,564, and the annual interest charge £35,187, the loss for the year amounting to £40,758 ...

... several other branches ... give similar results. The figures show that the traffic on these railways does not nearly come up to the capabilities of the gauge, or the standard of construction adopted for such lines, which have been designed and equipped without due regard to the traffic to be served, and at a cost altogether unwarranted by the prospective revenue.

It was the enormous first cost of these lines – the annual loss on which accounts for the greater portion of the railway deficit – and the high estimates for similar lines submitted by the railway engineers in 1890 that led to the urgent public demand for a less costly system of construction.

Report from the Standing Committee  
V&P LA V, vol 2, 1895, pp. v & vi

The Standing Committee set out to evaluate three options; retaining the present gauge of 5ft. 3in., but “cheapening” construction standards; “cheapening” construction by introducing lines of 1 m. or 3ft. 6in.; and introducing a gauge of 2ft. or 2ft. 6in. for feeder lines to main trunk railways (*ibid*, p. vi).

In doing so, it held 72 meetings and examined 28 witnesses. It relied on much evidence about the narrow gauge and very narrow gauge lines of India (see *ibid*, Appendices p. lvi), and from all of the operators of 3ft. 6in. lines in New Zealand, Queensland, Tasmania, South Australia and Western Australia. It did not seek equally comprehensive evidence about the “standard” gauge or broad gauges, and it made no reference to any of the evidence collected in the various enquiries over 1871 to 74, including the strong evidence presented by Molesworth and Evans (see above). Above all, it did not seek the input of North American experience.

The Standing Committee’s Report was critical of Victoria’s railway engineering staff, stating that:

While the evidence shows that the construction of these narrower gauge lines is extending in several countries, and that favourable opinions as to their usefulness are held by persons having a practical acquaintance with their working, it is urged by the departmental engineers and by other witnesses that 2-ft. or 2ft. 6in. lines are unsuitable for general railway purposes, and that any advantages likely to be derived from their introduction will be outweighed by the disadvantages of departing from the standard Victorian gauge. The question is not, however, altogether an engineering one, and too much weight can be attached to the departmental evidence.

*Ibid*, p. xiii

Further, the Standing Committee observed that:

The objections ... to a break of gauge are much more strongly pressed

by those who have not had practical experience of the working of two gauges.

Ibid, p. xiii

The Standing Committee adopted a more analytical framework for assessment of the costs of breaks of gauge than any of its predecessors in Victoria or the other eastern states, and identified five factors for consideration.

1. The delay and damage to goods at the junction stations, and the cost of transshipment.
2. The loss arising through the isolation of the narrow-gauge line, which prevents the interchange of rolling stock and the use of old stock thereon.
3. The necessity of separate repairing shops, with a staff of skilled mechanics at each junction.
4. The heavier working costs on narrow-gauge lines, and the lessened facilities for cheap and rapid transport for passengers and goods.
5. The small carrying capacity of lines on so narrow a gauge as 2ft. or 2ft. 6in.

Report *ibid*, p. xiv

Not only were these sources of “evil” enumerated – the report attempted to analyse their validity and relative significance. As to the first issue, the analysis ignored concerns about delays and damage to goods – these were costs which the railways’ customer had to bear, and were of no concern to railway management. The analysis under this heading focussed on costs of transshipment. It concluded that the “time spent [and presumably also the cost] in unloading and reloading goods will be relatively trifling” (Report *ibid*, p. xv). The Report proceeded (p. xv) “The most serious objection urged against departing from the standard gauge is, undoubtedly, the isolation of the narrow-gauge lines, which will prevent the interchange of rolling stock, and will preclude the use of branches as an asylum for old stock.” The Report does not produce a model for dealing with this issue, hinting that each situation needs to be dealt with on its merits. The need to build equipment-specialised maintenance workshops was also to be treated on an individual case basis.

The Standing Committee, in rebutting an argument put by Victorian Railways' Engineer-in-Chief (ibid, p. xv) stated "The evidence obtained is ... conclusive that a small traffic, such as will be available on most future branch lines, can be dealt with more economically with the narrow gauge ..." (Report ibid, p. xvi). As to speed, the Committee's opinion was that "Rapid transit is a great consideration on trunk lines, but on the branches it is not material ..." (Report ibid, p. xvi).

The Committee's conclusion was:

It is important, if any departure is made in Victoria from the standard 5ft. 3in. gauge, that a standard for the narrow gauge should be fixed, and the Committee are unanimously of opinion that the best gauge to adopt, wherever a departure is made, is the 2-ft gauge. They find that this gauge has been chosen, after careful trials, for the narrower gauge in France, and also in Germany. The Darjeeling line in India, previously referred to, is on the 2-ft gauge, and so also is the Festiniog line in Wales. The results of several years' practical working have shown that it is perfectly safe for passenger traffic, that commodious and comfortable passenger cars can be used upon it from 5ft. 6in. to 6 feet in width; that goods trucks of large carrying capacity can also be used, and that it can cope with any traffic which can be carried on a 2ft. 6in., a 3-ft, or a metre-gauge line (3ft. 33/8in.). It is cheaper to construct than any of these gauges, owing to the sharper curves which can be negotiated, if such curves should be found necessary in very difficult country. The curves on the Darjeeling line, for instance, have a radius of less than 1 chain.

Looking at all the objections raised, and bearing in mind the volume of traffic to be accommodated, and the urgent need of the settlers in several districts for facilities for getting their produce to market, the Committee think that any disadvantages of departing from the standard gauge would be slight compared with a substantial saving in the first cost of 2ft. lines.

Report ibid, p. xvii

The Standing Committee also recommended that one or two trial lines, in suitable districts, be constructed on a gauge of 2 feet.

In the event, four lines were built, at 2ft. 6in. rather than 2ft., as follows (length in miles and completion dates in brackets - Harrigan 1962, p. 97).

Wangaratta to Whitfield (30½, 1899)  
 Ferntree Gully to Gembrook (18½, 1900)  
 Colac to Beech Forest (29¾, 1902)  
 Moe to Walhalla (22, 1910)

The work of the Standing Committee in producing the above appears to have been less than competent. For example, it did not complete the task it set itself of evaluating three options for gauge. Its choice of witnesses and evidence was selective, and so was the choice of quotations in its report. To illustrate this, we might consider the Standing Committee's treatment of the evidence of Henry Mais. Mais had the unique qualifications of having worked at a senior level of the railways in each of NSW, Victoria and South Australia, and of having been in charge of the only colonial mixed gauge system on the continent, that is South Australia, for twenty years. Referring to the significance of breaks of gauge, the Committee asked Mais:

Although you think the break of gauge a difficulty, it is not insuperable?

Mais is quoted as having replied:

No; where the traffic is very limited I do not think it is worth considering.

Report, *ibid*, p. viii

There follows a quotation from subsequent correspondence by Mais to the Committee which elaborates on this opinion.

A more balanced account of Mais' verbal evidence before the Standing Committee about break of gauge is as follows:

**Committee**

543. Has that break of gauge been a grave difficulty with you?

**Mais**

Not a very grave one. Of course it is a nuisance - not for passengers but for goods, and it would be far better if we were without it, and I would not recommend any one to have a break of gauge if they could avoid it.

Report, *ibid*, p. xxxi

Writing in 1898, the then Railways Commissioner, John Mathieson, commented:

With respect to the narrow gauge lines which have been authorized, I desire to state that in my opinion they will be found to be very costly experiments. The estimated saving in cost of construction is relatively so small that it cannot possibly compensate for the delays in transit, transfer charges, additional cost of handling, and the general inconvenience necessarily involved in breaking the gauge on such branch lines.

Mathieson, quoted in  
Harrigan 1962, pp. 96 – 7

Finally, it may be noted that all of these very narrow gauge lines incurred deficits and were eventually closed. One was re-opened as a tourism venture.

### *Conclusions*

The evidence presented here suggests that it was Lieutenant-Governor LaTrobe's expression of his personal preference for a gauge of 5ft. 3in. which determined that gauge for Victoria. It was not the choice of his three major railway companies, nor was it the unguided choice of his Select Committee. LaTrobe's decision was made within the space of two or three days in late March 1853, and it lacked any basis in systematic economic or technical evaluation. It was not made in order to avoid writing off investments already committed at that gauge because orders for locomotives and rolling stock had not been placed by Victorian companies at that date. LaTrobe had an unconstrained choice of opting for 4ft. 8½in. and 5ft. 3in., and he opted for the latter, on grounds which may never become apparent.

The evidence also suggests that, even by Federation, two schools of thought persisted in Victoria about the relative merits of the "broad" and "narrow" gauges. By the end of the century, 5ft. 3in. was spoken of as the "broad" gauge, 4ft. 8½in. as the "standard" gauge (but not in Argentina, Brazil, India or Ireland), and 3ft. 6 in. and less as "narrow" gauge. Controversy about the relative merits of the "broad" vs "standard" gauge had virtually left the literature because most engineers had come to the view that, technically, there were little grounds for choosing between them – see for example the evidence of Evans referred to above. The controversy continued about the relative merits of "narrow" gauges vs "broad"/"standard" gauges. Two schools of thought also continued about breaks of gauge. To some, they were to be avoided under any circumstances. To others, they could be tolerated. Which view was taken depended on the comparison base.

The proceedings before the Standing Committee discussed above indicate that in the relative merits of various gauges, the role of operating costs was being given greater weight towards the end of the century rather than in its middle. For example, the cost components of breaks of gauge had been identified, and in the case of this Standing Committee, analysed separately. Yet first cost of construction remained the proxy measure of economy



in both construction and operation. Ways of estimating it had not been codified so that comparison could be made between the same gauge choice in different topographies, or even different gauge choices in the one topography. No coherent attempt was made to assess the benefits of railway construction, much less to differentiate between cost/benefit rates in development context and a static context. The Standing Committee's support, if not choice, of witnesses was selective. Its recommendations ignored much of the evidence and relied on selected engineering opinion.

There continued to be faith in the belief that railway development stimulated economic development, in some undefined way producing net benefits, despite evidence in Victoria suggesting the contrary. No effort had been put into identifying and measuring economic development benefits and costs in Victoria, or indeed anywhere else in the colonies. Perhaps this is because outside of the UK and North America, railways had become owned by governments, and the justification for investing in railways was predominantly political: that is, the capacity of railways expenditure to elicit votes became more important than the flow of net economic benefits, if any.

## **5.4 SOUTH AUSTRALIA**

### ***Introduction***

This part of the thesis describes and analyses the early development of railways in South Australia, and that state's gauge choices up to the year of Federation. There were two major differences in the pattern of railway development in South Australia when compared to that in other states.

Firstly, South Australia was unequivocal about the key objective for its railways. Their stated purpose was to carry freight, not passengers, nor some mix of freight vs passengers. Neither NSW nor Victoria had South Australia's clarity of purpose. As a consequence, a high speed system was not seen to be required, a view which in turn led to sponsoring tramways (that is horse drawn railways) instead of steam propulsion. Without the latter, "railways" could be constructed much more cheaply because they did not have to be sturdy enough to support "heavy" locomotives.

The second significant point of difference between South Australian railways and their NSW and Victorian counterparts is that although the first “railways” were radial from the capital, trade through the “outposts” became significant well before the turn of the century (Hirst 1973, p. 23). Until the 1870s Adelaide and its port were the main destination for the State’s railways. The lines that had been built to carry copper from Kapunda and Burra were carrying more wheat than copper by 1870. After the harvest of 1870, 88% of South Australia’s wheat exports were shipped through the main metropolitan port. In the next nine years, railways were built at a gauge of 3ft. 6in. to connect northern wheatlands with the ports of the Spencer Gulf – Wallaroo, Broughton, Port Pirie and Port Augusta. By 1880, Port Adelaide accounted for only 46% of wheat exports (Hirst 1973, p. 23).

### ***First Developments***

It was wool exports that provided the first stimulant to railway development in South Australia. By the 1850s wool had become the continent’s main export. Wool from NSW and Victoria, as well as south western Queensland, could be conveyed to port more economically via the Murray River than by overland means. Transshipment at the river mouth presented a challenge as it tended to silt up. It was also a victim of strong gales which came in frequently over the Southern Ocean. On both counts this made berthing for sailing ships difficult and dangerous (Harcus 1876, p. 55).

To overcome this, South Australia built a tramway from Goolwa at the Murray mouth to Pt Elliot, some seven miles away on the coast, and configured Pt Elliot as a port for sea-going vessels (Hodder 1893, p. 277). The tramway is deemed to have opened for business on 18 May 1854 (Thompson 2004, p. 34). Pt Elliot proved unsuitable. The nearby Victor Harbour was established as a replacement port, and the tramway extended from Pt Elliot. But Victor Harbour proved uneconomic to the shipping industry. As a single purpose port (wool), it did not provide ships with opportunities to load other commodities in intervals between arrivals of loads of wool, which were sporadic. Hence Victor Harbour was quickly superseded in favour of Port Adelaide (Harcus 1876, p. 56).

The original gauge selected for South Australia was 4ft. 8½in. It was incorporated in March in Ordinance No. 7 of 1847 of the South Australian Legislative Council under the administration of the then Acting Governor, Major FH Robe, following receipt of

Gladstone's despatch of 15 January 1846 (Thompson 2004, p.9). It was sent to the UK for ratification and the Secretary of State for War and the Colonies, Earl Grey responded as follows:

I have consulted with (UK) Commissioners of Railways with regard to the width of the gauge adopted in them. I have regarded that point not only with reference to the construction of railways in South Australia; but also with a view to the general extension and the probable junction eventually of those lines constructed in the different Colonies of the Continent of Australia.

The Railways Commissioners have identified their opinion that the gauge of 4 feet 8 ½ inches, which has been adopted in the legislation, and which is the width prescribed by Act 9 & 10 Victoria: cap 57 for railways in England is that which may be most advantageously used. I have addressed a communication to the Governors of New South Wales and Western Australia expressing my opinion that in the event of their undertaking railways in these Colonies, that gauge should be adopted."

Grey to Robe, 30 June 1848

Quoted in Thompson 2004, pp. 9 - 10

The South Australian Legislative Council enshrined 4ft. 8½in. as the selected gauge in Ordinance No. 1 of 1850 to facilitate its use by the Adelaide City & Port Adelaide Railway Company (Thompson 2004, p. 10). This company failed, and that railway was later built by Government at 5ft. 3in. (Harcus 1876, p. 47).

Earl Grey subsequently advised the new Governor of South Australia, Sir Henry Young that NSW had opted for a gauge of 5ft. 3in., and that having taken the advice of the UK's Railway Commissioners, he, Earl Grey, had concurred (Thompson 2004, p. 10). In October 1851, and in view of the failure of the private sector venture described above, the South Australian Legislative Council passed an Act which created a Board of Undertakers. The Board was authorised to design and build a steam powered railway between Adelaide and its port at a gauge of 5ft. 3in. A Select Committee reported on this construction on 10 November 1853 (SAPP Report No. 87 of 1853), and legislation was subsequently passed (Act 18 of 1853) which specified the gauge at 5ft. 3in.

Both South Australia's tramways and its early railways were built to a gauge of 5ft. 3in. This gauge was selected by the Legislative Council, rather than 4ft. 8½in., because weight was given to South Australia's proximity to Victoria rather than NSW. Sir Henry Young

was keen for a NSW/Victorian/South Australian transport system to develop. Coghlan (1969, p. 841) notes that “Sir Henry Young made a notable proposal for connecting Sydney, Melbourne and Adelaide by rail.” Subsequent correspondence was referred to a NSW Select Committee who took the view that the project “was too ambitious for the times, and was altogether beyond the pecuniary resources of the colonies if it were carried out. The three railway systems, therefore, were begun independently of each other” (Coghlan 1969, p. 841).

The South Australian adoption of a gauge of 5ft. 3in. seems to have occasioned hardly any debate. Indeed, as elaborated below, the issue of gauge in South Australia seemed always to have been much less contentious for legislators than the issue of railways vs roadways vs tramways (see for example Harcus 1876, p. 47). Notwithstanding, the first move towards adoption of 5ft. 3in. gauge in South Australia for *railways* (as distinct from *tramways*), was made by the Adelaide City & Port Railway Company. It was confirmed by the subject Select Committee. In its report, the Select Committee’s recommendation as to gauge reads simply:

As to the question of guage [*sic*], your Committee are of the opinion that the five feet three inch guage, recommended by the Railway Commissioners in England, as well as by Mr Babbage and Mr Hayes, should be adopted, as far preferable to the four feet eight and a half inch, or narrow guage.

Report – Adelaide City & Port Railway  
SAPP no. 87, 10 November 1853

It will be noted that the Railways Commissioners’ recommendation of 5ft. 3in., referred to above in the quotation from the Select Committee, was a recommendation derived from Irish railways rather than English railways. This discrepancy does not appear to have troubled the Committee. As implied above, Babbage’s evidence appears to have been given considerable weight by the Committee. His credentials were impressive. He had been engaged in railway engineering since 1835, first as a protégé of Isambard Kingdom Brunel on the Great Western Line and then on railways in Italy. At the time of his evidence to the Select Committee, he was employed as the engineer of the Adelaide City & Port Railway. Babbage’s written report to the Select Committee is a document important to the history of South Australia and of the gauge debate in Australia. This is because in a technical sense, its arguments are more comprehensive and specific than those of the

original case. It is therefore reproduced in Appendix 4. It will be evident that there was not a single point of agreement between Babbage and so much of Wallace's report to the Sydney Railway Company as had been made available to Babbage. Further, that the differences between Babbage and "narrow" gauge proponents, particularly in regard to construction costs (point 8 in Babbage's letter refers) are differences in professional judgment/opinion, not argument based on presented evidence. In any event, the legislature accepted the Select Committee's recommendation.

Another Select Committee had been constituted in May 1857 with a remit to "enquire and report whether in the general introduction of the railway system into this province in lieu of ordinary roads, it would be most expedient to adopt the locomotive system, or one adapted to animal power" (Report on Railways & Tramways, SAPP, no. 108, 1857). The Committee was further enjoined to report on the economics of converting the Adelaide-Gawler railway to animal power. The Committee's work was spread over three months. It put more than 2000 questions to 24 witnesses and recorded its proceedings in small print on 93 foolscap pages. It was not a trivial undertaking. It concluded:

The weight of evidence taken by your Committee is in favour of railways worked by steam power. There cannot be a doubt that such a system of railways affords the most perfect means of transit.

Your Committee are, however, strongly of opinion that railway formation should not be undertaken by the Government; but that, as the wants and circumstances of the Province shall justify their extension, private companies should be encouraged ... to construct ... approved Parliamentary lines of railway, of a uniform gauge ...

It is difficult if not impossible, to determine what point, as regards wealth of population, a country should arrive before the general adoption of a railway system; your Committee have no hesitation in recording their opinion that South Australia is not ripe for such a course.

Report – Railways & Tramways,  
SAPP, no. 108, 1857

It is not clear why the Committee was hesitant about adopting steam powered railways. After all, steam had been used in railways for thirty years. It had been employed in Melbourne and Sydney, both then of a size with Adelaide, for two years.

### *Development of the System*

None the less, South Australia too became engaged in the “the battle of the gauges”. The South Australian Government commissioned two major enquiries in the period 1865 – 1875. The first of these was a House of Assembly Select Committee charged with considering “*Railway Extension*”, that is, proposals for rail lines additional to those already laid down. This Committee was constituted of parliamentarians. It considered a range of issues other than rail gauge, but its deliberations about gauge indicated that more flexible thinking was abroad than previously. It considered what rail gauge might be adopted if a fresh start were available – and was favourably impressed by the credentials of 4ft. 8½in. It considered whether or not 4ft. 8½in. should be adopted from thenceforth, but decided against it on the grounds that the cost of converting/abandoning 5ft. 3in. rolling stock was excessive. Three of its final fourteen recommendations are of interest.

12. Considering the larger cost of altering the gauge of the present railways, your Committee are of the opinion that such alteration is not desirable, and that two gauges only should be adopted in the colony, viz.,
  - I. That of 5 feet 3 inches for the existing line as far as Kapunda.
  - II. A gauge 3 feet 6 inches for any further extension of this line, and for lines connected with Port Augusta and Port Wakefield. This gauge your Committee considers would be amply sufficient for the probable traffic, could be worked economically, and would effect a great saving in the cost of construction.
13. Your Committee are of the opinion that any line, properly and substantially constructed for horse traction, say with rails of from thirty-five pounds to forty pounds per yard, would be suitable for steam traction at a speed of from fifteen to twenty miles per hour, whenever such alteration of the motive power should be found desirable or warranted by increase in traffic.
14. Your Committee recommends that passenger traffic upon the existing lines should be separated as soon as possible from the goods traffic; that the goods trains should not travel at a higher speed than fifteen miles an hour, as the carriage of goods at a high rate of speed has already proved very destructive of the permanent way.

As intimated earlier, some South Australians had a much stronger preference for tramways over railways. They looked for ways to make the two systems compatible, to the point where quite impractical options, such as that in paragraph 14 above, were pursued. By 1875, half way through the century's second half, South Australia had 371 miles of tramways and railways. Tramways accounted for 71 miles of the total, the longer lines being Goolwa – Victor Harbour – Strathalbyn (32 miles), Kadina, Wallaroo and Moonta (privately-owned at 25 miles) and Port Broughton (14 miles). Of the 300 miles of railways, 293 were publicly-owned and the longest lines were spread around the State: Adelaide – Burra (124 miles), Lacepede Bay – Naracoorte (51 miles) and Port Wakefield – Wallaroo (34½ miles) (Boothby 1876, p 269). Note the non-radial structure of these lines. These systems had not been developed without controversy.

A detailed account of the competing interest of a variety of localities for local investment in railways is given in Hirst (1973 Chapter 2 – Public Works). There was considerable conflict in the State about where new lines should be located, and what priority should be allocated to their construction (Hirst 1973, p. 100). The first link that connected a narrow gauge component with the broad gauge main line was that between Hamley Bridge and Balaklava. The next was the connection of the broad gauge main line from Adelaide to the narrow gauge components running inland from Port Pirie to Port Augusta. This construction satisfied the needs of both pastoralists and farmers.

From the broad-gauge terminus at Terowrie, a narrow-gauge line was to run northwards to Quorn on the Port Augusta line and intersect the line from Port Pirie in the Youngaba district at which junction the railway town of Peterborough later developed. This gave the squatters what they had long hoped for: the means to shift stock quickly from the northern pastoral country to the Adelaide market, or to the better-watered country in the south in case of severe drought ... By 1878, the farmers were moving out into the land north of Terowrie, so the government planned the line to serve them as well as provide a connection between north and south. The narrow gauge line would take their wheat either to Port Pirie or to Port Augusta. So the needs of the squatters were harmonized with those of the local farmers.

Hirst 1973, pp. 101 - 2

In April 1867 Henry C Mais was appointed as South Australia's Engineer-in-Chief. It will be recalled that Mais had been Acting Engineer with the Sydney Railway Company, from which he had resigned in May 1852, when news of James Wallace's imminent arrival from

the UK had been announced. Hagarty (2002, p. 218), reports that Mais accepted the South Australian position on 9 April 1857, but this is perhaps a misprint. In the same article, Hagarty reports Mais having been employed in Melbourne at that date, and chronicles Mais' employment as a railway engineer in Melbourne up to the mid/late 1860s. By the time Mais had arrived in Adelaide, the South Australian Government was committed to constructing what it saw as a set of railways almost independent of the 5ft. 3in. system, (see reference below to the Report of the Commission on Railway Construction). While not a party to the decisions which led to breaking gauge in South Australia, Mais presided over the expansion of both the 5ft. 3in. and 3ft. 6in. lines in that colony over a period of twenty years. It is perhaps then not altogether strange that he should reply rather pragmatically to a question about the significance of breaks of gauge at the Victorian Select Committee on Narrow Gauge Railways in 1895 (see Chapter 5.3).

On 18 November 1874, the South Australian Government appointed another Commission to enquire into the subject of railway construction in the Colony. This Commission did not consist of elected members but consisted of, amongst others, the Colony's most senior public servants. They included Goyder, Surveyor-General; Mais, Engineer-in-Chief; and Hallett, Commissioner of the Central Board of Main Roads. The Commission sat for seven months, toured the State, heard 123 witnesses, and produced a report of more than 200 closely printed foolscap pages, plus voluminous appendices. It was one of the most thorough and extensive public enquiries into railway construction undertaken anywhere on this continent in the second half of the nineteenth century. Perhaps for this reason, and because a significant share of authorship lay with public servants who would have to live with the implementation of its recommendations, it set in place the ensuing structure of the South Australian railways system.

Its recommendations resulted in the South Australian Government abandoning the notion that macadamised roads could compete effectively with railways. It recommended reversal of previous policy supporting private ownership of railways in the Colony in favour of the state as constructor. It proposed perseverance with a two-gauge system. Some excerpts from the report which reinforce its significance are set out below.

1. As a preliminary basis for consideration, the Commission decided that the probable requirements of the country for railway accommodation



generally would include main trunk lines from Adelaide in the direction of the Blinman and Far North; Koorunga and the Barrier Ranges; the Murray; South-East and Victoria Border in the direction of Melbourne; and for local traffic lines to carry produce from the various agricultural, pastoral, and mineral districts, to the nearest available port of shipment, from whence colonial products might be shipped either to Port Adelaide, the neighboring Colonies, or to foreign ports, as the state of the markets rendered desirable ...

#### RATES DEPEND ON FIRST COST

9. If a line is intended to pay, the rate of charges depends, in a great measure, on the cost of first construction. Consideration of this point is, therefore, of the utmost importance, as every penny that is saved in the freight of produce to a market or port is in reality equivalent to an increased price received by the grower for his produce; so that economy in the construction of railways not only enhances the profit to producers, but also increases the value of the more remote lands, and enables the Government to construct additional lengths of line, and thereby to bring within their influence land that may then be profitably worked, and which, without such accommodation, it would not pay to cultivate.

#### CONSTRUCTION OF UNSUBSTANTIAL LINES TO BE AVOIDED

10. Whilst every care should be exercised to construct economical lines, equal care should be taken to avoid the construction of those of an unsubstantial or temporary nature, which entail increased cost of maintenance, if not speedy re-construction. The construction of unsubstantial lines is only justifiable in emergencies which are not likely to arise where lines are undertaken by the Government, as they are free from the competition of rivals, have no opposition from landholders, and can select such routes as are best adapted to drain the produce of the district to be accommodated.

#### GAUGE

11. The Commission observe that the Victorian Select Committee on Railways in 1871 state, in the fourth paragraph of their report, "It appears from the evidence submitted that a narrower gauge than the one adopted in Victoria (viz 5ft. 3in.) would be more economical, both in the construction of the permanent way and rolling stock; but as to the expediency of constructing any new lines on a narrower gauge, in view of the mileage already constructed on the present gauge, the value of the rolling stock now in use, and the inconvenience and risk which would result from a break of gauge, the balance of the evidence taken is opposed to any immediate change on main trunk lines." In South Australia lines have been constructed both on the 5ft. 3in. and 3ft. 6in. gauge. These lines are not, however, connected, but are distinct systems. South Australia is, therefore, not trammelled to the same extent as Victoria in the construction of new lines.

Report on *Railway Construction*  
SAPP, no. 22, 1875

Note here the repetition of the theme advanced in both NSW and Victoria, that the prime measure of railway economy is the first cost of construction of the system. Note too the view that South Australia's lines of different gauge were not expected to connect, a view which did not take long to prove invalid. By 1889, all but one of South Australia's lines were connected in a network of 1,420 miles (Hirst 1973, p. 95).

The scope of the Commission's enquiry was broader than might be inferred from the above report. Some consideration was given to the prospect of using gauges other than 3ft. 6in. and 5ft. 3in. In a letter to the Railway Commissioner of 14 June 1875, Mais reports on the weight of engines used on gauges of 1ft. 11½in., 3ft. 6in., 4ft. 8½in. and 5ft. 3in., and the implications of this, and target engine speeds, for number of locomotive wheels, and the weight of rails (see Mais to Chairman, Railway Commission, Appendix on Railway Routes and Construction, *ibid*, p. xxvi).

The Commission did not consider the option of converting all lines in SA to 5ft. 3in., or to 4ft. 8½in., but it *did* consider conversion of all 5ft. 3in. lines to 3ft. 6in. Mais commissioned Patterson, SA Railways Chief Assistant Engineer to study this issue. Patterson reported to Mais by his letter of 12 July 1875. In transmitting Patterson's reply to the Commission's Chairman, Mais said:

... I am of the opinion that the future gauge of the locomotive Railways of this province will depend entirely on the gauge to be adopted for a line to Victoria ... If it should be eventually determined to use the 3ft. 6in. gauge as the future gauge of the Province, it will be evident that, as the western system of railways is now being carried out upon that gauge, and as it is extremely probably that any extension of the same system will also be constructed on the same gauge, the reduction of the gauge of the present 5ft. 3in. lines to that of 3ft. 6in. will speedily follow.

There can, however, in my opinion, be no question as to the best course to recommend in case such reduction of gauge is determined, viz., to work up the existing rolling stock by continuing to run it on the present gauge, neither adding to it nor renewing it, but gradually to reduce the width of the line, and increase the stock on the 3ft. 6in. gauge until the whole system became uniform. I do not look upon a break of gauge at any up-country station as of so much importance as a terminus – such as that Port Adelaide – because before the inconvenience at an out-station could attain any serious dimensions, the work of reducing the gauge

would be completed. As a matter of fact, there is a break of gauge at every station on the line where goods are carted to it for transit.

Mais to Chairman  
op cit, p. xxvi

The SA system continued to develop. The extension to Kapunda was completed and opened in August 1860, and the line from Roseworthy to the main northern railway was gradually extended. It reached Burra Burra in 1870. They were both 5ft. 3in. lines. In the seventies a number of isolated 3ft. 6in. lines were built, connecting Port Augusta, Port Pirie, Port Wakefield, Kingston and Beachport with their respective hinterlands. Moreover, the main northern line was extended from Peterborough to Quorn by 1882, and then to Oodnadatta in January 1891.

The 3ft. 6in. line from Port Pirie was extended east through Peterborough and then north east to Cockburn, on the border between NSW and South Australia, thirty five miles from Broken Hill. This had been accomplished by 1887, the line of lode at Broken Hill having been discovered only four years earlier (Roberts 1995, p. 17). NSW would not build a railway to connect Broken Hill to either Cobar or Parkes, and refused to allow South Australia to build or operate in NSW territory. A group of business men formed the Silverton Tramway Company to build and operate a railway (not a tramway, in spite of the company's name) to a gauge of 3ft. 6in. from Broken Hill to Cockburn via Silverton (Roberts 1995, Chapters 2 and 3).

Whilst continuing in the employ of the South Australian Government, Mais carried out a design consultancy to the Silverton Tramway Company, using some of his staff. He charged the Silverton Tramway Company a fee for his services. His employer insisted that Mais hand the fees to the South Australian Government, and under something of a cloud, Mais' employment in South Australia was terminated (Hagarty 2002, p 219). He returned to employment as a consulting engineer in Melbourne. Mais presided over the expansion of both of the South Australian gauge systems. Not having been responsible for having introduced a mixed gauge system wherever he had worked, he was pragmatic about living and working with it (see his evidence referred to in Chapter 5.3).

The building of 3ft. 6in. lines and the creeping extension of the 5ft 3in. line meant that although conceived of as separate systems, the two gauges eventually met. Transshipment points to manage the breaks of gauge were established at Terowie, Hamley Bridge and Wolseley. The conversion from 3ft. 6in. to 5ft. 3in. of 200 miles of track between Hamley Bridge, Moonta and Gladstone eliminated the break of gauge at Hamley Bridge, but created a further one at Gladstone. This occurred in 1927, outside the timeframe of this thesis.

Three gauges are today operated in South Australia, the 4ft. 8½in. gauge as well as the 3ft. 6in. and 5ft. 3in. It is important to note that the 4ft. 8½ in. gauge was not introduced into that State until 1917, nor was it introduced at South Australia's initiative. It was introduced at the request of the new Commonwealth Railways organisation, brought into existence to fulfil the Federation promise of linking Kalgoorlie in Western Australia by rail to the eastern states' railway networks.

### ***Conclusions***

It is hard to escape the conclusion that South Australian nineteenth century rail gauge choices, all made by the Colony's government, were essentially derivative, and made on political rather than economic grounds. The original adoption of 4ft. 8½ in., the transition to 5ft. 3in., and the investment in 3ft. 6in. gauge were all decisions which do not appear to have been preceded by rational and objective economic analysis, but followed the lead of other governments. The 3ft. 6in. option, elected ostensibly because of the alleged economies in first cost of construction, was chosen fundamentally in an endeavour to increase the rate of regional economic development within the limits of available funds. Costs associated with breaks of gauge were rationalised by arguing that there was a low likelihood of 3ft. 6in. gauge lines connecting with those at 5ft. 3in., an argument of evident fallacy.

It also appears to be true that no disciplined study was conducted, or at least made public, of the relative costs and benefits of the mixed system with other options which include maintaining the system entirely at 5ft. 3in., substituting 4ft. 8½in. for 3ft. 6in. in the extended system and/or replacing 5ft. 3in. lines with lines at 4ft. 8½in. It is likely that if such comparisons had been made, it would have been both timely and appropriate for them to have been included in the work of the 1875 Commission referred to above. However

this Commission enquired briefly about the potential for very narrow gauge railways, but not into the options specified above. Hambley's work, which incorporated detailed archival research, did not uncover any work on these options (Hambley 1972). Hambley's study concluded:

Between 1856 and 1891 the criteria for railway investment changed in several ways. The role of the state in construction came to be accepted and indeed to be expected. The criteria for railway extension were gradually relaxed and with experience of running the South Australian railways expectations of profit were soon laid to rest.

Hambley 1972, p. 71

In any case, it was not always easy to measure railways' profit. In 1893 the South Australian legislature dispensed with its triumvirate Commissioners, and replaced them with a single person, in this case, Mr AG Pendleton. "Pendleton was a fine practical man but no match for Sir Richard Butler Snr., a parliamentarian, who tried to run the railways from Parliament House. Pendleton was apparently scrupulously honest, but the same could not be said of Sir Richard, who could make anything pay, provided no-one asked awkward questions ... Sir Richard Butler pointed out often to his critics that whether or not the SAR paid their way depended solely on how the books were kept" (Jennings 1980, pp. 20 – 1).

In short, South Australia was the only colony [apart from Victoria from the late 1890s] where a mixed gauge system operated. It had three breaks of gauge within its borders by the time of Federation. However, through running was possible from Adelaide to Melbourne even if not between Melbourne and Sydney.

## **5.5 QUEENSLAND**

### ***Introduction***

This section describes and analyses the reasons for Queensland's choice of a rail gauge of 3ft. 6in. Queensland's story is more straightforward than that of other colonies. Queensland came late to the status of colony, separation having been effected on 10 December 1859 (Carroll 1990, p. 2). It had a small population and a minute Treasury. But it also had pastoralists on the Darling Downs, it had politicians, and it had engineering firms, all of whom saw clearly that investment in railways was unavoidable in order to foster settlement and to develop the Colony's vast geography into a functioning economy.

Moreton Bay was settled as a penal colony and continued in this mode until 1842. It remained part of the Colony of NSW, and in 1856, the NSW government sent a party to survey thirty five miles of railway in each of the southern, western and northern sub-districts of what eventually became the Colony of Queensland. The results of those surveys were not made available to the Queensland government until late in the 1860s, although NSW billed Queensland for their cost upon separation (Kerr 1998, p. 3).

When Queensland separated from NSW, its total population was 28,000 (Carroll 1990, p. 2). Brisbane contained about 6,000. Ipswich was firmly settled (population 3,500) and saw itself as a competitor with Brisbane for the title of the State's prime commercial centre (Carroll 1990, p. 2). Situated on the Brisbane River, several kilometres from Moreton Bay, it saw itself as a port the hinterland of which was the Darling Downs, rich in wool production. Toowoomba and Warwick, both of the Darling Down, had populations of about 1,100 each. The bulk of the Colony's population was located in the south east corner. Wool, tallow and hides were the principal products: there was a workforce of about 4,300 in the pastoral industry with about 800 and 640 in agriculture and trade and commerce respectively (Carroll 1990, p.2). The revenue for the Colony for the year 1860 was no more than £178,589. The total value of exports was but £500,000 (Queensland Year Book 1901, p. 345). Note that as the first near-contemporary account of railways' history in Queensland, this source is particularly important.

Resources available to the new Colony were few. Writing to a friend on 6 June 1860, Sir George Bowen, the Colony's first Governor, said:

At the first start of all other Colonies, the Governor has been assisted by a nominee council of experienced officials, he has been supported by an armed force, and he has been authorised to draw at least at the beginning, on the Imperial Treasury for the expenses of the Public Service. But I was an autocrat, the sole source of authority here, without a single soldier, or without a single shilling ... I started with just 7 ½ d in the Treasury, but a thief supposing, I fancy, that I should have been furnished with some funds for the outfit – so to speak – of the new State, broke into the Treasury a few nights after my arrival, and carried off the 7 ½ d.

Bowen to Fortescue, 6 June 1860  
Quoted in Bernays 1919, p. 8

*The Ipswich – Toowoomba Tramway*

The first meeting of Queensland's legislative assembly was three months into its first session when it appointed a Select Committee to enquire into the subject of Internal Communication. Its focus was on main trunk roads. Railways were not mentioned, but tramways were considered in one context, and that context became the origin of Queensland's railways. Specifically, a civil engineer named William Coote informed the Committee that tramways could be built for between £600 and £1,000 per mile, that they could travel over grades up to 1:18, and that two horses could pull 1½ tons at five miles per hour (QYB 1901, p. 346). A government road surveyor estimated that a tramway could be built from Ipswich to the foot of the Great Dividing Range for £1,700 per mile, exclusive of bridges. The Colonial Architect estimated the cost of a tramway from Ipswich to Toowoomba at £1,760 per mile. In his view, ascent of the main range could be accomplished by means of stationary engines.

The private sector took the initiative in designing and building the first railway. Following receipt of authorisation by the Queensland Colony's government, the Moreton Bay Tramway Company issued a prospectus on 25 October 1860, seeking to raise capital of £150,000. These funds were to be applied to the construction of a "horse tramway" from Ipswich to Toowoomba at a gauge of between 4ft. 8½in. and 5ft., and at an estimated cost of £1,700 per mile. In 1861, the Moreton Bay Tramway Bill was brought before the Legislative Assembly, and referred to a Select Committee. In evidence before the Committee, one of the promoters of the company stated that shares to the value of £53,000 had been subscribed. Subscribers were required to pay a deposit of 2s. 6d. per share. A little more than £1,300 in cash had been raised through sale of shares, with four of the largest subscribers having "made special stipulations enabling them to cover their investment by selecting land which it was intended the company should secure from the State as a set-off against expenditure on the tramway" (QYB 1901, p. 348); presumably these "set-offs" account for the difference between the sum raised and what would have been raised if all deposits had been paid in cash (£6,625). The company had carried out a survey of the ground between Ipswich and Toowoomba, and produced plans and sections for the inspection of the Select Committee. A preferred line was chosen. The maximum grade was to be 1:25, and gauge was to be 4ft. 8½in. The Bill passed both houses and received royal assent on 12 August 1861 (QYB 1901, p. 348).

Early in 1861, the route of the proposed tramway was surveyed and in August, the Legislative Assembly considered a Bill to incorporate the Company (Cole 1945, p. 288). The Bill passed both houses. There was no debate about gauge, and the issue of connectivity with other colonies' systems was not raised. The company appointed Mr William Coote as general manager. Although it called tenders for the construction of 22 miles of tramway from Ipswich to the foot of the Little Liverpool Range, the company found it extremely difficult to raise capital locally. With a resident population of only 28,000, this is not hard to understand. Various manoeuvres were tried but the company became insolvent towards the end of 1862 (Cole 1945, p. 289). The Queensland Government acquired its assets.

The Premier, Mr Herbert, was an English-educated barrister who had come to Queensland as Private Secretary to the Governor, Sir George Bowen. Herbert visited the UK in late 1862/early 1863. This visit renewed his interest in railways, and convinced him that funds to build railways could be raised on the London equity market if the raisings were backed by a respected government (Cole 1945, p. 289). Upon his return, Herbert decided that the Queensland Government should construct the Colony's railways and borrow the funds necessary to do so.

The first Railway Bill, which would authorise the Government to construct and borrow, was brought before the Legislative Assembly on 19 May 1863 (Cole 1945, p. 291). By then, the Government had already received a proposal from a NSW engineering firm R & F Tooth & Company to the Queensland Government to build a light railway from Ipswich to Toowoomba (Carroll 1990, p.5). The Company entered into negotiations with the Government, and engaged the engineer Abraham Fitzgibbon to survey, design and construct the route. When put to the Assembly, the first Railway Bill passed only on the vote of the Speaker. Rather than proceed without the support of a significant majority, Herbert dissolved Parliament.

Fitzgibbon arrived in Brisbane two days after dissolution of the House of Assembly (Cole 1945, p. 292). Note that gauge had not yet become an issue – the dissolution of Parliament was caused not by disagreement about gauge but about Government's roles as a constructor and/or financier. Though Fitzgibbon's survey was not completed, he was engaged by



Government to prepare, as an input to further parliamentary debate, an estimate of the cost of lines from Ipswich to Toowoomba, and Toowoomba to Dalby and Warwick. Fitzgibbon's report was tabled in the Legislative Assembly on 9 July 1863 (Cole 1945, p. 292). It was this report which contained the first recommendation that Queensland adopt a railway gauge of 3ft. 6in., and the first parliamentary debate about it occurred following the re-introduction of the Railways Bill to the Legislative Assembly on 18 August 1863. The Bill passed by 14 votes to 11 and thus legislative approval was gained both for Government's role as owner and builder of railways and for adoption of the 3ft. 6in. gauge. A review of the argument/debate about this choice of gauge is set out below. Before entertaining it, it could be useful to examine Fitzgibbon's credentials.

Fitzgibbon was born in Ireland in 1823, and trained in surveying, architecture and engineering. At the time he arrived in Queensland, he was thus forty years old. He worked first as an assistant engineer, and then for five years as agent and manager for a contractor building railways in Ireland to the 5ft. 3in. gauge. In 1852, he went to the USA to examine a proposed railway route, and practised as an engineer there until 1857, when he went to work on the Ceylon Railway for two years. It may be noted that this railway of 5ft. 6in. gauge was built in mountainous terrain (see references to Molesworth's work in Ceylon in Chapters 5.3 and 5.4 above). In 1860-63, Fitzgibbon surveyed, designed and constructed a 3ft. gauge railway in New Zealand which climbed to 2,800 ft, with much 1:20 gradient, and which was sharply curved. This railway, 13.4 miles long, was horse-drawn. Fitzgibbon also recommended a 3ft. 6in. line for the Wairarapa region, and surveyed a 3ft. 6in. line in the Nelson area – neither were built (Knowles 1983, p. 113). Fitzgibbon presented his credentials in greater detail in evidence to the Legislative Council on the Railway Bill on 26 August 1863 (Q Pp 1863). Those credentials are more extensive than those of two witnesses who opposed his recommendations. They were Plews, Engineer of Roads for the Northern Division of the Colony of Queensland, and Coote, who had been employed by the Moreton Bay Tramway Company.

In his evidence, Fitzgibbon presented estimates of the comparative costs of building railways from Ipswich to Toowoomba, and from Toowoomba to Dalby and to Warwick at the 3ft. 6in. and 4ft. 8½in. gauges, together with estimates of operating costs for both gauges. There was considerable concern in the Council about the basis on which

Fitzgibbon's estimates had been formed. Fitzgibbon's starting point was the survey which had been carried out by the Moreton Bay Tramway Company, which was an *initial* survey, considered satisfactory for coarse estimates only. Fitzgibbon had detailed it to a point only 32 miles from Ipswich to the Little Liverpool Range, when negotiations between his employer and the Queensland Government collapsed (Cole 1945, p. 292). However he claimed to be familiar with the rest of the route and he had modified the route proposed by the Moreton Bay Tramway Company, which route would take the line over the range.

His case for Queensland's adoption of the 3ft. 6in. gauge was put in his report of 9 July as follows:

### **The Mode and Cost of Constructing the Railway**

18. Were it assumed that at the very outset a very large goods traffic should be provided for, I would at once recommend the construction of a Railway of a guage [*sic*] not less than 4 feet 8 ½ inches, similar to that in general use upon the English and American lines; which may be constructed, over an *ordinary* country, at a cost of ten to twelve thousand pounds per mile, inclusive of land, buildings, and rolling stock.
19. Believing, however, that perhaps for the next twenty years, only a comparatively moderate amount of traffic may be looked for, and that the object to be accomplished should be, while sufficiently providing therefore, as well as for a reasonable increase of it, to open up the country at the minimum of capital outlay, I have no hesitation in recommending in the present case the adoption of a Railway having a 3 feet 6 inch guage.
20. Whereas the locomotive engines in ordinary use upon the European and American Railways weight from twenty-two to thirty-six tons; the engines to be used upon the line I propose will weigh no more than eleven to twelve tons. The weight of engine being thus reduced, a rail of 30 lbs. to 35 lbs. per lineal yard will be sufficient, instead of 70 lbs. to 90 lbs. per yard; and the permanent way, bridges, and superstructure of the line generally, may be of a much lighter and less expensive character than would be admissible up a line of broader guage.
21. Again, whereas upon lines having a 4 feet 8 ½ inch, or wider guage, curves of less than ten chains radius cannot with prudence be used, except at stations; upon a line such as that I propose, curves of half that radius may be adopted with safety, thereby effecting an immense saving in works, wherever the course of the line is tortuous, through broken country, or along sidelong ground.

22. Locomotive engines, such as I propose to use, capable of passing round curves of five chains radius, will draw upon a level Railroad a gross load of 160 tons at a speed of fifteen to twenty miles an hour; a gross load of sixty-five tons up an incline of one foot in a hundred, and of thirty-five tons up an incline of one foot in forty.
23. On a 3 feet 6 inch gauge, goods and passenger carriages seven feet in width may be used, sufficiently commodious for every purpose, and they may be made of thirty feet or more in length, similar to those in use upon the American lines.

Fitzgibbon – Report upon Proposed  
Line of Railway from Ipswich to Dalby etc.  
Q Pp 1863

Sensing perhaps that he would be required to defend this case, Fitzgibbon prepared a written statement in support. He tendered this written statement in the evidence which he gave before the Bar of the Legislative Council on 26 August as follows:

1. It is laid down as an axiom by the most eminent engineers, that the weight of the locomotive engine intended to be used upon a railway, and the speed proposed to be maintained, governs the strength and cost of structure to carry it.
2. If it be admitted that the requirements of the traffic upon the proposed Railway from Ipswich to Toowoomba will be met, if we provide an engine capable of taking a gross load of 160 tons upon the level, and of 35 tons up the proposed incline of the Main Range, the former at a speed of twenty, and the latter at a speed of ten miles an hour; all we have to do is to ascertain the weight of such engine, and supply a permanent way and bridges, etc., sufficient for carrying it in safety at the speeds mentioned.
3. We have the authority of Mr Bridges Adams, Sir Charles Fox, the Messrs. Stephenson and Co, Messrs. Manning, Wardle, and Co, and numerous other first-class engineers and engine-makers, for stating that the weight of a locomotive engine, sufficient for the service stated, need not exceed twelve tons; and that to carry such an engine at twenty miles an hour, a 3 feet, or 3 feet 6 inches gauge railways is sufficient.
4. Moreover, we know that such railways are now being extensively laid down in India for the purpose of bringing cotton and other goods from the interior to ports of shipment – See *'Quarterly Review'* for April, 1863; and *'Illustrated News'*, May 23, 1863.
5. Referring to the subject of using engine power on narrow gauge railways, Mr Charles Burn, C.E., the able advocate of horse railroads,

says, in his pamphlet written in 1859: ‘We believe, however, that, under certain circumstances, and with a sufficiency of trade, the transport of goods could be advantageously propelled by locomotive steam power along road railways. The adoption, however, of locomotive steam power for this object will most probably come, when the advantages of road railways have been appreciated, and when the traffic upon them has become too great to use horses advantageously.’

6. The question of safety depends entirely on speed; and here it may be remarked, that a speed of twenty miles an hour is no more unsafe on a 3 feet 6 inches gauge, than is forty miles an hour on a 4 feet 8 ½ inches gauge, or sixty miles an hour on a 5 feet 6 inches gauge. ‘Experience has demonstrated the error of the opinion formerly held, that it was essential to safety, especially at high speeds, to keep the centre of gravity of a locomotive at a very low level – an opinion by which the designers of locomotives were much fettered when planning engines for high speeds on the narrow gauge, in which great boiler power had to be combined with large wheels. The locomotive engineers of the present time, being freed from that restraint, do not hesitate to place the weight of the engine as high as may be required for convenient arrangement of its parts.’ - *From Report by Messrs. McConnel and Rankine, M. Inst. C.E. Professor of Engineering Mechanics, University, Glasgow, upon Locomotive Engines in National Exhibition, 1862.*

Fitzgibbon, Q Pp 1863

Elaborating on construction cost estimates, Fitzgibbon compared and contrasted estimated costs for a 3ft. 6in. line in Queensland with actual costs drawn from Engineer Whitton’s Report of 1861 to the Secretary for Public Works in NSW in respect of each of one mile of permanent way, iron topped bridges, the savings of reducing minimum curve radii from 10 chains to 5, the cost of locomotives and sundry items. He concluded that “in fact the adoption of a 4 feet 8½ inches gauge would add not less than £251,000 to the present estimate of £617,000 for a 3 feet 6 inches gauge line from Ipswich to Toowoomba, being an increase of nearly 41 per cent.” He concluded his written statement by arguing that he estimated that it would cost 21% less per annum to operate the 3ft. 6in. line he proposed between Ipswich and Toowoomba than a 4ft. 8½in. line. It might be noted that Fitzgibbon was arguing explicitly not only for the narrow gauge, but also for a lighter standard of construction than in use elsewhere. Again, first cost of construction had become the prime measure of economic railways.

Fitzgibbon was then cross-questioned by Members of the Legislative Council about gauge, gradients, the radii of curves, the line of way and the weight of engines. The questioning was most direct in regard to gauge and became acrimonious, with the Hon. W Hobbs accusing Fitzgibbon at one stage of having misled the House. The following exchanges between Hobbs and Fitzgibbon hint at the heat generated by the debate.

<b>Hon W Hobbs</b>	<b>Abraham Fitzgibbon</b>
147 ... What gauge do you consider best adapted for this Colony?	3 feet 6 inches
148 Don't you think it would be desirable to have what is called a "standard gauge?"	I do Sir – and that standard should be 3 feet 6 inches, in my opinion, for this colony.
149 The proposed railway to Dalby is likely to be what is called a main trunk line?	I think it will be.
150 Would you recommend the Colony to adopt the 3 feet 6 inches gauge for the main lines of the Colony? ...	Yes, I do, decidedly; and I am quite sure it will answer all its requirements to the next hundred years.
175 In adopting the 3 feet 6 inches gauge, would not the colony be put to additional expense for rolling stock?	No, not at all
176 Those small engines would be, comparatively speaking, expensive, would they not?	No.
177 Are not small engines very difficult to keep in repair?	No.
178 Where are the cylinders placed in these small engines?	Outside – outside the frame
179 And, by being placed there, they increase the oscillation?	No.
180 I have read so?	You may have read so; but I have had experience.

This line of questioning implies that Hobbs, and perhaps his parliamentary colleagues, were prepared to rely on engineering opinion as a basis for their decision-making. They did not

challenge Fitzgibbon on the grounds of either theory or empirical evidence. In turn, Fitzgibbon seemed content to rely on stating his experience, without elaborating which parts of it were particularly relevant to the point in question. As has been seen, this practice was common in the other colonies.

On 3 September 1863, the Council returned the Bill to the Assembly without amendment, gauge not being mentioned in the Bill. The following day, it received Royal Assent without amendment, although the Council, while commending emphasis on economy, had advised the Assembly to seek further advice from English engineers. The Legislative Assembly rose on 22 September, and Sir Charles Fox, resident in London, and long associated with Fitzgibbon (Kerr 1998, p.6), was invited to become the Queensland Government's agent in the UK and its Consulting Engineer. Fox had consulted to the Norwegian Government since the early 1850s in respect of its standard gauge lines. He was well known to Carl Pihl, Engineer of the Norwegian State Railways. It was Pihl who instigated the construction of the first narrow gauge line in Norway, commissioned in 1862 (Hilton 1990, p. 7 and p.10; see also Fox 1886 – 7). Two days earlier, an order had been despatched to London for railway equipment (Knowles 1983, p. 118). Construction began, and the first section, twenty one miles in length, from Ipswich to Grandchester was opened for traffic on 31 July 1865, and the extension to Toowoomba opened on 1 May 1867.

Fitzgibbon was appointed Chief Engineer late in September 1863, on a contract to survey, produce specifications and supervise contractors, at the rate of £400 per mile of line laid. On 23 December of that year he was appointed Commissioner for Railways (Kerr 1998, p. 6). Construction work proceeded, and milestones were passed. The Ipswich – Toowoomba line was opened on 1 May 1867, and the Toowoomba – Dalby extension on 10 April 1868. Further, Rockhampton to Westwood was opened on 19 September 1867, and Townsville to Charters Towers on 4 December 1882.

Recitation of these milestones obscures the fact that railway building in the mid 1860s and 1870s in Queensland was a dramatic process. Fitzgibbon's cost estimates for the construction of the line from Ipswich to Toowoomba were found to be exceeded by almost 40% in practice (Carroll 1990, p. 8). This was a traumatic discovery, because it called into question not only the need to finance the contingency, but also the authority/judgment of

Fitzgibbon, those who supported his judgment and those who accepted his recommendation for a gauge of 3ft. 6in. There were disputes between Fitzgibbon and the contractor, Peto Brassey & Betts. Arbitration (supplied by Higinbotham, Chief Engineer of Victorian Railways – see Kerr 1995, p. 18) favoured the contractor (Daddow 1995, p. 325). Fitzgibbon left the railways and Queensland with his reputation under question. There was a world-wide recession in which one of the Queensland Government's banks went into receivership (Cole 1985, p. 304); Daddow 1975, p. 29). And finally, there was a drought, the breaking of which caused floods which did extensive damage to railway structures. The Queensland Year Book of 1901 reports:

When Mr Fitzgibbon's report was presented to Parliament the colony was in the throes of a terrible financial agony. A commercial crisis in Great Britain had broken a number of banks and brought numerous trading firms crashing to ruin. The Queensland Treasury was empty – a loan just before authorised was unflated. Advances in anticipation of its flotation, promised by the Agra and Masterman's Bank, were rendered unavailable by the fall of that institution. Peto, Brassey and Betts, the contractors, suspended payment, and their operations came to a standstill.

QYB 1901, p.354

These occurrences are reported more elaborately in Carroll (1990); Cole (1945); Daddow (1975); Kerr (1998); Knowles (1983), and McDonald (1950).

The brief account above of Queensland's rationale for adoption of the 3ft. 6in. gauge is remarkable for the almost complete lack of weight given to the costs/benefits of standardisation at 4ft. 8½in. The debate about the relative merits of 3ft. 6in. and 4ft. 8½in. is conducted to some extent in terms of costs. But costs were seen largely to flow from engineering decisions, and it was on the engineering decisions that most of the debate focussed. What makes this remarkable is that by 1863, the "battle of the gauges" had become conducted in a global setting – the UK's Gauge Act was already seventeen years old – and the costs and inconvenience of managing breaks of gauge were widely seen as something to be avoided – see for example the Gauge Act and the railway literature from North America. Commentaries about contemporary views and policies in respect of break of gauge in North American railroads make this explicit. It carries special weight for those involved in railroading during the Civil War – refer to Chapter 4.4 above, and to Stover

(1997, Chapters 5 – 7); Taylor & Neu (1956, Parts IV – VII); and Vance (1995, Chapters 2 and 3) for further information on this point.

Yet government policy in respect of railways had emerged; it was based entirely on the Colony's autonomy, and excluded any concept of gauge uniformity with the other colonies.

The essence of the government's railway policy was to use railways to open up the interior of the new colony in the absence or inability of private enterprise to provide such communication. State railways were to be restricted to main trunk lines, to commence from the heads of navigation so as to avoid competition with river transport, to be restricted to those lines likely to be "reproductive" and to be concerned primarily with the carriage of goods rather than people.

Carroll 1990, p.5

Kerr claims that "Residents of the colony were not well-informed on recent overseas developments" (Kerr 1995, p. 5). This may have been so, but appears unlikely because the most comprehensive reports of the day, the Proceedings of the Legislative Assembly and Council, were public documents and other reports, such as Fitzgibbon's, were also published (Kerr 1995, p. 5). For example, the evidence presented to Legislative Council's enquiry into a Proposed Line of Railway between Ipswich and the Downs (V&P LC Q 1863) contains numerous references to recent issues/policies/practices in NSW, South Australia and international locations, including Ceylon, India, New Zealand, the UK and the USA. Augustus Gregory, Queensland's Surveyor-General referred to having "examined the [Sydney] railway. I was several months out examining the railway there. And I had also, an opportunity of examining one in South Australia ..." (Evidence ... Proposed Line of Railway Between Ipswich and the Down, Q Pp 26 August 1863), and Fitzgibbon referred to railway engineering design standards and practices as he had observed them in Ceylon, New Zealand, UK and the USA (op cit 26 August 1863).

Cole noted that "it would be erroneous to conclude that the desirability of providing a gauge uniform with that in other Australian States was totally ignored or overlooked" (Cole 1945, p. 297) and that "The adoption of a similar gauge in Queensland was favoured by many colonists" (Cole 1945, p. 294). Cole's evidence for the former statement is not strong. He claims that "Mr William Coote pointed out that in the event of the narrow gauge being adopted, any junction made with the railways of NSW in the future would necessitate



the laying down of a new line and the relegation of rolling stock to feeder lines” (Cole 1945, p. 297). Coote certainly made comments to this effect, but before the Council rather than the Assembly (see Q Pp, August 1863). Whether they were ignored or overlooked is not known. What *is* known is that Coote’s evidence in respect of gauge preference is incorporated in the response to 6 questions out of total of 115 which he was asked on 27 August, and that no member of the house sought to pursue the issue of compatibility with the NSW rail gauge. Cole concludes “But the question of cost outweighed all other considerations and the desirability of adopting a 4ft. 8½in. gauge merely for the sake of interstate communication was never seriously considered” (Cole 1945, p. 298). This seems a more accurate reflection of the criteria actually used.

The commentary provided in the QYB of 1901 is instructive. By now (1901), it was possible to travel from Brisbane to Adelaide by rail, with breaks of gauge at Wallangara and Albury/Wodonga.

What was sought to be achieved in Queensland was the substitution for highways, which themselves had to be made, of some system of railroads permitting of the employment of locomotive engines to draw trains of carriages and wagons at some approach to speed, and without interruption by weather condition or consideration of day or nights. It was urged at the outset, and is acknowledged now, that many miles of railroad permitting of a speed of 30 miles per hour, and of loads of say, a couple of hundred tons, would be better value for a given outlay than fewer miles of railway allowing of a speed of 50 miles per hour and loads of, say, 400 tons.

On the whole, therefore, it may be affirmed that the choice of the 3-foot 6-inch gauge for the first Queensland railway, and subsequent adherence to that system of construction, have proved eminently satisfactory, and if no extraneous influences came into operation would probably be continued for generations to come; until, in fact, quite different conditions relating to density of population and amount of internal trade should have come into existence.

QYB 1901, pp. 351 - 2

The QYB goes on to refer to the recent visit by British Major General Edwards, and his recommendations for gauge uniformity to promote defence preparedness, and forecast discussions with other colonies on this issue. This quotation suggests that in 1901, as in 1863, Queensland did not find it easy to focus on issues outside its boundaries.

Queensland's choice of a 3ft. 6in. gauge for its railways was very deliberate. It was strongly influenced by the rhetoric of the railway engineer, Abraham Fitzgibbon. As Cole put it:

He came as the apostle of the 3ft. 6in. gauge, and by his strong advocacy persuaded the legislature that the formidable main range could be successfully subjugated by such a railway. It was the extremely difficult topographical features of this tract of country which led to a prevalent belief that even if it were possible to build a railway over it, the cost would be prohibitive. For this very reason, the Government hesitated to incur the expenditure which the comparatively easy grading and curvature of a 4ft. 8½in. railway would involve. Abraham Fitzgibbon showed the way out of the difficulty.

Cole 1945, p. 294

It is certainly true that Fitzgibbon espoused the 3ft. 6in. cause, and that Government saw his proposal as a least cost solution. It is also true that so preoccupied was the Government with cost that it paid little if any heed to assessing the benefits and costs of inter-colonial collaboration. It seems that it was enjoying the autonomy which followed separation. It can however be argued that Cole's explanation of Government's concern for the costs of 4ft. 8½in. may be misplaced. After all, it did not object to the Moreton Bay Tramway Company's determination to build at 4ft. 8½in. (though with risk capital rather than government funds), nor did it seek to exclude building at any gauge other than 3ft. 6in. from legislation enabling railways. It is also true that the evidence put to the legislature for building a 3ft. 6in. gauge railway was equivocal.

### ***Railway Development***

Notwithstanding a deliberate and conscious choice of the lowest first cost of construction method available to it, the Queensland Government was still very concerned about the economics of railways and how to afford them. By the end of the 1860s, 207 miles of new line had been opened, but only 12 miles of new lines were opened in 1870 – 1873. More seriously, and more fundamentally, policy in respect of railways was under considerable pressure from both regional and local power centres. As to the latter, and consistent with Government's treatment of railways as an economic development tool, local members were vocal in their demands for local railways. Further, Queensland's central and northern regional populations were beginning to argue that their resources (tax revenues etc.) should

not be used to benefit only those in the south east corner. A petition was presented in the Queensland Legislative Assembly which, in part, read as follows:

The humble Petition of the undersigned landed proprietors, pastoral tenants of the Crown, merchants, storekeepers and others resident in the town of Rockhampton, and in the districts adjoining ... are of the opinion that to make these Northern Districts and the revenue derivable from them liable to the imposts which must follow on the contraction of any loan, would, in the present unrepresented state of these districts be an extreme instance of that which Englishmen have ever been taught constitutionally to resist – namely taxation without representation.

Q Pp 28 July 1863

The petitioners demanded representation in the House, or inclusion in a new Railways Bill of authorisation to extend the Rockhampton line to Emerald, which in their view would be at least as remunerative as the Toowoomba – Dalby extension. This is a reappearance of the forces which drove the separation of Victoria from NSW. It was recognised as such by the politicians in Brisbane (Carroll 1990, p. 8). The Queensland Government's agreement to build a railway from Rockhampton to Westwood (33 miles) when Rockhampton's population was a mere 5,000 is testament to its view that a petition to separate the northern part of the Colony was a genuine threat to the integrity of the Colony, and owed nothing to the search for an adequate return on funds invested.

The financial performance of the Rockhampton – Westwood line was not encouraging. The Northern line's Traffic Manager was given notice in May 1868 because he had not attracted traffic enough for the railways' revenue to cover his own salary. In F1869, income amounted to only 65% of expenditure. Despite the retrenchment of the Traffic Manager and others, the line still required twenty staff to operate and administer it, and another twenty three to maintain it (Kerr 1998, p. 26). It can readily be seen why a penurious Government might be hesitant about spending further money on railways, and why it would search assiduously for ways to make savings. Even so, it does not seem to have become apparent that not building a line in the first place would save much more money than could be saved in either construction costs or operating costs – or if it were apparent, it was also clear that there could be a political price to pay which the decision-makers were not prepared to risk.

In August 1872, the Queensland Parliament authorised significant extensions to both the southern and northern lines. The southern extension was to connect Ipswich to Brisbane. The northern was to extend the line starting at Rockhampton from Westwood to Lurline, at the junction of the Comet and Mackenzie Rivers. This legislation followed receipt of recommendations from a Royal Commission. This Royal Commission's recommendations included one that the northern line from Westwood be constructed at a gauge of 2ft. 9in. As Kerr reports,

... its members also decided to investigate the question of gauge, and concluded that money could be saved by reducing the gauge in the north from three feet six (1067 mm) to two feet nine (838 mm). Given the cost of altering the existing track and rolling stock for such a modest saving, and the inevitable problems of break of gauge when south and north were eventually connected, the recommendation was stupid. It was ignored.

Kerr 1998, p. 29

There appears to be some dissension about Kerr's comment "It was ignored." Another writer states, in relation to adoption of 2ft. 9in., "but unfortunately, the residents of Rockhampton refused to accept the proposal and by threatening separation succeeded in retaining the 3ft. 6in. gauge" (Cole 1945, p. 309).

The Royal Commission's report is an important document because of what it tells us about how the politicians and engineers of the day conceptualised the gauge issue in relation to railway costs. Accordingly, relevant aspects of this Royal Commission's report are reviewed here. The Commission consisted of three members of Queensland's Legislative Assembly. They met on twelve occasions over three and a half months (31 Jan to 16 April 1872), called eighteen witnesses, and reported twenty submissions. Kerr (1988, p. 29) notes that it was appointed "to investigate the entire question of Railway Extension." In fact, its remit was even broader. Its job was "to inquire into, and report upon, the construction of Railways in the colony, including the northern and southern extensions, as well as other lines, and the whole subject of railway construction ..." (Q Pp 1872). This qualification is important, because Kerr's report (quoted above) implies that the Commissioners' examination of the gauge issue was decided at their discretion. The quotation above makes it quite clear that they would have been remiss if they had not done so. At its first meeting, the Commission resolved to seek "printed reports and returns as may show what has already been done, and what is contemplated in railway construction",

in each of NSW, Victoria, South Australia, Tasmania, New Zealand, Ceylon, Canada and the United States. In the end, inputs from inter-colonial and international sources were few except for input from India.

The contributions from India appear to have been very influential. Perhaps this is because they dwelt upon the possible introduction of a narrow gauge railway in a context where significant main trunk line mileage had been laid at the broad gauge (it will be recalled that the Indian standard gauge was 5ft. 6in.). The Secretary of State for India appointed a Committee of four in 1870 “to consider the precise gauge and general character suitable for an average narrow gauge line of railway in India ...” Two were military engineers, and two were civilian. One of the civilian engineers, Mr J Fowler, presented a minority report. The majority took the view that since the efficacy of 3ft. 6in. had already been established (albeit recently), the reference to “narrow” gauge in its brief required it to examine even narrower gauges. The Committee’s report stated that:

... there can, therefore, be no doubt that thoroughly successful railway may be constructed on a gauge of 3 feet 6 inches. But the question, after all, is whether 3 feet 6 inches is a minimum gauge which will answer the purposes of the projected Indian extensions, or whether some gauge intermediate between those of Festiniog (1ft 11 ½in.) and Norwegian Lines (3ft. 6 in) will suffice.

The conclusion we have arrived at upon careful consideration of the whole question is, that a gauge of 3 feet 6 inches is unnecessarily wide for the proposed narrow gauge lines in India ...

Our conviction is, that the gauge for such lines need not exceed 2 feet 9 inches. We have satisfied ourselves that engines of sufficient power may be put on this gauge to draw at a sufficient speed the largest traffic which the lines for which a narrow gauge is suitable are likely to carry; that vehicles may be used on this gauge which will afford complete accommodation for all classes of passengers and goods traffic; and that this range presents no reasonable objection on the ground of risk, whether from wind, oscillation, or other causes or of discomfort to the economical and convenient transport, at a sufficient speed, of both passengers and goods.

Q Pp Appendix A, 1872

This is the origin of the 2ft. 9in. gauge selected for review by Queensland’s Royal Commission. As can be seen, its choice by both the Committee in India and the Royal

Commission is essentially pragmatic, if not arbitrary. We do not know whether the same claims could have been made for gauges of, say, 2ft. 8in. or 2ft. 10in.

Fowler's minority report saw things differently. Unusually for commentators of the time, he produces something akin to a theoretical underpinning for his cost estimates:

The chief causes of difference of cost in railways are really as follows:

- 1<sup>st</sup> Heavy works to obtain superior gradients to enable the same power to take greater loads.
- 2<sup>nd</sup> Heavy works to obtain curves of large radius for high speeds.
- 3<sup>rd</sup> Heavy rails, fastenings and sleepers.
- 4<sup>th</sup> Greater dimensions of formation, ballast, drainage etc.
- 5<sup>th</sup> Greater strengths of bridges for greater weight and speed.
- 6<sup>th</sup> Works for accommodating large traffic at stations.

These and similar works, and not gauge, cause the vast differences of cost between a railway for the accommodation of heavy and rapid traffic, and one to suit the requirements of light and slow traffic; and though the causes above enumerated may possibly even quadruple the total cost of a railway, it will be seen that they are only very slightly influenced by gauge.

As far as possible, no doubt, the gauge should bear over exact relation to the extent and nature of the work to be done; and (except for the purpose of avoiding a break of gauge) it would be absurd to adopt a wide gauge for light traffic, or a narrow gauge for heavy traffic. I believe, however, it may be taken as a result of experience down to the present time, that no traffic has been found to be so heavy, or to require so high a rate of speed, that it could not be as well and cheaply conducted on a 4 feet 8 ½ inches as on any wider gauge; and, on the other hand, that no traffic worthy of a locomotive railway of any description so light that it cannot be as well and as cheaply conducted on a 3 feet 6 inches line as on any narrower gauge.

... I cannot hesitate to advise that in all cases where circumstances justify the introduction of a second gauge in India, a width of 3 feet 6 inches be adopted in the clear ground that it is not greater in first cost of works and rolling stock than a gauge of 2 feet 9 inches, and is greatly superior in carrying capacity, convenience and economical working.

Q Pp Appendix A 1872

The Queensland Royal Commissioners were swayed by the Indian Committee's majority view, and recommended adoption of 2ft. 9in. for the northern line west of Westwood. In the case of India the Secretary of State for India was not convinced of the merits of the argument for 2ft. 9in. – nor did opting for 3ft. 6in. give him the outcome which he wanted.

He opted for 3ft. 3in. (in practice, 1 m.), a gauge which his Committee had not considered at all. A final note to this story reflects that the Indian Committee's majority held that there would be few breaks of gauge in India, and that transshipment costs would be negligible. Fowler was more cautious.

I need scarcely remark that the introduction of a second gauge in a country which already possesses a great length of railway is a step of much responsibility. The evils of a break or difference in gauge are well known in England, America, Sweden and elsewhere; but notwithstanding this, there are many countries where the introduction of cheap railways on an exceptional gauge has become a necessity to avoid the much greater evil of having no railway at all.

Q Pp, 1872

The Queensland Government's policy in developing railways was driven from the earliest days (1863) by railways' participation in the "tripartite" policy. Railway construction, immigration and settlement were the three initiatives to be proceeded with simultaneously, and each process was to support and be the complement of the other (QYB 1901, p. 356). The lands made accessible by railway development were to be populated by immigrants and early colonists. They would be provided with jobs and wages by employment in railway construction and operation. The settlers would provide passenger and goods traffic to yield revenue which would make the railways pay. This policy persisted to the end of the century even though its implementation fell far short of its expectation. This result was obtained largely due to pastoralists' opposition to the policy, and the action they took to augment their own holdings by acquiring lands granted to new settlers. But it also failed in part because even though five legislative initiatives were taken between 1860 and 1890 to procure private sector participation in railway construction and operation, they all, with one exception, failed. That exception is the Chillagoe railway from Mareeba to Mungana, which opened in 1901 (Kerr 1995, p.98).

This example of success led the Philp Administration in to introduce five bills each authorising private railways for the carriage of mineral products. These bills were vigorously opposed by the Labor Party, then a newly emerging political power. Its policies included the state ownership of infrastructure. To ease acceptance of the bills, in three of the five cases proposed, the railways were formally styled tramways – although each bill incorporated permission to use steam locomotives. In two of the five cases, a minimum

gauge of 2ft. was permitted, and in one case, a qualification was added giving the Commissioner for Railways discretion as to choice of gauge. For the third, the nominated gauge was 3ft. 6in. In the final two cases, the “tramways” were officially designated “railways” and the gauges specified at 2ft. and 3ft. 6in. respectively. It appears that although four of these five bills were passed into law, none of the tramways/railways which they authorised were in fact built (QYB 1901, p. 365).

Queensland’s railway system had grown to more than 4,500 kilometres by the turn of the century (Kerr 1995, p. 94). It operated in eight regional sub-systems. The southern system, centred on Brisbane, accounted for more than half the total. The sub-system based on Rockhampton was the second largest, and the units around Mackay, Bowen, Cairns, Cooktown and Normanton together accounted for under 500 kilometres. The mobile assets consisted of 335 locomotives, 388 carriages, 105 brake vans and 6,036 wagons (Kerr 1995, p. 94). Work continued to extend and connect the system’s components. Brisbane did not become connected to Cairns until December 1924 (Kerr 1995, p. 130).

Survey of a route for a railway south from Warwick to Stanthorpe began shortly after the discovery of tin in commercial quantities at Stanthorpe in 1872 (Kerr 1995, p. 40). After debate about an extension in the Legislature in 1876, parliamentary approval for an extension in two sections, which would meet the NSW 4ft. 8½in. gauge, was achieved in 1877 and 1884. According to Kerr,

The neighbouring colony saw no point in the gauges meeting in the wilderness and proposed Tenterfield instead. Brisbane businessmen welcomed the idea of access to a new market, but the Queensland Government wanted its railway expenditure confined to its own voters. Thus the unnecessary township of Wallangarra was created – named Jennings on the New South Wales side.

Kerr 1995, p.40

The inaugural Sydney Mail via Wallangarra ran on 16 January 1888, and with it, the option of travelling from Brisbane to Adelaide by train became available, albeit with changes of train at Wallangarra and Albury.

### ***Conclusions***

Queensland’s choice of a 3ft. 6in. gauge at a time when NSW and Victoria had committed to 4ft. 8½in. and 5ft. 3in. was both radical and purposive. It was radical because there was



so little precedent for a main line railway at this gauge, anywhere on the globe, and because standardisation at 4ft. 8½in. had been committed to in the United States. It was purposive because its early political leaders saw with stark clarity that railways would be a prime tool for opening up the economy of a colony which was fifty to sixty years behind its two main rivals in its ability to compete for capital. As the Queensland Government saw it, it had absolutely no choice but to adopt a design base which could give it the maximum mileage laid to railway at minimal capital expense. This factor drove not only adoption of a gauge of 3ft. 6in., but also standards of construction which were minimal, and well below those adopted in NSW and Victoria. The potential value of seamless connection with the NSW railway system was considered near to nil.

The only move for further diversification of rail gauge in Queensland in the period in question was the proposal for the use of 2ft. 9in. west of Rockhampton, put early in the 1870s. The fact that such a proposal was put underscores the fact that the railway in Queensland was at the centre of political attention in Queensland from birth. The concern to absolutely minimise first cost of construction overrode any other concern, except the need to win votes. This need was more powerful than the need for adequate returns on investment, and a number of unprofitable lines resulted (Carroll 1990, pp. 17, 24, 34).

These powerful structural factors were so overriding that the most “economic” solution to investment in railways was always that which minimised first cost of construction. Few knew or cared that low standards of construction could later mean disproportionately large running and maintenance costs. The only way to produce even more “economical” railways was not to build them at all – after all, the marginal cost of not building a railway extension was zero. This solution was not palatable politically, and as a result, many miles of railway were laid in Queensland which might not have been laid if there had been the economic methodology available to demonstrate their lack of value, and the political will to act accordingly.

## 6. SYNTHESIS

The purpose of this chapter is to review rail gauge decision-making processes and mileposts in the Australian colonies in an international context. The rail systems of Brazil, India and the USA are the principal points of reference for international practice. Its starting point is the 1848 admonition of Earl Grey, Britain's Secretary of State for the Colonies and for War to colonial governors to standardise the gauge of railways at 4ft. 8½in. (see Appendix 3). The first railways in the Australian colonies began operation in Victoria (5ft. 3in. gauge) and NSW (4ft. 8½in. gauge) in the middle of the 1850s. At this time, a global "battle of the gauges" was being fought between the relative merits of the "broad" gauge (5ft. 3in.+ ) and the "narrow" gauge, then 4ft. 8½in. India was in the process of electing 5ft. 6in. The railways shortly to be built in Argentina and Brazil opted for 5ft. 6in. and 5ft. 3in. respectively. In the USA, a variety of gauges were deployed when railways were established in the 1830s, and had multiplied. The variety of gauges in use in the USA proliferated around the gauge of 4ft. 8½in., and to a lesser extent, the broad gauges (Puffert 1991, p. 197).

In none of the countries mentioned is there any evidence that the choice of gauge was based on economic evaluation. India's choice of 5ft. 6in. was made by the Governor General himself on the functional grounds of greater stability, speed and safety. Government in Brazil was not involved in gauge decisions at establishment. The choice followed the personal preference of the British engineers engaged to design and build railways (da Silva Telles, 1989, p. 6). In the USA, railways were initially regarded as local facilities connecting with existing facilities such as canals or rivers. Governments, national or state, were not involved in gauge choice. Gauge choice was a function of local corporate preference, and occasionally of the desire to create and preserve a monopoly by choosing a distinctive gauge (Brown 1952, pp. 82 - 3).

In Brazil, Britain, India, the USA and the Australian colonies, the earliest railway ventures were undertaken by private sector corporations. In the Australian colonies, all such corporations failed, with a single exception in each of NSW and Victoria. The assets of the failures and the operation of those assets were taken over by government. In India and Brazil, railways were built and operated within the framework of a "concession" granted by

government. These concessions often included an undertaking by government to subsidise the interest rate on equity capital borrowed to build the railway in question.

By 1860, it had become apparent that railways, whether directly owned by government, or subsidised by government guarantee, were incurring costs at a level causing concern to governments everywhere. In the USA, concern for costs did not manifest itself directly in government concern, but in concerns by customers. Pressure from them caused railways to continually search for ways to reduce costs (see Chapter 4.4). A major strategy for railways in response was to seek ways to improve “through running”, that is the unimpeded passage of freight over lines of different gauge owned by different companies (Taylor & Neu 1956, p. 63).

The response elsewhere was to seek to reduce costs by reducing the gauge at which future railways were built, and/or to build future railways at lower engineering standards. A number of observers had noted the success of the Festiniog railway in Wales. This catalysed a focus on the relative merits of narrow gauges, including gauges not necessarily as narrow as those of Festiniog (1ft. 11½in.). Hence, the early 1860s debate about the “battle of the gauges” shifted to one about the relative merits of the (now) “standard” gauge of 4ft. 8½in. and narrower gauges.

This new focus of the debate coincided with the establishment of railways in what had become, in 1859, the colony of Queensland. Its government explicitly adopted a narrow gauge of 3ft. 6in., although there was no precedent anywhere for this gauge on such a scale as contemplated in Queensland. In 1863 the national government of Brazil decided that all future concessions would be devoted to narrow gauge railways (Wiener 1913, p. 56). Thus it ceased to fund the construction of railways at the original gauge of 5ft. 3in. in favour of railways of around 1 m. gauge. In India at the same time, a new Governor General directed the design and construction of a new railway system at 1 m. gauge, which was not to compete with the existing 5ft. 6in. gauge line. Lord Mayo’s comment (see Chapter 4.3) suggests that the debate about gauge came to be undertaken in simplistic terms. It was also simplistic to assume, as many did, that construction and operating costs would vary directly in proportion to gauge. It was simplistic to assume, as many did, that cost of first construction could serve as a measure of value for money spent on railways.

Australia was not immune from such simplistic thinking. Debates about the relative merits of the narrow gauge took place in all of the eastern colonies (see Chapter 5). Their progress may be followed in the parliamentary debates and enquiries of each of the colonies. In the first instance only South Australia introduced a second gauge. It decided late in the 1860s to build a supposedly separate set of lines designed chiefly to serve the agricultural ports on its southern and western coasts. Queensland, NSW and Victoria all held parliamentary enquiries at about this time. Queensland's Committee of Enquiry unsuccessfully recommended building a main trunk line railway west of Rockhampton at a gauge of 2ft. 9in., but NSW and Victoria recommended against the introduction of narrow gauge railways, and no narrow gauge railways were built in either colony at that time.

At the same time, the US railroad industry was responding to concerns about costs by moving to "through running" solutions, and increasingly, standardisation at 4ft. 8½in. The difficulties in shifting both men and materiel North-South during the Civil War had heightened concern about gauge proliferation (Taylor & Neu 1956, p. 55). Further, in 1863, the US Congress decided that transcontinental railroads would be built at 4ft. 8½in. Relying first on compromise solutions such as third rails or sliding axles, the USA had become standardised at 4ft. 8½in./4ft. 9in. by 1886. This occurred notwithstanding a debate about the relative merits of narrow gauge which occurred some years later than in Europe, India or Australia. That debate was itself spurred by the decision to build the Denver and Rio Grande Railway at a gauge of 3ft. By 1878, there were almost 3,000 miles of 3ft. gauge track in the USA, and by 1880, 5,200. But this figure had peaked, and almost a third of the 3ft. gauge tracked was compatible with the standard gauge in some form – either new track had been overlaid or a third rail inserted (Taylor & Neu 1956, Chapter 7).

In Brazil by contrast, gauges proliferated around the 1 m. gauge standard, so that by 1880, 13 narrow gauges were in use, ranging from 0.6 m. to 1.4 m. (Randall 1977, p. 127; Wiener 1913, p. 54). However, that proliferation had reversed by 1889, at which time there were 7,585 km. of 1 m. gauge track, and only 653 km. of other narrow gauge. There remained 1,345 km. of broad gauge track (Randall 1977, p. 144). Extreme proliferation and near-standardisation had both occurred in the space of only 25 years, and at about the same time as standardisation had been effectively achieved in the US.

India's two gauge system continued until the end of the nineteenth century (and beyond). By the mid 1880s, as in South Australia at about the same time, the objective of keeping the two systems separate was found to be unachievable in practice. In India however, the "battle of the gauges" had turned to debate about if and how best to convert metre gauge to broad gauge railways. This debate entailed the use of an early form of cost-benefit analysis on a significant scale – see Upcott (1903) and Royal-Dawson (1921). A disciplined comparison of the costs, if not the benefits, of different gauges had appeared in a report prepared by Victorian railways Engineer-in-Chief for the Secretary for Railways (V&P LA V 1871). This, together with substantial evidence gathered from overseas, seems to have persuaded the Victorian government of the time not to invest in the introduction of a narrow gauge railway in Victoria. Even so, the Victorian Government created a Standing Committee on Railways in which both houses of parliament were represented, and this Committee instigated an enquiry into narrow gauge railways in 1895. This is well after the narrow gauge was rejected in other regions of the world, except for the geography-specific hill railways of India (Upcott 1903, p. 198). Disregarding professional advice and overseas practice, the Victorian Government introduced railways at 2ft. 6in. gauge in 1899. Their construction continued until 1911. They were abandoned, except for one resuscitated as a tourism venture (Harrigan 1962, p. 97).

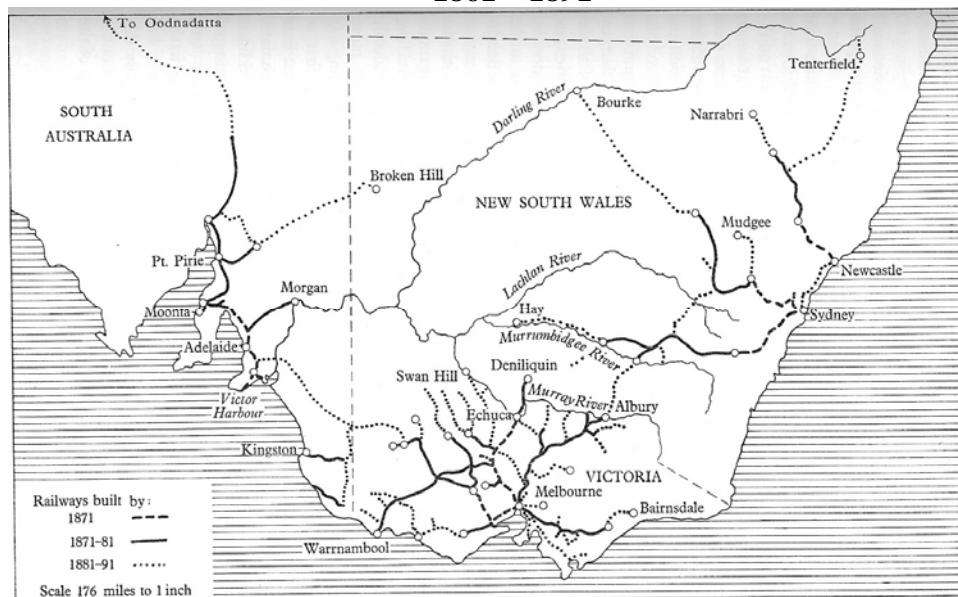
Thus, at Federation, Australia had four rail gauges in use by its state government-owned railways: Queensland used the 3ft. 6in. gauge, NSW 4ft. 8½in., Victoria 5ft. 3in. and 2ft. 6in., and South Australia used 5ft. 3in. and 3ft. 6in. Victoria's 2ft. 6in. gauge track of less than one hundred and fifty miles may be disregarded, as with India's hill railways and the remnants of Brazil's narrow gauge proliferation. These aside, Australia used three main line gauges, whilst Brazil and India each used two. The UK and the US had standardised at 4ft. 8½in. Australia had arrived at its three gauge outcome without experiencing the considerable proliferation in rail gauge choice experienced in Brazil and the USA.

It was and is not possible however to speak of an Australian railway system prior to Federation. There was no *Australian* railway system as such, because there had been no Australia. The new national "system" could not be described as being anything other than a collection of independently derived systems, designed with interconnectivity considered as a low priority issue, if considered at all. Nonetheless, 10,566 miles of railway track had

been laid in the eastern mainland colonies by 1900. The peak period for railway construction in all colonies was the twenty-year period starting in 1870. In the next twenty years, 7,463 miles of track were laid, or 88.7% of total miles laid to 1900; and of those, 5,069 were laid in the decade commencing 1880, or 48% of all nineteenth century track construction in the colonies.

By 1891, railways in Queensland had been started at nine points on the coast, ranging from Cooktown to Brisbane, and had reached as far west as Hughenden, Longreach and Charleville. In the north of NSW, railways had reached Tenterfield, Narrabri and Bourke; in the west the railway extended to Hay, and in the south, to Albury. The Victorian network spread east to Bairnsdale from Melbourne, reached Albury, and had crossed the Murray River to reach Deniliquin in NSW. It had reached northwest to Swan Hill, and extended west into South Australia. In South Australia, railways connected Adelaide to Port Pirie and beyond to Oodnadatta, Broken Hill in NSW, Morgan on the Murray River and connected to Victoria in the south east of the state. See Fig 5.1 for a map of south east railway construction, and Fig 5.2 for a map of Queensland railway construction.

**Fig 5.1**  
**Railways Built in South East Australia by Decade:**  
**1861 – 1891**



Source: Butlin 1964, p. 325

**Fig. 5.2**  
**Railways Built in Queensland by Decade:**  
**1861 - 1891**



*Source: Butlin 1964, p. 328*

The development of colonial railways in Australia occurred as railway technologies were being diffused globally. The Australian colonies' first railways were in operation by 1855, only about twenty five years after the commissioning of the first commercial railway in the UK. The experience of the rest of the world was available to Australia, albeit with some delay. Shields and Wallace, two of the Sydney Railway Company's first three engineers-in-chief, had been trained in Britain and had brought knowledge of overseas practices with them, though that knowledge was less than complete. There were a number of other engineers in Sydney, Melbourne and Adelaide with significant railway experience. Lardner's text on railway economics (Lardner 1850) was to be found in a Melbourne library by 1856, and Governor General Denison had been trained as a military engineer and had some knowledge of the disciplines involved in railway engineering. Australia may not have been in the mainstream of nineteenth century railway development, but it was not far behind. In fact Queensland's selection of the 3ft. 6in. gauge for its railways was close to an international precedent for that gauge.

As described above, the colonies' three mainline gauges were being developed within and not separate from a global context. One feature of this context was that early national systems inclined to gauge proliferation (for example, in Brazil, Ireland and the USA). The "battle of the gauges" was fought in the Australian colonies as elsewhere; it went through the stage of debating between "broad" and "narrow" gauges; it experienced railway costs and cost increases which came to cause great concern to governments everywhere; it adopted the simplistic views that first construction cost was a reasonable proxy for total (construction and operating) costs, and that first construction costs varied directly with gauge. The colonies learnt that this last *was* simplistic, save for South Australia and Victoria. South Australia followed India's rationale that it was possible to separate the running of contiguous broad and narrow gauge systems. At all times, the Australian colonial system was not far out of step in time with what was happening globally. But early gauges in Australia did not proliferate because British leadership saw to it that colonial governments legislated to avoid the "evils" of mixed gauge, like India, but unlike Brazil and the USA.

What also differentiates Australia from most other countries was the structure of its governments and the timing of becoming a national entity. The Australian colonies were, from their inception, separate and autonomous units of government. The *raison d'être* of each colony's government was to manage the affairs of its colony, not to manage the affairs of other colonies, nor to manage the possible integration of the colonies. It is to be expected that colonial governments would manage their economy in ways which they saw as being best suited to their particular colony's needs. People who saw a need for railways to perform a continental or supra-colonial function did exist but were rare, and such considerations did not drive colonial governments. Even the management of the interfaces between colonies did not become a practical issue until it became necessary to deal with Riverina trade issues in the 1870s. The breaks of gauge in the continental system did not become apparent nor begin to impose additional costs on railway operations until NSW and Victoria, and NSW and Queensland, were connected in the 1880s.

To sum up, that Australia has a railway system built around three gauges is a function of less than competent administration in early NSW and Victoria, and railway development decisions in the second half of the nineteenth century by South Australia and Queensland



that were predominantly political. Queensland's selection of 3ft. 6in. was based more overtly on initial cost considerations than those of other colonies. This was so much so that even if NSW and Victorian gauges had harmonised at 4ft. 8½in. or 5ft. 3in., Queensland would still have opted for 3ft. 6in. In that event, Australia would have had a two gauge system, much like the Brazil and India of today.

## 7. CONCLUSIONS

It has been found that individual rail gauge choices in Australian colonies cannot be viewed merely as stand-alone events. Rather they were embedded in decision-making processes which, over a period of the fifty years before federation, were aimed at achieving railways at least construction cost. Consistent with this it was also found that previous studies have paid insufficient attention to a number of records, a knowledge and an understanding of which is critical to any comprehension of rail gauge choice in the Australian colonies. For example, corporate records in Victoria, even some of which appeared in parliamentary proceedings, have been largely overlooked, while Gladstone's despatch of 16 January 1846 to colonial governors on the subject of railways has been almost universally misinterpreted. These conclusions, and others described below, result in a new and more accurate narrative and interpretive history of rail gauge choice in the Australian colonies.

Community leaders of the nineteenth century in the Australian colonies, as in Brazil, India and the USA, saw investment in railways as a major stimulant to the development of their economies. This belief appears to have been an article of faith because there was no rational basis on which to form it, either theoretical or practical. In the first half of the nineteenth century, with no history to guide action, and no theory to justify it, this is entirely understandable. It is less understandable however that despite massive investment in railways throughout the nineteenth century, no theoretical models emerged in the second half against which the emerging body of data from experience could be interpreted. Models for evaluating the relative costs and benefits of one railway gauge over another were neither available nor developed in the relevant time-frame. Instead engineering opinion was widely regarded as adequate authority, even though it emerged that such opinion diverged in the relative evaluation of different gauges. In particular, too heavy a weight was given by many to minimising first construction costs as opposed to running costs, especially running and other costs engendered by breaks of gauge. Such divergences in the base of supposedly informed opinion left gaps for the intrusion of opinions from other sources of power, such as those of bureaucrats and politicians.

Engineering opinion played a significant part in rail gauge choice in all of the Australian colonies. The account of gauge determination in NSW given in Chapter 5.2 indicates that a number of others in both the private and public sectors played a part in the process. There

was in fact, a well-established chain of command, of which the engineers were either not part or, at best, constituted the lowest level in the hierarchy. Nonetheless, it appears reasonable to hold that Shields and Wallace initiated the gauge decision-making process, and that their opinions were relied upon by others further up the chain. Unfortunately much of the advice offered by Shields and Wallace was, in fact, either advocacy or opinion. It was either not based on evidence, or upon evidence that was fallacious or spurious. This was compounded as the SRC directors, and the politicians of NSW, including the Governor, were less than diligent in testing the validity of Shields' and Wallace's proposals.

Whatever the quality of the engineers' advice, as opposed to the determining role usually attributed to them, they lacked any authority to make the gauge choice. That choice was made by the colonial governors, advised by elected representatives and other interested parties. There is no reasonable basis on which to hold Shields/Wallace accountable for the mixed gauge outcome in NSW and Victoria. The allocation of blame to the SRC's engineers for Australia's mixed rail gauge system, and especially its persistence until now, raises questions about the quality of scholarship brought to bear on colonial rail gauge history over a long period of time. As has already been stated, it overlooks the key roles played by others in the contemporary decision-making systems. More than that, in Victoria at least, it overlooks the facts of the sequence of events in Victoria. These are described in detail in Chapter 5.3.

In summary however, and as opposed to previous claims, it was *not* the case that Victorian railway companies had placed orders for locomotives and rolling stock at 5ft. 3in. *before* the Victorian decision to choose this gauge. Nor is it correct that those Victorian companies, or their engineers, unanimously supported the choice of 5ft. 3in. The record states that they did not. The record states that LaTrobe decided on a gauge of 5ft. 3in. for Victoria *before* companies placed orders for equipment. The record states that in making this decision, LaTrobe received no worthwhile guidance from Victorian railway companies for both their directors and engineers held views which differed from company to company.

Constitutionally, Lieutenant-Governor LaTrobe reported to the Governor General of the Australian colonies, who also happened to be the Lieutenant-Governor of NSW. LaTrobe

ignored this element of the chain of command, and appealed directly to the Secretary of State for War and the Colonies for concurrence in LaTrobe's choice of 5ft. 3in. Other than for his formal accountability to the Governor General, LaTrobe's choice between 4ft. 8½in. and 5ft. 3in. was unconstrained. It was *his* choice of 5ft. 3in. that originated Australia's mixed gauge system.

Historians' failure to recognise the facts of the transactions about rail gauge in Victoria is not the only example of inadequacy in the treatment of historical records in respect of rail gauge choice. Many observers, of whom Lieutenant-Governor LaTrobe appears to have been the first, have wrongly depicted Gladstone's despatch of January 1846 as an authority for adoption of a standard gauge at 4ft. 8½in. As has been demonstrated such advocacy is not tenable. Its persistence is a further demonstration of appeal to an authoritative source for lack of an agreed model for analysis.

Finally, it is necessary to recognise that constitutional developments in Australia played a significant role in the development of railways in Australia. When the Australian colonies federated in 1901, the railway systems in place used four gauges. But it is also true that up until Federation, each colony had been an autonomous, independent unit. It may have lived next to a like colony, but each reported directly and separately to the British Crown. Within those colonies, railway gauges had become highly standardised – 3ft. 6in. only in Queensland, 4ft. 8½in. only in NSW (save for two outlying lines), 5ft. 3in. and 2ft. 6in. in Victoria, and 5ft. 3in. and 3ft. 6in. in South Australia. Save for Riverina and Broken Hill-based traffic, there were few market connections between the colonies. In this respect, their position is different to that of the USA, where railway growth was driven to a significant extent by needs to service domestic markets, particularly during and after the Civil War.

Federation created the prism through which separate colonial systems might be perceived as a national system. Colonial systems were not built with an eye to becoming components of a national system. Arguably, Australia has never had a national rail system; even now the east-west and north-south services created by Commonwealth participation in the rail industry do not constitute a national system. Commonwealth facilities are properly to be regarded as sub-components of a continental component of a larger national system which

also embraces the separately-controlled railways of Queensland, NSW, Victoria, and Western Australia.

What Federation delivered to Australia was not a national railway system but a national system of railways. In so doing, it demonstrated that in Australia *the* standard gauge was a myth – and it remains a myth today, more than one hundred years after Federation.

## APPENDICES

**Appendix 1** Operational issues pertaining to mixed rail gauge systems in Australia; extract from Denniss, AG 1942, History of the break of gauge in Australia, *Journal of the Institute of Transport* December, pp. 54 – 60.

In later years the question of the unification of gauge has, as in the past, been the subject of periodical Conferences and suggestions from all and sundry, but the major difficulty of financing such a huge undertaking still remains to be overcome, and in all probability will never be surmounted: that a definite need exists for the provision of a uniform railway gauge throughout Australia there is little denial.

Lord Bacon once said there are three things which make a nation great and prosperous – a fertile soil, busy workshops, and easy conveyance for men and commodities from one place to another. Whilst we have a fertile soil and vast industrial undertakings, the railways of Australia, with their hampering gauges, do not provide easy conveyance. The disabilities of the present railway system with breaks of gauge are everywhere manifest, and from a railway standpoint Australia is in reality divided into compartments – each system works independently whilst trade and commerce is seriously embarrassed.

Where business is brisk in one State and slack in another; where one State is pressed to its utmost whilst another State has rolling stock lying idle, there can be no interchange of stock apart from the broad-gauge lines of Victoria and South Australia.

Australia unfortunately suffers from periodical drought, and is such times a system which would give rapid transport of wagons from one end of Australia to the other would be of the greatest value. Early in the year 1920 New South Wales suffered one of its worst droughts, whilst there was ample fodder in Victoria. The stock could not be transferred from New South Wales due mainly to extreme weakness, nor could the fodder be transferred from Victoria except under great disabilities. In one day the number of trucks at Albury or approaching there loaded with fodder was well over 800. There was train-load after train-load of fodder transported, and all halted, unloaded, and reloaded at the Boarder. Transfer charges, agents' fees, irritating delays, and losses found their way to the consignee already so much hurt by the drought itself. The fodder went to the farthest points of New South Wales, taking weeks to reach its destination after consignment in Victoria. New South Wales and Queensland suffered from severe drought conditions during 1939, and fodder had to be brought similarly from Victoria, with identical difficulties at Albury and Wallangarra.

In America huge train-loads of traffic are hauled over tremendous distances, where as in Australia we haul our commodities a certain distance and then handle them across to another train. This is particularly harmful with fruit traffic, which has now assumed large proportions. For the year ended June 1941, 103,277 tons of fruit was conveyed through New South Wales to the various Capital Cities, some of the fruit being railed as long a distance as 2,600 miles, and having to be transhipped twice in transit from Queensland stations to Victoria or South Australia, and four times en route to Perth. The otherwise

unnecessary expense and terrific amount of work under these conditions can be readily understood when it is realised that approximately four million cases of fruit annually require to be handled between the various States. Five or more fully loaded trains for New South Wales and Victoria leave Clapham (Queensland transshipping point) every week with this traffic alone. The fruit is largely tropical, and requires careful handling. An average of four fully loaded fruit trains leave Sydney weekly for Melbourne. In America this class of traffic is transported in sealed cars, unopened from one side of the Continent to the other. Heavily loaded trains of oranges, grapes, antelopes, etc., are transported in this way, with great advantage to the grower and the consumer.

An even more serious question than the handling of the fruit traffic between the Australian States has been the recent growth of meat traffic Interstate due to shipping restrictions, such commodity being conveyed from Clapham, Bourke, Tenterfield, and Casino to Melbourne. The meat, which averages approximately 400 tons weekly, is loaded into mail-speed refrigerator cars at these points, is exposed to the air during transshipment at Albury, and again placed into refrigerator cars for transport to Melbourne. Australia is seriously hampered by its railway transport, and the railway systems with never afford the country the service they should confer until trucks can be loaded in Queensland, and, without transshipment, run across the Continent to Western Australia.

Serious as is the loss through transshipment charges, damages, and delays to consignments, it has long been realised that the main evil of break of gauge is not the handling charges of goods transhipped, but the serious detention of rolling stock at the several points of transshipment.

Writing on the Indian question some number of years ago, the Chief Engineer of the Indian Railways Board, said that the appallingly low service of goods wagons in India at that time was, no doubt, largely due to forced detentions at transshipment stations, during which they cannot earn anything, while such detentions necessitate outlay on a far larger reserve of stock than would otherwise be necessary. The economic waste through this cause is greater in Australia than the public has any idea of.

An examination some years ago of one of the break-of-gauge stations over a comparatively short period showed instances of delays to wagons of as many as 18 days, a period of time which with a unified gauge would have been sufficient to have permitted the wagons to cross the Continent, and be returned again.

Whilst the unification of the gauges will not give any new mileage, it will make the existing railways of greater assistance to the producers; will encourage closer settlement by giving rapid and direct access to the whole of the States' markets; will prevent loss and delay to perishable products and safeguard stock in times of drought; and will give a much better and more economical use of rolling stock. It will also secure a standardisation of rolling stock, which would lead to cheaper construction and operating costs. From a military point of view also – particularly at the present time – it is apparent that the first consideration is to make the existing railways connecting the main centres of population capable of expeditiously handling large bodies of troops. In war to-day, speed in either offence or defence is unquestionably a deciding factor.

**Appendix 2** Railways, Gladstone, WE; Despatch to Governors, 15 January 1846

Right Hon. W. E. Gladstone to Sir George Gipps  
(A circular despatch, per ship Agincourt.)

Downing Street, 15<sup>th</sup> January, 1846

Sir,

I find that the impulse which has been given in every other part of the Civilised World to plans of Railway communication has been felt in many of the British Colonies. The subject has been pressed on my attention from many different quarters and under circumstances both physical and economical, as distinct and as various as are the conditions of those widely extended Settlements. To attempt to lay down any one set of rules or even a single rule, binding inflexibly on the Executive Governments of them all, would obviously be futile and impracticable. But the experience of this Country has ascertained some general principles on the subject, the application of which is neither transitory nor local, but which it may now be presumed, are applicable in various degrees to the Legislation of every Country in this new field of enquiry. The object of this Despatch is to state, compendiously, what those rules or principles are.

It will, however, be convenient that you should be in possession in the utmost practicable detail of all the provisions which have been established, either by positive Statutes or by Standing orders of both Houses of Parliament for the more effectually preventing the evils and securing the advantages incident to the creation of new Lines of Railway in this Country. I subjoin a list of the various documents of this nature which accompany this Despatch. You will, of course, find in them much which could not be applied to the circumstances of the Colony under your Government. But you will also find much which will greatly abridge the labour of drawing up any Railway Acts and much which embodies in a small space the results of long and laborious investigations and of very costly experiments.

But whatever may be the utility or the inutility of such details, I revert to the more general topic which has been already mentioned.

First, then, it is necessary that it should be expressly stipulated in the formation of every Railway Company that the Legislature shall be free by any future Enactments to repeal, alter or amend any part of the original grant without being responsible on that account to provide compensation or indemnity to the Shareholders. It is, of course, assumed that, in the exercise of this reserved authority, the local Legislature will always respect the obligations of Justice and sound policy. But to attempt once for all to enact a Law of this kind, which is thenceforward to remain unchangeable, unless the concurrence of the Shareholders can be obtained or purchased, would be to subject Society at large to all the hazards of what must, at first, be a precarious and doubtful experiment.

2d. You will regard it as an indispensable preliminary to the enactment by Her Majesty of a Railway Bill that, of the proposed Capital, one tenth at least should have been actually invested in good and available securities for the prosecution of the work.

3<sup>rd</sup>. Every Railway Bill ought to contain provisions for the conveyance of the Royal Mails. The object of such provisions should be to secure moderation in the charges of



Conveyance, and to afford the utmost possible facility for the effectual discharge of this branch of the Public Service. Reference may be made on this head to such sections of the Imperial Railway Acts as relate to it.

4<sup>th</sup>. Every such Bill should also contain all necessary provisions to ensure the prompt and punctual conveyance of Her Majesty's Forces, whether belonging to the Regular army or to the Militia, and of all Policemen, Constables or others, travelling on Her Majesty's Service. Rules of this nature will be found in the accompany Acts of Parliament.

5<sup>th</sup>. In the contingency of Electrical Telegraphs being established on any line of Railway, provision should be made for a proper controul (sic) and superintendence of them according to the terms or spirit of the section of the Act of Parliament on that subject.

6<sup>th</sup>. The Statute 7<sup>th</sup> and 8<sup>th</sup> Vict; Chapter 85, Sec. 1, contains a provision respecting the revision of the scale of Tolls on Railways, and the fixing a new scale in cases where, after 21 years, the profits shall have exceeded 10 per cent. The principle of this clause, with the substitution of 15 per cent, for ten, and of seven years for three as the basis of the average to be calculated, ought, I apprehend, to be adopted in every Colonial Railway Act.

7<sup>th</sup>. The Second Section of the same Act contains provisions for the purchase, if it shall be thought fit, by the State after a certain lapse of time, and on the terms there prescribed, of any Railway. In substance, such a provision should form a part of any Act, which may be passed in the Colony under your Government.

8<sup>th</sup>. The fifth Section of the same Statute contains a provision for the keeping and the inspection of the accounts of Railway Companies, which, with the necessary variations of form, should, I think, constitute an integral part of every Railway Bill which may be passed in any British Colony. It is however material that you should observe, with respect to the three last provisions, that they are not intended to rule affirmatively by anticipation the questions to which they relate, or in any manner to prejudge the policy of the purchase of any Railway by the State. They have been prompted by the belief that the Railway System is still in a great degree an infant system, and that it is impossible accurately to predict the accompaniments and effects of its maturity, or to measure the exigencies which it may create. It has, therefore, been thought wise to take the best general guarantee, of which the circumstances will admit, by keeping the field open for the free exercise at a future day of the discretion of the Legislatures, and to prevent the growth of any notion or constructive or prescriptive claim on the part of the Companies to retain, without reference to public interests as they may hereafter stand, their original position.

9<sup>th</sup>. You will find in the accompanying Act various provisions, which have the Public safety for their immediate object. Some modifications of them will, of course, be requisite to meet peculiar local exigencies, but enactments of this kind, very carefully considered, are essential to all good legislation on the subject.

10<sup>th</sup>. In those Colonies in which Representative Assemblies exist and where the population is numerous, there will, I trust, be an adequate Security both for the protection of private rights, and for preventing any improper favour being shewn to the interests of persons possessing peculiar local influence. In other Colonies, the Security against abuses may be less perfect and the duty of vigilance on the part of the Executive Government to

prevent them may be the more urgent. It is a duty, for the effective discharge of which the Governor of every such Colony will consider himself as peculiarly responsible.

Such appear to me to be the main general principles or provisions which ought to be embodied in any Railway Act which may be passed in the Colony under your Government. You will perceive that my general object in framing them has been to leave the freest scope to private and associated enterprise by the avoidance of all minute interference, and at the same time to take some simple securities for vesting the solidity of projects for guarding against risk to life and for guaranteeing to the public service from the first a fair share of the advantages of the construction of any railway, and to the state as the representative of the public the means of dealing with future contingencies. But I do not venture to insist even on these provisions as absolutely indispensable in every Colony, and in every Railway Act. I am too well aware of the diversity of circumstances prevailing in the various dependencies of the British Crown to attempt so to fetter the discretion of the local Governments, or so to impede the free exercise of the discretion of Her Majesty's confidential advisers. The practical purpose, which these rules may serve, is as follows. It will not be necessary to reserve for the signification of Her Majesty's pleasure any Railway Law, which satisfies all these conditions. On the other hand, any Railway Law, framed in neglect or disregard of them, must be so reserved. In transmitting any Railway Law for the signification of Her Majesty's pleasure, you will distinctly point out to what extent these rules have been followed or neglected, and what are the reasons which in any such case of neglect are supposed to justify or to have occasioned it. On the other hand, it may happen that in particular instances Companies may desire to accredit their schemes by soliciting a larger measure than I have proposed of the intervention of the Government. I do not object to the guarded extension of that intervention, even beyond what the Legislature of the Colony under your administration may generally require, if it be within the active concurrence of the parties and without expence (sic) to the public. For example, it may happen that parties may desire to submit their projects to the examination of Officers appointed or approved by yourself for the purpose. In such a case or in any which you may judge to be analogous to it, I leave to you an unfettered discretion.

I have, &c.,

W. E. Gladstone

P.S. Lest the language, in which my first recommendation is couched, should be liable to an exaggerated construction, I beg to apprise you that it is intended only to recommend a Provision strictly conformable to that of the 26<sup>th</sup> Clause of the Model Railway Bill of 1845, and in no degree to go beyond the Spirit of that Provision.

**Appendix 3** Despatch, Earl Grey to Fitzroy, untitled, 30 June 1848

Sir,

With reference to Mr. Gladstone's circular despatch of the 15<sup>th</sup> January, 1846, transmitting the Standing Orders of the Houses of Parliament for the information of your Legislature in framing Laws and Regulations for the construction of Railways, I have to acquaint you that it has appeared to me to be highly desirable in the event of Railways being established in the Colony of N.S. Wales that one uniform gauge should be established with a view to the probability of the Meeting at some future, though probably distant, period, of the lines, not only in the same settlement but by a junction of those constructed in the adjacent Colonies. I have communicated with the Commissioners of Railways in order to ascertain the width of gauge which might be best suited for general adoption and I have been informed that, in their opinion, the most desirable gauge would be that which is prescribed by the Act 9 and 10 Victoria Cap: 57 for Railways in England, and which is the width of 4 ft. 8½ in. That gauge has already been adopted in the rules framed by the Government of South Australia for regulating the principle on which Railway Bills should be drawn in that Colony, and it will be desirable that the same gauge should be adopted at any future period in the construction of Railways in the Colony under your Government.

I have the honour to be, Sir,  
Your most obedient Servant,

Grey

**Appendix 4** Report to the Board of Undertakers of the Adelaide City & Port Railway, B Herschel Babbage

Railway Office, 27 May, 1853

To the Board of Undertakers of the Adelaide City and Port Railway

Gentlemen – An extract from a report by the Engineer of the Sydney Railway Company, upon the guage [sic] established in that Colony, having been submitted to me by your Secretary, I have the honor [sic] to lay before you the following remarks upon this subject: -

1. I cannot agree that the reason why the Irish Railway Commission gave the preference to the guage of 5ft. 3in. was, that more powerful engines might be used, by giving greater space between the rails for the application of the machinery.
2. The chief object of giving, in the Irish railways, an increased space for the machinery of the locomotives, was to allow more scope for the manufacturer conveniently to arrange the working parts and to enable them to be more easily got at and repaired.
3. I cannot admit the statement of the above-mentioned engineer as to the limited market for rolling stock, adapted to a 5ft. 3in. guage, causing a sacrifice in its purchase or manufacture of from 20 to 30 per cent.
4. The fact of 5ft. 3in. being the guage of the Irish railways, of which there are now many both at work and in course of construction, makes it evident that there can be no difficulty in procuring rolling stock to suit that guage.
5. The cost of railway locomotives and carriages is so great, that manufacturers are not in the habit of keeping a number of them on hand in their shops, so as to allow of an engineer walking in and selecting those which he requires: the rolling stock is almost invariably, except in the case of branch railways, made to order for the particular railway upon which it is to be used.
6. A change in the guage from 4ft. 8 ½ in to 5ft. 3in. would make no difference in the size either of the bodies of the carriages or in their under frames – this is determined with reference to the internal passenger accommodation proposed to be obtained. The only difference would be in the addition of 6½ inches to the length of the axles, and in the disposition of the axle-boxes, guards, and breaks; the latter, however, requiring no increased expense.
7. With respect to the locomotive engines, a similar increase of 6½ inches to the length of the axles would be necessary, and the frame supporting the boiler would require to be widened in proportion; but on the other hand the increased space afforded for the working parts of the machinery would cause an economy in the construction of them, which would probably more than counter balance the slightly increased cost of the axles; whilst, in the facility given for repairs, the annual cost of maintenance would be diminished.

8. In the construction of a line of railway, an increase of guage, such as has been contemplated, would make no difference: the width of the bridges, tunnels &c, is determined by the width of the widest carriages – ample space being allowed to prevent the possibility of an accidental passer-by being crushed between the side walls and the train.
9. The greatest defect of the powerful narrow guage engines at present employed, is the height of their centre of gravity, caused by the narrow space between the wheels: every addition to the width of the guage, within certain limits, would, by allowing the boiler to be lowered, reduce this height.
10. A guage of 5ft. 3in. is, essentially, a narrow guage, and partakes of all the advantages which the Engineer the Sydney railway claims for the narrow guage: advantages, however, which as regards speed, safety, and convenience, public opinion is apt to ascribe rather to the broad guage of 7ft than to the narrow guage of 4ft. 8 ½in.
11. When it is considered that in all probability, before many years elapse, one continuous line of railway will be carried from the shores of the English Channel to our Indian Possessions, and that already about one-third of this distance is traversed by railways with a guage of 4ft. 8½in., a very good reason may be assigned for the adoption of the same guage in India, if not in Egypt.
12. The circumstances of this continent are entirely different from those of India and Egypt. Our insular position cuts us off entirely from immediate connexion with any external railway – hence, an argument which may hold good for India is entitled to no weight here.
13. In conclusion, I decidedly recommend that the guage of 5ft. 3in., already established by law in New South Wales, should be adopted throughout Australia, in preference to the narrower one of 4ft. 8½in.

I have shown that the increase of 6½ inches would make no appreciable difference either in the cost of the rolling stock, or in the construction of the railway – whilst the addition of nearly one-eighth to the width of the base of the engines and carriages would, in these days of express trains, contribute most materially to their safety.

B.Herschel Babbage, Engineer to the Board  
Report – Adelaide City & Port Railway, SAPP no. 87, 10 Nov 1853

**Appendix 5** A chronology of selected secondary sources about railways and railway gauge in Australia.

SUBJECT AREA LEGEND

HISTORY

-	GENERAL	H
-	ECONOMIC	E
-	CONSTITUTIONAL/POLITICAL	C
-	TRANSPORT	T
-	RAILWAYS	R
-	GEOGRAPHY	G

**NATIONAL/INTERSTATE**

<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1852/3	Parkes, H	Railways.	Empire – 11,13,19 & 24 Nov, 4, 10, 15, 20, 25 & 31 Dec 3, 8 Feb.	R
1853	Denison, W	Railroads.	Sydney Magazine of Science & Art vol.1, pp. 62 – 69.	R
1857 (a)	Jevons, WS	The western line of railway, and the general policy of government extension.	Empire – 10 February.	E
1857 (b)	Jevons, WS	Comparison of the land and railway policy of New South Wales.	Empire – 8 April.	E
1857 (c)	Jevons, WS	Railway economy.	Empire – 29 December.	E
1858	Pell, MB	On the application of certain principles of political economy to the question of railways.	Sydney Magazine of Science & Art vol. 1, pp. 124 – 130.	R
1870	Chapman, HS	On the political economy of railways.	Transactions & Proceedings of the New Zealand Institute vol. 3, no. 1, pp. 337 – 351.	R
1878	Johnson, LM	Are narrow-gauge roads economical?	Scribner's Monthly vol. 17, pp. 292 –296.	R
1899	Howell, P	Comparative statistics of Australian railways.	Journal of the Statistical Society vol. 62, pp. 83 – 114.	R
1902	Coghlan, TA	A statistical account of the seven colonies of Australia 1901 – 1902.	Government Printer, Sydney.	E
1906	Kernot, WC	Railway gauge.	Proceedings, Victorian Institute of Engineers, 26 <sup>th</sup> August & 7 <sup>th</sup> September.	R
1907/8	Clark, V S	Australian economic problems: I The railways.	Quarterly Journal of Economics vol 22, pp. 399 – 451.	R
1911	Deane, H	The gauges of Australian railways & their unification.	Commonwealth of Australia Parliamentary Papers, vol. 11, pp. 1363 – 66.	R

<b>NATIONAL/INTERSTATE - continued</b>				
<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1911	Smith, JA	What gauge should be made standard in Australian railways?	Engineering News vol. 66, no. 3, p 674.	R
1911	Taylor, G	Australia in its physiographic & economic aspects.	Clarendon Press, Oxford.	E
1912	Mais, HC	Historical account of the introduction & construction of railways in the Commonwealth of Australia & the Dominion of New Zealand up to & including the year 1911.	Manuscript (Australian National University).	R
1912	Pratt, EA	The state railway muddle in Australia	John Murray, London.	R
1922	Anon	Uniform railway gauge.	Government Printer, Melbourne.	R
1924	Roberts, SH	History of Australian land settlement.	Macmillan, Melbourne.	H
1930	Shann, E	An economic history of Australia.	Georgian House, Melbourne.	E
1935	Roberts, SH	The squatting age in Australia 1835 – 1847.	Melbourne University Press, London.	H
1942	Denniss, AG	History of the break of gauge in Australia.	Journal of the Institute of Transport, December, pp. 54 – 60.	R
1945	Clapp, H	Standardisation of Australia's railway gauges.	Report to the Minister for Transport & External Territories, Government Printer, Melbourne.	R
1950	Butlin, NG	Public enterprise in Australian economic development 1860 – 90.	Exploration in Economic History, vol. 2, March, pp. 141 – 158.	E
1950	Ward, JM	The germ of federation in Australia.	Historical Studies Australia & New Zealand, vol. 4, no. 15, pp. 214 – 223.	C
1955	Bach, J	Sea communications between Sydney & Melbourne before 1860.	Royal Australian Historical Society, Journal & Proceedings vol. 41, part 1, pp. 1 – 22.	T
1955	Gollan, R	Nationalism & politics in Australia before 1855.	Australian Journal of Politics & History vol. 6, no. 2, pp. 33 – 48.	C



<b>NATIONAL/INTERSTATE – continued</b>				
<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1955	Singleton, CC	The beginning of the railway era in Australia.	Royal Australian Historical Society of Australia, Journal & Proceedings vol. 41, pp. 267 – 283.	R
1956	Bean, CEW	The ‘dreadnought’ of the Darling.	Angus & Robertson, Sydney.	T
1956	Butlin, NG	Colonial socialism in Australia 1860 – 1900.	Aiken (ed.) 1959.	E
1956	Government Printer, Canberra.	Government Members Rail Standardization Report.		R
1956	Wentworth, WC	Responsible government in Australia: state constitutions & federal power.	The Australian Quarterly vol. 28, no. 2, pp. 7 – 19.	C
1958	Harding, E	Uniform railway gauge.	Lothian Publishing, Melbourne.	R
1958	Ward, JM	Earl Grey & the Australian colonies 1846 – 1857: a study of self-government and self-interest.	Melbourne University Press, London.	C
1959	Aitken, HGJ (ed)	The state & economic growth.	Social Science Research Council, NY.	C
1960	Smith RHT	Rigidity of rail hinterland boundaries in Australia.	Annals of Association of American Geographers, vol. 50, no. 1, pp 55 – 7	T
1963	Appleton, JH	The efficacy of the great Australian divide as a barrier to railway communication.	Transactions & papers of the Institute of British Geographers vol. 33, pp. 101 – 122	G
1963	Goodwin, CD	Economists & railways in Australia.	Journal of Transport History vol. 6, no. 2, pp. 65 – 86.	R
1963	Melbourne, ACV (2 <sup>nd</sup> ed.)	Early constitutional development in Australia.	University of Queensland Press, St. Lucia.	C
1963	Singleton, CC & Burke, D	Railways of Australia.	Angus & Robertson, Sydney.	R

<b>NATIONAL/INTERSTATE – continued</b>				
<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1963	Smith RHT	Transport competition in Australian border areas: the example of southern New South Wales	Economic Geography, vol. 39, no. 1, pp 1 – 13	E
1964	Butlin, NG	Investment in Australian economic development.	Cambridge University Press, London.	E
1966	Birch, A	Economists and railways in colonial Australia: a note.	Journal of Transport History vol. 7, no. 3, pp. 180 – 182.	R
1966	Shaw, AGL	Convicts & the colonies.	Faber & Faber, London.	H
1967	Matthews, R	Public investment in Australia – a study of Australian public authority investment & development.	Cheshire, Melbourne.	E
1969	Quaife, GR	Make us roads no matter how: a note on colonial politics.	Australian Journal of Politics & History, vol. 15, no. 1, pp. 47 – 54.	R
1970	Fearnside, GH	All stations west – the story of the Sydney – Perth standard gauge railway.	Haldane Publishing Co, Sydney.	R
1970	Webb, GR	Towards a new era in Australian rail transport.	CEDA, M Series no. 31, Melbourne.	R
1971	Brady, I	A brief history of the standard gauge in Australia.	Australian Railway Historical Society – Bulletins nos 403, 404.	R
1972	Lamb, PN	Historians & Australian railways.	Australian Journal of Politics & History vol. 18, no. 2, pp. 250 – 260.	R
1973	Bayley, WA (2 <sup>nd</sup> ed)	Standard gauge railway across Australia.	Austral Publications, Bulli.	R
1973	Clark, CMH	A history of Australia, vols. III & IV from 1824 – 1888.	Melbourne University Press, Melbourne.	H

<b>NATIONAL/INTERSTATE – continued</b>				
<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1975	Gobbett, BJ	Australian railways in the 19 <sup>th</sup> century: some primary effects.	B Ec (Hons) thesis, University of Adelaide.	R
1976	Sinclair, WA	The process of economic development of Australia.	Longmans Cheshire, Melbourne.	E
1976	Webb, GR	The planning & management of rail standardisation projects in Australia.	Paper presented to the Australian Transport Research Forum, Adelaide.	R
1977	Jackson, RJ	Australian economic development in the nineteenth century.	Australian National University Press, Canberra.	E
1977	Lougheed, A	Economic effects of railway construction in Australia, 1861–1914.	Working Paper, Department of Economics, University of Queensland.	R
1978	McCarty, JW	Australian regional history.	Historical Studies Australia & New Zealand vol. 18, pp. 88 – 105.	H
1979	Dodgson, JS	The economics of Australian railway deficits.	Occ-Paper no. 11, Centre for Research on Federal Financial Relations, ANU, Canberra	R
1984	Butlin, NG	Contours of the Australian economy 1788 – 1860.	Working Paper in economic History no. 21, ANU, Canberra.	E
1984	Nayda, ML, Adams, JCB	New perspectives for railway gauge standardisation in Australia.	Paper presented to the 9 <sup>th</sup> Australian Transport Research Forum, Adelaide 15/16 May.	R
1986	Butlin NG, Sinclair, WA	Australian gross domestic product 1788 – 1860: estimates, sources & methods.	Australian Economic History Review vol. 26, no. 2, pp. 126 – 147.	E
1986	Krbavae, LP	Rail transport costs & cost structure.	Technical Paper no 18, Australian Railway Research & Development Organisation, Melbourne.	R
1987	Stevenson, G	Rail transport & Australian federalism.	Centre for Research on Federal Financial Relations, ANU, Canberra.	R
1988	Quinlan, H	Index to the bulletins of the Australian railway historical society 1937 – 1987.	Australian Railway Historical Society (ACT Division).	R

<b>NATIONAL/INTERSTATE – continued</b>				
<b>Year</b>	<b>Author</b>	<b>Title</b>	<b>Reference</b>	<b>Subject Area</b>
1989	Docwra, GE, Kolsen, HM	Transport & Australian federalism 1901 – 1972.	Journal of Transport History, vol. 10, no. 1, pp. 59 – 73.	T
1989	Fitch, RJ	Making tracks – 46 years in Australian railways.	Kangaroo Press, Kenthurst.	R
1991	Burke, D	Road through the wilderness: the story of the transcontinental railway, the first great work of Australia's federation.	NSW University Press. Kensington, NSW.	R
1991	Greasley, D Oxley, L	Segmenting the contours: Australian economic growth: 1828 – 1913.	Australian Economic History Review vol.37, pp. 39 – 53.	E
1991	Lougheed, AL Tamaschke, RHU	A statistical analysis of the crowding out effects of government investment in the railways & other public enterprises in nineteenth century Australia.	Australian Economic Papers, vol. 30, pp. 99 – 113.	E
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1876	Lang, JD	Metropolitan & Illawarra railway.	Gibbs, Shallard & Co, Sydney.	R
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- A. MANUSCRIPT SOURCES
- B. CONTEMPORARY PRINTED MATERIAL
- C. PARLIAMENTARY PAPERS
- D. THESES
- E. SECONDARY PRINTED WORKS
  - E.1 BOOKS
  - E.2 JOURNAL ARTICLES & PRINTED PAPERS

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- (2) Select Committee reports usually consisting of Reports, Minutes of Committee Proceedings, and often Appendices. The particular source of quotations from any Select Committee is specified in the text.
- (3) There are some differences in the conventions adopted by different colonial governments in recording their proceedings. Here the practice for NSW and Victoria is to give the reference as Votes & Proceedings Legislative Council (or Assembly) followed by the name of the colony, e.g. Victoria.
- (4) The corresponding short form of reference used in the text is V&P LC(orA), followed by volume number as appropriate, and designated year of volume in which the proceedings have been reproduced. For South Australia, the short form of references for parliamentary proceedings and SA Parliamentary Papers is SAPP, and for Queensland, Q Pp.
- (5) It is not common for collections of parliamentary papers which make up a volume to be numbered seriatim. Page numbers have been included where available.

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