WAGON BRIDGES OF THE EASTERN CAPE,

c.1840 – 1900

THE CONTRIBUTION OF ENGINEERING

TO INFRASTRUCTURAL DEVELOPMENT

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ABSTRACT

This thesis examines an aspect of economic and technological history which has been little explored in South African history. It argues that the military subjugation and the economic development of the Cape Colony, and particularly of the Eastern Cape, were contingent upon good transportation. The geography of the country, which included relatively impassable mountains and numerous often flooded rivers, necessitated bridges as well as roads. Both were expensive. As a leader in industrial technology, Britain was well placed to extend bridge-building skills to its colonies. This thesis examines the processes by which a small and undeveloped colony strove to create an efficient technological infrastructure. As wagon traffic increased through progress, delays in crossing rivers became a hindrance leading to agitation for bridges. It will be shown that the construction of wagon bridges over the numerous rivers encountered in the Eastern Cape Colony was imperative for the initial free flow of military forces and for later commercial expansion as new towns were established. The eastward expansion was led by the military during the frontier wars followed by the Royal Engineers who built roads and bridges along the eastern frontier. The new Colonial Secretary John Montagu, who arrived in 1843, boosted the colonial finances by overhauling the administration. He established the Central Road Board, an organisation that would drive the building of mountain passes, roads and bridges. The Public Works Department succeeded the Central Road Board and with the financial intervention of the Crown Agents for the Colonies, carried on with an extensive programme of road and bridge building. From the 1870s wagon bridge building lagged behind the huge railway building enterprise in response to the opening up of the diamond and gold mines. The final quarter of the 19th century saw increased bridge building activity in the Eastern Cape with the construction of many iron lattice girder, stone masonry arch and timber trestle bridges. The surviving bridges remain as mute testimony to the skill and expertise of British engineers such as Lewis, Woodifield, Robinson, Fforde, Wakefield, Berkley, Grier, Newey, Westhoven and others.

TABLE OF CONTENTS

ABBREVIATIONS

ACC - Accessions, Western Cape Archives Depot

CAD - Western Cape Archives Depot, Cape Town

CC - Civil Commissioner (and magistrate)

CO - Colonial Office

CRB - Central Road Board

GH - Government House, Western Cape Archives Depot

ICE - Institution of Civil Engineers, London

NAK - National Archives, Kew, London

PWD - Public Works Department

VOC - Dutch East India Company (translation)

WO - War Office, National Archives, Kew

LIST OF FIGURES

The dates accompanying the figures of bridges indicates when the construction of the bridges was completed.

PREFACE

I am not an historian. I am from the discipline of Civil Engineering, as a practising Consulting Civil and Structural Engineer. I have a great interest in historical events and heritage structures such as bridges in the Eastern Cape, where I live. The motivation for pursuing this thesis came from the publication of my book about Joseph Newey. This is a little back to front as one normally completes the thesis and then you write the book. I have had several wonderful Mentors who have encouraged and guided me enormously along the way. They are the late Dr Graham Ross, an old *'*padmaker*'* and distinguished Civil Engineer, and the late Dr Gill Vernon, without whom my book would not have seen the light of day. Then there is Dr Elizabeth van Heyningen and Dr Bill Domeris who have assisted me immensely and for which I am most grateful. I have spent many days and over a number of years conducting research at the Cape Archives in Roeland Street, Cape Town, where Jaco van der Merwe and Erica Le Roux, were always most accommodating. My thanks also go to Dr Cornelius Thomas of Cory Library, Rhodes University. A trip to the National Archives at Kew, London for ten intensive days to research the Royal Engineers in South Africa was most fruitful. Finally a special thanks to my Supervisor Prof Gary Baines who has been most patient while attempting to transform me from a Civil Engineer into an Historian.

I would like to extend sincere appreciation to the three external examiners of this thesis, Prof Johannes Haarhof, Prof Tim Stapleton and Dr Bill Harvey, for the very gratifying comments and helpful suggestions provided during the examination process.

Last but not least to my long-suffering wife, Inge, who has had to put up with my bridge book and now my thesis, thank you, its over. Also thanks to my daughter, Nicola, for her Cape Town accommodation and to my son, Martin, for his help in putting this document together.

CHAPTER ONE – INTRODUCTION

This thesis will investigate the role played by civil engineering in the early infrastructural development of the Eastern Cape Colony. The research will concentrate on the bridge building activities, both design and construction, and will outline the events that necessitated their development during the ensuing expansion of the colony. The scientific discipline of civil engineering, of which the design and construction of bridges is a significant component, played an important role by introducing this technology to the Cape. The history of bridges is a topic that has become a favourite subject for those involved in construction heritage. An understanding of the history of bridge building is necessary if the evidence, both archival and archaeological, is to be placed within its proper context.[1] A useful approach has been to view the subject of bridge building in terms of the early stages of the development of the fledgling colony at the tip of Africa.

The motivation for this thesis is to add to the growing field of history and technology that has yet to gain much purchase in South African historiography. The history of civil engineering and in particular the specialist subject of bridge engineering is a lacuna that has yet to be filled. The research in this field has proved to be quite novel, like a journey through uncharted waters, and is the justification or rationale for studying this subject. No one has ever done anything like it in South Africa before. The objective of this thesis is an attempt to make a fourfold contribution to the history of civil engineering in South Africa: (1) to record and describe the large number stone arch, iron lattice girder and timber bridges that were erected during the second half of the 19th century in the eastern half of the Cape Colony; (2)) to situate bridge construction within the wider socio-political and economic situation of the Cape Colony; (3) to trace the development of 19th century bridge technology in Britain as adopted and adapted in the Cape Colony; (4) to record the part played by government departments, structures and agents that shaped local construction; and the funding of finance for bridge building.

[1] E.L.Kemp, 'The Fabric of Historic Bridges', *Journal of the Society for Industrial Archaeology*, 15, 2 (1989), p.1.

This thesis argues that the construction of wagon bridges over the numerous rivers encountered in the Eastern Cape Colony was imperative for the free flow of military forces and their commissariat, and thereafter the commercial expansion as new towns were established. By extension of this central thesis, it is argued that the construction of these permanent bridges, which made a critical contribution to the economic and social expansion of the Eastern Cape, would not have been possible without the initial efforts of the Royal Engineers, the later evolution of a more sophisticated Public Works Department that commissioned the construction process and the expertise contributed by engineers such as Joseph Newey. [2]

The economic development of overseas European colonies was dependent upon the growth of effective infrastructure in order to accomplish the reason for Imperial conquest. This was accompanied by the need to find, develop and protect new markets and maintain privileged access to natural resources. It was particularly difficult in the Cape Colony since neither the Dutch East India Company nor the British government was willing to invest much in a place which was seen as little more than a strategic staging post on the sea route to the East. The impetus for development therefore had to come mainly from the settler colonists, apart from a few enthusiastic administrators like John Montagu, as the colony expanded. The eastern districts of the Cape Colony presented particular difficulties, including a difficult terrain with rugged mountains and many rivers often flowing through deep ravines. Added to this was a small white population and a turbulent indigenous population who fiercely resisted white encroachment on their lands. The intervention of the military to maintain order and facilitate exploitive expansion was essential for the imperial ideal. This thesis argues that road and bridge building engineers played a critical role in development which has been largely ignored by historians. While the history of civil engineering in South Africa offers new perspectives on and a deeper understanding of the process of development.

The early expansion from the initial settlement at the foot of Table Mountain from the place that was to become Cape Town, involved crossing mountain barriers and numerous rivers, travelling along rough tracks across the veld, as the colony expanded eastwards. To become effective and to benefit the economy, the network of roads and bridges slowly developed to keep track with the demographic and mercantile requirements of the colony. The introduction and improvement of the transportation system has been highlighted within the context of the development of the Cape Colony

[2] D.E.Walters, *Bridging the Eastern Cape, the Life and Work of Joseph Newey*, (East London: Coral Tree Press, 2014), pp.84-91, 108-115.

as the crossing of rivers evolved from the fording of shallow drifts, to the introduction of pontoons and ferries, and finally to the construction of bridges.

Cape colonial expansion was driven by several often inter-related and primary agencies such as demographic and agricultural expansion, military conquest, missionary activity and the spread of mercantile trade. Several other secondary processes followed such as settler occupation of land, the establishment of new towns, the growth of government agencies and bureaucracies and the construction of infrastructure and transportation networks. Political, social anthropological, economic and even military aspects of the colony have received far more attention from historians than the neglected study of the history of civil engineering with special reference to bridge building.[3]

During the process of the nine frontier wars, the Eastern Cape became one of the most heavily fortified areas of South Africa,[4] mainly because it was the region where the British first attempted to expand into independent parts of Southern Africa and where they first encountered stiff resistance from the African people in the form of the amaXhosa. Some of the fortifications were erected and abandoned within a few months, while others endured, becoming more permanent and evolving into towns, thereby playing an important role in the expansion of colonial power and the establishment of colonial hegemony. These forts and posts served as symbols of British and colonial power, erected to form barriers along declared boundaries, and provide protection of lines of communication such as roads and bridges and centres for trade and settlement. Many of the small posts of communication were sited along wagon routes where detachments of soldiers could patrol and provide shelter. The same soldiers were required to maintain the interlinking roads, clear the dense vegetation along their routes and build drifts across the rivers.[5]

Bridges are a special subject since they may be considered as pure structures whose only function in transporting wagons, carriages and later railway locomotives, is to safely carry imposed loads. Bridges and roads are inseparable, for it is the roads which require the bridges, and the bridges make possible the extension of roads. Bridges have traditionally represented the greatest challenge to structural engineers in their attempt to provide larger and larger spans over wider and wider rivers to carry heavier and heavier

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3 D.A.Webb, 'Kraals of Guns and Redoubts of Authority: Military Conflict and Fortifications in the Wars of Dispossession and Resistance in South Africa's Eastern Cape, 1780-1894', (PhD Thesis, University of Fort Hare, 2015), p.2.

4 Only to be exceeded by the 441 masonry and 7,447 corrugated iron 'Blockhouses' of the Anglo Boer War during 1901-1902 in R.Tomlinson, 'Three Centuries of Fortifications in South Africa 1652-1958', *Fort*, 34, (2006), p. 8.

5 Webb, Kraals of Guns and Redoubts of Authority, p.29.

loads. These requirements were largely driven by the demands of the rapid industrialisation of imperial Britain and mainland Europe during the nineteenth century, at the end of the industrial revolution, and had a significant bearing on the expansion of the Eastern Cape Colony. The late 19th century was characterised by a widespread belief in the civilising potential of technology which accompanied the rapid imperial expansion into numerous parts of Africa by Britain and later by the other European powers.

Bridges are a most visible and an often taken-for-granted part of the Cape colonial landscape and as such the conception, design and construction of bridges may be seen as a significant undertaking demanding large commitments of financial, industrial and human resources. In addition, historians of engineering heritage studying old bridges need to investigate the development of bridge types, materials of construction and distinctive information on individual bridges, their fabrication and erection. Bridge building, which made development possible, improved infrastructure and the lives of the inhabitants, can thus be considered as an appropriate subject for both economic and social historians, while this thesis may be considered to be firmly located in the genre of historical civil engineering. [6]

The eastward expansion of the Cape Colony was demarcated by successive rivers being declared to be the eastern boundary of the colony: the Breede River in 1743, the Gamtoos River in 1770, the Bushman's River and upper Fish River in1775 and the Great Fish River in 1778. Thereafter in 1819 the Keiskamma River followed by the Kei River in 1835 and again in 1847. As the eastern boundary of the Cape Colony was extended, the northern-eastern boundary also expanded until it came to rest along the Orange River.[7] Colonisation was accompanied by a need for improved transportation and infrastructure especially roads and bridges.

LITERATURE REVIEW

Nineteenth century Eastern Cape history has been the subject of a number of publications and academic theses by historians over the past 50 years. Historically the region has gone through some turbulent times of which most has revolved around the nine so-called frontier wars, as British imperial hegemony held sway. Remnants of the conflicts and confrontations may be seen in the forms of numerous ruins of forts and

[6] E.L.Kemp, The Fabric of Historic Bridges, p.1.
[7] D.A.Webb, 'Kraals of Guns and Redoubts of Authority, p.4.

military posts, dotted over the region. The seminal publication of Coetzee,[8] *Forts of the Eastern Cape, Securing a Frontier, 1799-1878*, is the most comprehensive description of fortifications in the Eastern Cape. Coetzee devotes fifteen pages to the communication system on the frontier as the Royal Engineers built the Queen's Road and other roads linking the various forts. It contains a large number of plans, maps and drawings of fortifications and signal towers including Royal Engineer plans of Fort Brown and Kat River (Victoria) bridges. A trip to the National Archives at Kew was made by the writer to locate references of bridge building activities undertaken by and recorded in the files of the Royal Engineer Corps at the Cape. Publications covering various aspects of the frontier wars and other aspects of the history of the Eastern Cape have been produced by several historians such as Webb,[9] Stapleton,[10] Crais,[11] Legassick,[12] Milton,[13] le Cordeur,[14] Galbraith,[15] MacLennan,[16] Mostert,[17] Smithers,[18] Baker[19] as well as the extensive works of Theal[20] and Cory.[21] These publications, while describing the various aspects, reasons, conditions and interpretations of the conflicts at the time, ignore the transportation situation which played a not insignificant part in the success of the British subjugation of the indigenous people.

A number of rather dated publications deal with transport and infrastructure of the Eastern Cape Colony in passing. The oldest book appears to be by Mossop[22] who describes the roads, passes and a few bridges around the Cape Peninsula and the immediate hinterland from the early days of the Dutch settlement, while Burman[23] has simply produced accounts of numerous historical events. Richings[24] has described Michell and his works of designing mountain passes, roads and bridges in a most

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[8] C.G.Coetzee, *Forts of the Eastern Cape, Securing a Frontier, 1799-1878*, (Fort Hare Press, 1995).
[9] D.A.Webb, 'Kraals of Guns and Redoubts of Authority',
[10] T.J.Stapleton, *A Military History of South Africa: from the Dutch-Khoi Wars to the End of Apartheid,* (Santa Barbara: Praeger, 2010*); 'Xhosa Resistance to Colonial Advance'*, (Johannesburg: Jonathan Ball, 1994).
[11] C.Crais, *Poverty, War and Violence in South Africa,* (Cambridge: Cambridge University Press, 2011)
[12] M.Legassick, *The Struggle for the Eastern Cape 1800-1854: Subjugation and the Roots of South African Democracy,* (Johannesburg: KMM, 2010),
[13] J.Milton, *The Edges of War, A History of Frontier Wars 1702-1878,* (Cape Town: Juta, 1983)
[14] B.le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* (Cape Town: Oxford University Press, 1981)
[15] J.S.Galbraith, *Reluctant Empire, British Policy on the South African Frontier 1834-1854,* (Berkeley and Los Angeles: University of California Press, 1963)
15 B. Maclennan, *A Proper Degree of Terror, John Graham and the Cape's Eastern Frontier,* (Johannesburg: Raven Press, 1986)
[17] N.Mostert, *Frontiers - The Epic of South Africa's Creation and Its Central Tragedy, the Agony of the Xhosa People,* (London: Pimlico, 1992)
[18] A.J.Smithers, *The Kaffir Wars 1779-1877,* (London: Leo Cooper, 1973)
[19] M.Baker, 'Representations of the "enemy" in military narratives of the South African Frontier Wars of 1834, 1846 and 1851', (PhD thesis, University of the Witwatersrand, 2014)
[20] G.M.Theal*, History of South Africa, 1795-1884,* (London: Swan Sonnenschein, 1891)
[21] G.E.Cory, *The Rise of South Africa, from the beginnings – 1846,* (London: Longmans, 1926)
[22] E.E.Mossop, *Old Cape Highway',* (Cape Town: Maskew Miller, 1927)
[23] J.Burman, *Towards the Far Horizon, the Story of the Ox-wagon in SA*, (Cape Town: Human & Rousseau, 1988), and *So High the Road, Mountain Passes of the Western Cape*, (Cape Town: Human & Rousseau, 1963), and *Early Railways at the Cape,* (Cape Town: Human & Rousseau, 1983)
[24] G.Richings, *The Life and Work of Charles Michell*, (Cape Town: Fernwood Press, 2009)

comprehensive manner. Michell as the Surveyor General from 1828 to 1848 was the first engineer to tackle the thorny issue of the transportation system by designing the first mountain passes including several substantial bridges. In his thesis J.J.Smit,[25] concentrated on the historical roads, mountain passes and bridges of the western and southern Cape, in which he covered the early transportation initiatives in three phases, the pioneering period of 1806-1828 which was restricted to the Cape Peninsula, the next phase of 1828-1843 was undertaken by the Surveyor General and his work in crossing over the mountain ranges that restricted the population from the first settlement. The third and final phase of 1843-1858 described the works of John Montagu and the Central Road Board, and the last project to be described is that of Howison's Poort outside Graham's Town. Smit only makes fleeting mention of bridges along the various routes. Dods[26] takes up the narrative with a description of roads around Graham's Town, the area of the Zuurveld, later called Albany, from the time of the 1820 Settlers until the end of the 19th century, including the railways and the harbours of Algoa Bay and Port Alfred. Here again, he only touches on the bridges along the routes. Storrar[27] produced a book about the mountain passes of Thomas Bain, the padmaker, similar to the book by Ross,[28] who later also brought out a comprehensive and extremely useful guide to research of all the roads, mountain passes and bridges of the Cape.

Robson outlined the British colonial policy of exerting control over an area by means of strategic settlement expansion. Here the Royal Engineers promoted development in the Eastern Cape through their scientific training by building fortifications, roads, surveying, mapping and the establishment of towns.[29] A serious omission is that the author omitted to mention the construction of bridges. Porter[30] and Connolly[31] have provided histories of the Royal Engineers and the Sappers and Miners, their training and postings to all parts of the empire with scant mention of their bridge building activities. Thompson has focussed on the work of the Royal Engineers during the Iberian Peninsula military campaigns which included siege warfare and the building of many temporary bridges

[25] J.J.Smit, 'Die Paaie, Passe en Rivieroorgange in Suid-Kaapland 1806-1858', (PhD thesis, UNISA, 1974)
[26] G.D.R.Dods, 'Nineteenth Century Communications in the Zuurveld', (MSc thesis, Rhodes University, 1960)
[27] P.Storrar*, A Colossus of Roads,* (Cape Town: Murray & Roberts/Concor, 1984).
[28] G.D.Ross, *The Romance of Cape Mountain Passes,* (Cape Town: David Philip, 2002); '*Mountain Passes, Roads & Transportation in the Cape, a Guide to Research',* (Somerset West: Self-Published, 5th Ed, 2013).
[29] L.G.Robson, 'The Royal Engineers and Settlement Planning in the Cape Colony 1806 – 1872 : Approach, Methodology and Impact', (PhD thesis, Pretoria University, 2011) and L.G.Robson & M.Oranje, 'Strategic Colonization : The Cape Eastern Frontier 1806-1872'*, Scientia Militaria, SA Journal of Military Studies*, 40,2 (2012).
[30] W.R.Porter, *History of the Royal Corps of Engineers, Volume 1,* (Woolwich,1889).
[31] T.W.J.Connolly, *History of the Corps of Royal Sappers and Miners,* (London: 2 volumes, 1855).

and repairs to destroyed ones.[32] The many diverse duties and operations of the Crown Agents for the Colonies have been recorded by Abbott[33] and Sutherland[34] without a single mention of bridges. While Purkis[35] is acknowledged to have produced one of the most comprehensive studies of the dealings of the Crown Agents in the Cape Colony, he does so without mentioning anything about bridges. In the monthly *Transactions of the South African Institution of Civil Engineers* occasional articles about historical bridges throughout the country, including their construction details, appeared under the title of 'Hallmarks', a celebration of engineering accomplishments. However, very few Eastern Cape Bridges were covered under these articles, the Victoria Bridge at Fort Beaufort[36] and the 1874 flood-destroyed bridges,[37] were exceptions. The only book to provide a detailed account of bridge building in the region is by the author.[38] While providing a narrative of the career and achievements of Joseph Newey, it covered most of the bridges which this thesis has described in some detail. This project inspired and informed the work undertaken for this thesis.

SYNOPSIS

This thesis is organised as follows: The introductory chapter comprises a statement and brief overview of the thesis which covers the field of research and a discussion about the significance of the study. The previous section evaluated the state of historiography of bridge building in the eastern half of the Cape Colony. The second chapter outlines the civic and political situation at the Cape Colony mainly during the 19th century and the impetus for growth in the economy of both trade and services will be described. The colonial expansion of the population that led to the need for improved transport routes along roads, over mountain passes and bridging many rivers. The involvement of the British military, the resistance of the amaXhosa and the various frontier wars, European immigration during the 19th century, and the stages of annexation up until the 1880s will be outlined. The third chapter highlights the fact that very few bridges had been built by the Dutch administration so that the Royal Engineers had a huge task in eliminating the backlog when they first landed at the Cape. They commenced work by designing and

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32 M.S.Thompson, *Wellington's Engineers, Military Engineering in the Peninsula War 1808-1814*, (Barnsley: Pen and Sword, 2015).
33 A.W.Abbott, *A Short History of the Crown Agents and their Office*, (Private, 1959).
34 D.Sutherland, *Managing the British Empire; the Crown Agents, 1833-1914*, (London: Boydell Press, 2004).
35 A.J.Purkis, 'The Politics, Capital and Labour of Railway Building in the Cape Colony 1870-1885', (PhD thesis, Oxford University, 1978)
36 H.L.Huisman, 'The Victoria Bridge at Fort Beaufort', Hallmark 15, *The Civil Engineer in SA*, (March 1975), pp.71,72.
37 D.R.Nelson, 'Bridging the Fish', Hallmark 32, *The Civil Engineer in SA* (July 1980), pp. 188-190.
38 D.E.Walters, *Bridging the Eastern Cape, the Life and Work of Joseph Newey,* (East London: Coral Tree Press, 2014).

supervising the construction of buildings, fortifications, roads and bridges. Chapter four describes the establishment of colonial government structures such as the Central Road Board which drove the regulation, financing, surveying, design and construction of various roads, mountain passes and bridges. They included the first permanent, convict built roads in the Cape Colony, including several stone and timber deck bridges.

Chapter five covers the period when the Public Works Department took over the building of roads and bridges and outlines the organizational structure of the PWD, including its hierarchy and duties. Chapter six describes the activities of the Crown Agents for the Colonies who were appointed by the Cape Colonial Government, and fulfilled the functions of securing the funding and logistical support in financing the various government projects, engaging consulting engineers, bridge fabricators and contractors. Chapter seven will outline the world-wide growth of the theory of structural analysis and how it was used in designing 19th century bridges with the emphasis on British bridge design methods. It will be shown how the Industrial Revolution directly influenced the technology of bridge building through the coming of the railway age and its need for numerous heavy load-bearing iron bridges. The methods of design and construction of the bridges will be described. Chapter eight will survey the construction record at the Cape of the various stone arch, iron lattice girder and timber bridges, for the period from their inception in the 1860s through the recession that overwhelmed the whole colony during the 1880s. During this period numerous bridges were constructed when economic recovery heralded by the discovery of gold on the Witwatersrand demanded an increase in transportation infrastructure for both roads and finally railways. This period concluded with the outbreak of the Anglo Boer War which suspended all bridge building activity. Chapter nine will detail the histories of the most significant bridges outlined in the previous chapter. The basic format to be used will be to detail the various bridges on which river, their physical configuration and dimensions, followed by the designers, the bridge fabricating companies and finally who erected them, together with selected period photographs. The conclusion summarises and evaluates the main contribution to historical knowledge made by this thesis and outlines how the research goals have been achieved.

The trend of shifting topical historiography from the field of political history to social history[39] has been adopted by this study. It has been shown how the progress and prosperity of communities was improved by being able to cross rivers by bridges as

[39] P.N.Stearn, 'Social and Political History', *Journal of Social History*, 3, (1983)

opposed to having to use ferries and ponts or being partially submerged on wagons. While documenting the dozens of bridges of the region, an attempt has been made to analyse their suitability and the benefits they provided for the transportation system at the time. Behind every successful bridge construction, dozens of skilled engineers and artisans toiled to present a practical solution and improvement to the transportation network across the region. Their efforts will be highlighted as they made a significant contribution to the infrastructural development of the Eastern Cape.

Fig 1: A map of the Cape, Orange Free State, Transvaal & Natal, c.1990

CHAPTER TWO – COLONIAL EXPANSION AND THE BUILDING OF ROADS AND INFRASTRUCTURE IN THE CAPE COLONY

The following chapter describes four broad developments: The first was the expansion of the original Dutch settlement at the Cape. The Cape coastline and immediate hinterland is a land of mountains and rivers. In their quest for new grazing land, the migration of the early free burgher trekboers[1] opened up the hinterland, however their progress was impeded by the difficulty of crossing the many mountain ranges and rivers in their path.[2] In the process they dispossessed the indigenous Khoekhoe[3] of their grazing land.[4] It was only after the British finally took over the Cape in 1806 that their financing of infrastructure made possible improvements in transport that boosted the wellbeing for all colonialists, as roads, mountain passes and bridges were constructed. The second development was the British attempt to secure the eastern frontier which had previously brought the trekboer expansion to a sudden halt as they met up with the migrating amaXhosa[5] between the Sundays and Fish Rivers. In 1778 the Dutch Administration had proclaimed the Fish River as the boundary of the colony which was never enforced. Initially the British tried to maintain the status quo recognising the Fish River as the limit of colonial expansion.[6] As the amaXhosa were well entrenched in the Zuurveld, the land between the Sundays and Fish Rivers this proved difficult. Subsequently the British military forced the amaXhosa to retreat across the Fish River as they dispossessed them of their land by successive conflicts, now referred to as the frontier wars. The continued domination of the British military on the eastern frontier required the establishment of a number of military posts and forts, several later evolving into towns, such as Graham's Town and Fort Beaufort.[7] Dependable roads between these posts and forts became essential for the transport of soldiers and commissariat.

The third development commenced with the immigration of the 1820 British Settlers and their settlement in the Zuurveld, now called Albany.[8] The amaXhosa proved to be resilient and resolute foes well adapted to guerrilla warfare as continuing conflicts required the construction of more military forts and posts. In addition, the ever

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1 Trekboers were nomadic pastoralists descended from mostly Dutch colonists, French Huguenots and German Protestants who had originally settled at the Cape from Europe from the seventeenth century

2 E.E.Mossop, *Old Cape Highways*, (Cape Town: Maskew Miller, 1929), p.28.

3 Khoekhoe, the modern name for Hottentots, people distinguished by short stature, yellow-brown skin, and tightly-curled hair, and speaking a language characterized by click sounds

4 A.Wilmot, J.C.Chase, *History of the Colony of the Cape of Good Hope*, (London: Longmans, 1869), pp. 191-196.

5 amaXhosa, a black African ethnic group of the eastern Cape, divided into several tribes, speaking Bantu language

6 Wilmot & Chase, *History of the Colony*, p. 248.

7 L.A.Thompson, *A History of South Africa*, (Sandton: Radix, 1990), p.55.

8 H.E.Hockly, *The Story of the British Settlers of 1820 in South Africa*, (Cape Town, Juta&Co, 1957), p.43.

increasing European immigrant population, including the British and German settlers, drove the continued colonial expansion, with the amaXhosa eventually being forced over the Kei River.[9]

The fourth development introduced a further essential dimension, that of commercial trade of supplying commodities to the newly established towns, military posts and farms and of exporting agricultural produce such as wool. The wagon building industry flourished as the demand for transport increased. With trade came the need for an expanded network of reliable transport routes for wagons, such as additional roads, mountain passes and bridges over flooded rivers in the newly conquered territories.

THE DUTCH OCCUPATION OF THE CAPE AND THE BEGINNING OF ROAD CONSTRUCTION c.1652-1825

The permanent settlement at the Cape commenced in 1652 with the arrival from the Netherlands of Jan van Riebeeck (1619-1677) to establish a fortified base where Dutch fleets could be replenished with fresh water, vegetables, fruit and grain and where sick sailors could recuperate. He had been sent by the Dutch East India Company (VOC), a hugely profitable trading corporation at the time, which required a station on the trade route between the Netherlands and their eastern empire centred on Batavia.[10] In order to satisfy the high demand for fresh produce from passing ships and to accommodate the expanding settlement, the first nine men were released from their contracts by the Company in 1657 and given farms to cultivate produce, thereby becoming the first free-burgher farmers.[11] In due course, many free burghers set themselves up as blacksmiths, wagon makers, carpenters, masons and other types of craftsmen,[12] when van Riebeeck had the first ox wagon manufactured out of local timber.[13]

Eventually this isolated replenishment station grew into a colony as increasing numbers of free burghers expanded beyond the Cape Peninsula occupying surrounding land and displacing the original occupants, the local Khoekhoe pastoralists. As the Khoekhoe were unwilling to work for these newcomers, the Company imported several hundred slaves to do the manual labour on farms, with road building being a common task.[14]

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9 Hockly, *British Settlers*, p.123.
10 Thompson, *A History of South Africa,* p.33.
11 Thompson, *A History of South Africa,* p.35.
12 J.Burman, *Towards the Far Horizon- the Story of the Ox-Wagon in South Africa*, (Cape Town: Human & Rousseau, 1988), p.20.
13 J.Malan, *Rytuie van Weleer*, (Cape Town: Van Schaik, 2004), pp. 55-57.
14 Thompson, *A History of South Africa*, pp.33-34.

In 1679 Governor Simon van der Stel (1639-1712) authorised the second phase of expansion and allowed larger land grants for farms, with free passage offered to Europeans wishing to settle at the Cape. The settlement grew and expanded with a second village, Stellenbosch, established in 1679, then further inland Swellendam in 1743 and Graaff-Reinet in 1786. As the local indigenous Khoekhoe[15] population were systematically and forcefully deprived of their land; they resisted and eventually revolted. The revolts were brutally suppressed, while the smallpox epidemics in 1713 and 1755 finally destroyed the resistance of the Khoekhoe and they became subservient as cowherds, shepherds and domestic servants of their Dutch masters, treated no better than slaves.[16]

The first wagon road from Cape Town to Stellenbosch, known as 'w*agenweg na de Caab*', crossed the Plankenbrug River on the Steenebrug bridge on Lower Dorp street at Stellenbosch. It comprised a timber bridge deck on several stone piers, which had been built by stonemasons Simon Janssens and Matthijs Diederick in 1691.[17] The crossing of the Hottentots Holland Kloof, the mountain barrier beyond the Cape Flats, had to be undertaken to reach eastern destinations of Swellendam and the interior. After 1707, the route followed the steep and dangerous Gantouw Pass, where the ox wagon brake shoes of old have left deep incised grooves in the sandstone bedrock.[18] Travellers, then, had to cross the Palmiet River before descending to the coastal plain via the Houw Hoek Pass, even rougher than the previous pass. The first Palmiet River bridge, the Oudebrug, was only built much later in 1811, a timber bridge deck supported on stone piers.[19] Initially the roads were little more than tracks across the veld and travelling in those days could be hazardous as wagons often overturned on the uneven tracks. After fording deep rivers and traversing the rough terrain of mountain passes, wagons often needed repairs. Transportation between the inland trekboer homesteads, comprising wattle branches and clay daub '*hartebeestehuise'* [20] houses with thatch roofs, and the main trading towns, was over these rough game tracks across the veld, traversed on horseback or by ox wagon. From Graaff-Reinet it took up to three months for a wagon to undertake a return trip to Cape Town in the 18th century**.**[21] The collection

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15 Khoekhoe were an indigenous people, called Hottentots by the Dutch, traditionally practiced nomadic pastoral agriculture

16 Thompson, *A History of South Africa,* p.50.

17 D.Van Stappen, 'Simon van der Stel, en de uitbreiding van de Kaapkolonie', 1679-1699, (MA Thesis, University of Gent, 2007), p.46.

18 J.J.Oberholster, *The Historical Monuments of SA* (Cape Town: Rembrandt van Rijn Foundation, 1972), p.105.

19 G.D.Ross, The earliest SA road bridges outside of a town, *Civil Engineering magazine,* (Sep 2008),p.38.

20 A rudimentary house from the North European Long House tradition, built of reeds and plastered with mud

21 J.Burman, *Towards the Far Horizon- the Story of the Ox-Wagon in South Africa,* pp.69-72.

of tolls before passing over a stretch of road in order to use the money to keep the road in repair was an old medieval custom that was applied at the Cape under the Dutch East India Company. Anders Spaarmann in 1776 describes paying '….a trifling toll which is levied to defray the expense of keeping this (Oude Tulbagh Kloof, Roodezand) pass in repairs…' This toll and repairs were contracted to persons by the Company for a fixed annual sum. Another toll was collected at the foot of the original Gantouw or *Elandspad* pass over the Hottentots Holland Mountains.[22]

In order to search for suitable grazing and loan farms, many trekboers trekked further and further away from the Cape peninsula. The expansion created further conflict with the local indigenous Khoekhoe over livestock and grazing land. In reaction to expansion, the Khoekhoe raided the cattle and sheep and sometimes the homes of the migrating farmers. In response, the farmers established their one and only co-operative institution, the 'commando', and recaptured the livestock. In the process, the farmers dispossessed the Khoekhoe of their land, who in turn became part of a captive labour force as they were absorbed onto farms as servants and labourers.[23] By the 1770s the trekboer expansion was constrained in all directions, the arid Karoo to the north; the San hunter-gatherers to the northeast; and beyond Algoa Bay to the east, the amaXhosa pastoralists, a sizeable and determined opposition.[24]

By 1793, the Dutch East India Company's colony at the Cape of Good Hope had a population of 13,830 burghers and 25,754 slaves.[25] Colonists who lacked sufficient land and capital for successful agriculture were forced to make a living as pastoralists and hunters. This burgeoning section of the population that accounted for the bulk of the natural increase in the white population became known as trekboers, pastoralists and migrant farmers. The company granted them 'loan farms' of 6,000 acres in extent beyond the Cape Peninsula[26] and for which annual rent had to be paid.[27]

As the burghers moved into the eastern-most fringes of the Cape Colony, they found it already inhabited by the amaXhosa, a people whose lifestyle was essentially pastoral and who had a tradition of assimilation and whose organisation and numbers prevented their ready subjugation like the Khoekhoe had been. The main areas of competition

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22 E.E.Mossop, *Old Cape Highways*, (Cape Town: Maskew Miller, 1928), pp.52,63.
23 S.Newton-King, *Masters and Servants of the Cape Eastern Frontier*, (Cambridge University Press, 1999) p.57.
24 Thompson, *A History of South Africa*, pp.47-50.
25 J.Amstrong, and N.Worden in R. Elphick and H. Giliomee (eds) *The Shaping of South African Society 1652-1840*, (Cape Town: Maskew Miller Longman,1989) p.130.
26 Cape Town and its immediate surrounding environs
27 Thompson, *A History of South Africa*, pp.40-46.

centred on the land between the Sundays and Fish Rivers, known as the Zuurveld, and the Boschberg of Agter Bruintjieshoogte to the north. During this time three rather inconclusive wars were fought; in 1781, 1792 and 1798. The loose and arbitrary way in which the Dutch East India Company determined the boundary of the colony, both inflamed the conflict and provided the justification of the future warfare.[28] In particular, the manner in which Governor Baron Joachim van Plettenberg (1739-1793) decided upon the Fish River as the boundary in 1778 ignored the fact that the area in question had long been in the possession of the Khoekhoe and the amaXhosa of late and that his so-called agreement was not considered to be binding on all of those living there. A period of intense competition for control of the land ensued, marked by broken peace treaties, cattle raids and wars.[29]

Continental Europe was in turmoil following the French Revolution and the defeat of the First Coalition, by the French Revolutionary army, of which the Netherlands was a partner, which established the Batavian Republic in May 1795 as a colony. Fear of the Cape falling into the hands of the French motivated the British government to send a force under General Craig to secure the colony. When Britain first took possession of the Cape Colony in 1795, it was a slave-owning outpost, three months sailing distance from London, previously run by a Dutch commercial enterprise that had teetered on the brink of bankruptcy for several years.[30] Britain's primary interest was to use the Cape as a naval base at the foot of Africa and was determined to keep it out of the hands of the French. The Peace of Amiens of 1803 restored the Cape to the Dutch who were ousted once more, three years later, in January 1806 by General Baird at the battle of Blaauwberg. The Cape was permanently ceded to Britain in 1814 by the London Convention.[31]

When the Batavian Republic regained the Cape following the Treaty of Amiens, the Dutch Governor General Janssens promulgated the following regulations in 1805, starting with Article (Ordinance) 1.

> Article 164, Landdrost and Heemraden are also to look to the making and keeping in repair, of streets and roads; and they are in particular to endeavour, that all the passes over the mountains or rivers, by which the produce of the colony is to be conveyed, either to Cape Town or to any other market are put in the best possible state; and they are to satisfy themselves by frequent inspections and other expedient means, of being kept so. Article 273, The Fieldcornets each in their respective districts shall pay attention to the

[28] Wilmot & Chase, *History of the Colony of the Cape of Good Hope*, p.251.
[29] D.A.Webb, 'Kraals of Guns and Redoubts of Authority', pp. 50-53.
[30] Thompson, *A History of South Africa*, p.52.
[31] Thompson, *A History of South Africa*, p.53.

improvement and repairs of the public roads and in particularly obey and cause to be obeyed, the orders they receive respecting them, or which the Proclamations and Ordinances prescribe to them.

This was the method employed by the authorities to build and maintain roads in the Dutch era, always with slave labour, that continued until their emancipation in 1834.[32]

Governor Macartney appointed a Burgher Senate whose duties and powers amongst others included the construction and repairs to main roads throughout the Peninsula. They in turn delegated their duties to the Landdrosts and Heemraden of the various districts. Duties were further delegated to 'baaspadmakers' (master road builders) in each fieldcornetcy.[33] The military road from Cape Town to Simon's Town was reconstructed and maintained for a time by Khoekhoe soldiers of the Cape Regiment. In 1806 the first substantial Cloete Bridge was built over the Liesbeeck River, followed by the Westerford Bridge in 1809, all to the design of L.M.Thibault and comprising timber decks on stone pillars.[34] While farm workers and slaves were used on road works, prisoners were used for the first time in 1824. In 1825 all roads of the Peninsula were placed under the superintendence of the Royal Engineers.[35] The reconstruction of the road from Westerford Bridge to Muizenberg included the Diep River bridge, designed by Thibault and built by master mason J.Diehl for 5,500 rix dollars in 1811. During the same period mason Mocke built two more bridges, including a second one over the Liesbeeck River,[36] while mason Herman Schutte built a stone arch bridge at Simon's Town in 1814.[37] In 1825 Major W.C.Holloway RE presented a plan to Governor Somerset to construct a 'hard road' between Salt River and Stellenbosch. The comprehensive plan had been prepared by Lieut Cowper Rose RE[38] who compared four separate routes across the Cape flats at an estimated cost of £8,399 which was too expensive and the project was shelved in favour of the new Fransche Hoek pass. Apart from the construction of bridges over the Liesbeeck and Palmiet Rivers, and a few small streams, all the other river crossings were served by ponts.[39] Rudimentary rural road construction and repairs continued unabated with the use of local labour, farmers and contractors, funded mostly by tolls at toll gates and limited government grants.

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[32] G.M.Theal, Records of the Cape Colony, 24 (1904), pp. 402,422
[33] J.J.Smit, 'Die Paaie, Passe en Rivieroorgange in Suid-Kaapland, 1806-1858', (D.Litt et Phil, UNISA, 1974,) pp.18-25.
[34] Smit, 'Die Paaie, Passe en Rivieroorgange', p.64.
[35] Smit, 'Die Paaie, Passe en Rivieroorgange', pp.31-32.
[36] Smit, 'Die Paaie, Passe en Rivieroorgange', p.65.
[37] Smit, 'Die Paaie, Passe en Rivieroorgange', p.68.
[38] CAD CO234, No.303 Report Rose to Holloway, 5 December 1825.
[39] Smit, 'Die Paaie, Passe en Rivieroorgange', pp.92-99.

After a few years of relative peace, the second occupation of the Cape by the British was to change the situation, with the introduction of a powerful, organised military force. In 1809 Governor Lord Caledon, sent Lieutenant Colonel Richard Collins, of the 83rd Regiment, to explore the northern and eastern frontiers of the Colony and interview the various amaXhosa chieftains, Hintsa, Ngqika, Ndlambe and Umhala.[40] The Landdrost of Uitenhage, Jacob Cuyler, who sided with the Boers against the amaXhosa, probably influenced Collins in his report in which he advised, inter alia, that the Xhosa in the Colony should be expelled by force and that plots of land of 120 acres should be offered to European immigrants to achieve a suitably dense population in the Zuurveld. In order to avoid expensive military interventions, Caledon declined to act against the amaXhosa who had settled west of the Fish River boundary and left them in peace.[41]

In 1811 Caledon was succeeded by Lieutenant General John Cradock. Cradock, in contrast to his predecessor, embarked on military action by mobilising the burgher commandos of several districts and troops of the Cape Regiment of Khoekhoe soldiers, 21st Light Dragoons and the 83rd regiment (Royal Irish Rifles). Lieutenant Colonel John Graham of the Cape Regiment was appointed to carry out the military action, with instructions to expel the amaXhosa from the Zuurveld and to use force if they resisted.[42] The Ndlambe and other amaXhosa retreated across the Fish River before the advancing troops. In two months some 20,000 amaXhosa were expelled from of the Zuurveld. The power of the amaXhosa west of the Fish River had been broken with the use of well-trained British soldiers carrying out a deliberate policy of terror, shooting anyone in their path. For the first time the amaXhosa were faced with a well-organized enemy prepared not only to deliberately seize vast herds of livestock but to systematically burn huts and destroy cultivated crops.[43] Afterwards Cradock was to report to London that, "…and I am happy to add that in the course of the service there has not been shed more [Xhosa] blood than would seem to be necessary to impress on the minds of these savages a proper degree of terror and respect."[44] Burghers who had previously suffered most from the amaXhosa depredations and cattle rustling and had

[40] Wilmot & Chase, *History of the Colony*, p. 250.
[41] G.M.Theal, *The History of South Africa from 1795 to 1872'*, (London: Allen & Unwin, Vol I, 1929)' pp.232-234.
[42] B.Maclennan, *A Proper Degree of Terror, John Graham and the Cape's Eastern Frontier,* (Johannesburg: Raven Press, 1986), p. 79.
[43] Maclennan, *A Proper Degree of Terror,* pp.110-115.
[44] Letter Sir John Francis Cradock to Lord Liverpool, 7 March 1812, in Maclennan.

abandoned their loan places (farms) before the intervention, could now return to their burnt-out farmsteads.[45]

The conclusion of the war allowed Col Graham to complete his commitment to arrange the necessary measures for a lasting peace and stability along the frontier districts. He improved the lines of communication by initiating the construction of strategically important roads in the Zuurveld. Soldiers, farmers and Khoekhoe labour repaired the road from Korhaan Drift on the Sundays River to Rautenbach's Drift on the Sundays River and built a new, wider road over the Addo Pass.[46]

In order to secure the Fish River boundary, Col Graham established a number of military posts between the Great Winterberg to the north and the coast. The posts basically formed two parallel lines of defence and each comprised several temporary dwellings of wattle-and-daub, some with rough earthen or stone-packed perimeter walls, constructed close to burgher loan farms after whom many were named. The establishment of these forts and military posts in places far distant from one another and the regular proviant wagon traffic necessitated the construction of better inter-linking roads. The bulk of the patrol work was undertaken by soldiers of the Cape Regiment of Khoekhoe soldiers, who also carried out the bulk of the construction work under the supervision of Royal Engineer officers.[47] The first line of sixteen military posts stretched along the west bank of the Fish River, while a second line of nine posts, were erected from the coast and west of the Fish River, and finally to the extreme west a further four posts were erected.[48] An acceptable site was chosen as the headquarters for the military occupation of the Zuurveld, named Graham's Town in recognition of Col Graham's achievements in expelling the amaXhosa from the area. The arrangements were consolidated administratively in 1814 with the establishment of the magisterial district of Albany.[49]

In reality the initial temporary posts were only partially successful in preventing the amaXhosa from reverting back to their previous Zuurveld kraals. When Lord Charles Somerset became governor of the Cape in April 1814 he embarked on a system of strengthening the frontline military posts by reducing those in the rear. In addition he

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45 J.B.Scott, 'The British Soldier on the Eastern Cape Frontier 1800-1850', (PhD Thesis University of Port Elizabeth, 1959), pp.56-60.

46 J.De Villiers, 'Perspective on John Graham and the Fourth Eastern Cape Frontier War', *New Contree*, 6 (2013).

47 Webb, 'Kraals of Guns and Redoubts of Authority', pp.67-69.

48 *Military Sketch of that part of the Colony of the Cape of Good Hope, Bordering on the Caffres and Most Exposed to their Depredations with the different Military Posts, Farms, Roads, Rivers etc., by Lieut Wily… in the year 1816,* (London: W.Faden, July 1818)

49 G.E.Cory, *The Rise of South Africa*, (London: Longmans, 1921), pp.267-272.

increased the effectiveness and mobility of the garrisons by stationing detachments of the 21st Light Dragoon Regiment at some of the forts to assist in patrolling and in following up the spoor of cattle across the frontier. In 1817 Somerset amended the front line of previous fortifications along the Fish River to comprise of fourteen consolidated and strengthened military posts, in more or less the same locations as those established on the orders of Cradock. A second line of defence consisted of some ten posts to the west of the first line, within the districts of Albany and Uitenhage, mostly sited on farms or at river crossings.[50]

The nature of these posts varied, the majority were temporary thatched roofed wattle and daub dwellings with perimeter earthen ramparts or timber stockades, while some were built of rough-packed stone, indicating more permanent forts, with corner bastions and loop-holed walls. Proper roads were also constructed linking the posts, along which the monthly commissariat wagons had to travel. The more sophisticated structures were to the design of Lieutenant R.H. Rutherford RE of the Royal Engineers and constructed with the assistance of 32 artificers of the Corps of Sappers and Miners.[51]

The British occupancy of the Cape in 1806 introduced British rule together with its rules and ordinances. Governor Cradock made the following proclamation in June 1812 with nine regulations regarding the collection of tolls. These regulations required payment for 'every waggon or other carriage coming to any of the toll gates', in addition it covered fines for the damage to toll gates, mile stones, or for avoiding the payment of tolls, and penalties for other toll-related misdemeanours. The Governor was convinced that the establishment of good roads would induce '…the cheerful cooperation and contribution of the people of the colony…' and result in the improved construction of carriages and reduce the number of animals required to haul them. Tolls were required to raise finance to maintain the roads and would only be liable from people using the roads. Once the necessary toll houses and toll bars (turnpikes) had been erected the following tolls would be payable.[52]

Waggons drawn by 10 oxen, and by 8 horses, and upwards…….	4 sk	0 st
By 8 oxen and 4 horses ……	2	0
Coaches, carriages, etc, by 4 horses ……	2	0
Coaches, curricles, charetts, etc. ……	1	0
Saddle horses ……	0	2
Horned cattle, per 12 ……	1	0

[50] Scott, 'The British Soldier on the Eastern Cape Frontier', pp.103-105.
[51] T.W.J.Connolly, *The History of the Corps of Royal Sappers and Miners*, (London: Longman Brown & Green, Vol I, 1855), p.234.
[52] G.M.Theal, *Records of the Cape Colony*, Vol 8, p.433 [1 Rix dollar = 8 schellings & 1 schelling = 6 stivers]

In 1818, an escalation of internecine amaXhosa relations resulted in a major confrontation when Ndlambe went to recoup lost cattle from his nephew Nqgika, resulting in the battle of Amalinde, after which British forces went to Nqgika's assistance by ravaging Ndlambe's conquered possessions.[53] Coupled with the withdrawal of most troops from the frontier and spurred on by the prophesies of Makana (Nxele), the amaXhosa attacked Graham's Town on 22 April 1819 and after a fierce battle, they were eventually repulsed by 333 troops of the garrison under Col Thomas Willshire of the 38th (South Staffordshire) regiment.[54] Henry Somerset then assembled a force 3,300 strong and in a three-pronged attack drove the amaXhosa back over the Fish River and so ended the fifth frontier war.[55] At the conclusion of the war, Somerset concluded a treaty with Ngqika and declared the land between the Fish and the Keiskamma Rivers as the Ceded or Neutral Territory. The strategy of maintaining many small isolated fortifications to prevent the amaXhosa crossing the Fish River had been exposed as flawed, as they had easily evaded the posts and patrols. A number of posts had been abandoned and subsequently burnt down. The military began replacing the numerous small fortifications with fewer larger ones made of stone, with larger garrisons as the primary line of defence, such as Upper Kaffir Drift Post, Hermanuskraal and De Bruin's Drift. In October 1819 Somerset authorised construction of a fortification for a garrison of about 250 infantry and cavalry in the Ceded Territory. Construction of Fort Willshire, built on the banks of the Keiskamma River, was undertaken by the Royal Engineers and the Royal Africa Corps and which came to be one of the largest stone fortifications built on the frontier.[56]

THE ARRIVAL OF THE 1820 BRITISH SETTLERS

During 1819, Continental Europe and Britain still reeled from the consequences of the Napoleonic Wars that ended at the battle of Waterloo in 1815, with resultant widespread unemployment, poverty, distress and social unrest in England. As more and more people found life intolerable in post-Waterloo Britain, hundreds of able- bodied men and women immigrated to the New World.[57] The Governor at the Cape, Lord Charles Somerset, pressed the Colonial Secretary Lord Bathurst for an emigration scheme, an attractive proposition to solve the problems of many afflicted individuals, while assisting the authorities in defending the colony. For many years, the idea had been propagated

53 Cory, *The Rise of South Africa*, pp.371-372.
54 Cory, *The Rise of South Africa*, pp.388-390.
55 Scott, 'The British Soldier on the Eastern Cape Frontier 1800-1850', p.122.
56 Webb, 'Kraals of Guns and Redoubts of Authority', pp.70-72.
57 Hockly, *The Story of the British Settlers,* pp.20-21

that England could be saved much money in the defence of the troublesome Eastern Cape frontier if a block of densely distributed settlers could be settled along its length. An amount of £50,000 was voted by Parliament to aid emigration to the Cape. Eventually 4,000 British immigrants, the 1820 Settlers, departed in sixty organised parties aboard twenty one ships from a number of ports, destined for Algoa Bay, the present day Port Elizabeth.[58]

These new settlers, who were given modest 100 acre plots on which to eke out an existence, struggled under the foreign African climatic conditions. They faced hardships as failed wheat crops, famine, severe droughts, torrential rains and strict conditions of establishment by the colonial authorities added to their hardships. In order to maintain a closely-packed community on small farms constituting a solid block against invasion, the governor, Lord Charles Somerset, insisted that the settlers were not allowed to trade, to own sizeable farms, to move about freely or to practice their crafts and professions. Dissatisfaction with Somerset's rigid rule led to several petitions being sent to London as the settlers felt that their rights were being eroded. A commission of enquiry into these allegations was instituted which resulted in Somerset being recalled in 1826.[59] Later many settlers migrated to Graham's Town to continue with their trades, while those who remained on the land began to prosper as they introduced stock farming methods of raising cattle and sheep, and growing vegetables and maize. Merino sheep were introduced which significantly increased economic activity through the export of wool.[60] Several settler farmers turned to the introduction of wooled sheep to boost their flagging fortunes. Major Pigot was one of the pioneers of the merino breed, having brought six merino sheep with his party, while Major T.C.White imported a flock of Saxon merinos in 1828. After being almost bankrupted by wheat failures, settler Richard Daniell in 1828 bought Merino sheep from the Western Cape and was soon on the path to wealth.[61]

In July 1824 Somerset proclaimed regulations establishing 'a fair and equitable barter between the Colonists and the amaXhosa tribes' at the Fort Willshire barracks.[62] The market master at Fort Willshire fairs presented returns which showed that from August 1824 to the end of 1825, an estimated £19,317 worth of produce was obtained from the

[58] Hockly, *The Story of the British Settlers,* pp.35-37
[59] D.E.Rivett-Carnac, *Thus Came the English*, (Cape Town: Howard Timmins, 1961), p.77.
[60] W.Beinart W, *The Rise of Conservation in SA, Settlers, Livestock and the Environment, 1790-1950*, (Oxford University Press, 2003), pp.52-53.
[61] K.S.Hunt, L.Bryer , *The 1820 Settlers*, (Cape Town: Don Nelson, 1984), p.66.
[62] Rivett-Carnac, *Thus Came the English*, pp.84-85.

amaXhosa. In the first year 82,672 lbs of ivory, 10 864 hides and 58,602 lbs of thorn tree gum were bought. In exchange for ivory and other products like hides, gum, mats, baskets, skins of wild animals, the colonists traded beads, buttons, mirrors, pen-knives, tinder boxes, axes and blankets. The Fort Willshire trade fairs represented the first large-scale officially-sanctioned trade between the Colony and the amaXhosa, who were slowly introduced to the system of commercial capitalism, a cash economy not necessarily to their benefit.[63] After six years, trade was opened up to all across the whole region, as Graham's Town began to prosper and more settlers located to the town, providing a steady market for the remaining settler farmers.[64]

FURTHER amaXHOSA DISPOSSESSION AND EUROPEAN SETTLEMENT

On 21 December 1834, without prior warning, thousands of amaXhosa under the leadership of Chiefs Maqomo and Tyali attacked the colonists over a wide front. They had been provoked by evictions, drought and the harassment of colonial patrols ostensibly reclaiming stolen cattle through the 'spoor law,' The sixth frontier war was one of the most significant and tragic episodes in the history of the Cape Colony.[65] The regular military forces on the frontier, numbering about seven hundred and scattered in small groups along the two hundred mile frontier, were quite inadequate to repel the sudden invasion. Thousands of amaXhosa, bent on reclaiming their previously dispossessed land, overran and laid waste the districts of Albany and Somerset East, penetrated as far as Uitenhage, burning, pillaging and killing. By the end of the year the marauders had burnt 456 homesteads, pillaged 300 others, destroyed 58 laden wagons and driven off 5,715 horses, 11,930 cattle and 161,000 sheep and goats; damage amounting to an estimated £300,000. The Xhosa invaders ravaged the whole of the Albany district until Colonel Harry Smith restored order and drove off the attackers.[66]

Most of the settlers and their families were able to escape from their farms just in time and fled to the villages of Bathurst, Salem and Graham's Town for protection. The invaders mostly attacked small isolated groups of farmers, pillaging and burning barns, stores and farmhouses and driving off livestock. Colonel (later Sir) Harry Smith made his epic horseback journey from Cape Town, six hundred miles away in six days, in

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63 R.Beck, 'The Legalisation & Development of Trade on the Cape Frontier', (PhD, Indiana University, 1987), pp.175-176.

64 G.Cory, *The Rise of South Africa, A History of the Origin of South African Colonisation and its Development towards the East from the Earliest Times to 1857*, Vol IV, (London: Longmans Green & Co, Vol IV, 1926)' p.209.

65 T.J.Stapleton, *Maqoma, Xhosa Resistance to Colonial Advance 1798-1873*, (Johannesburg: Jonathan Ball, 1994), pp.86-87.

66 R.Godlonton, *A Narrative of the Irruption of the Kaffir Hordes into the Eastern Province of the Cape of Good Hope 1834-35*, (Graham's Town: Meurant & Godlonton, 1835), p.23.

early January, to take control of the situation. Within a few days of his arrival, on 10 January 1835, Smith commenced with the task of driving the amaXhosa out of the Colony. By the end of March this difficult task had been accomplished and they had been pushed out of the Ceded or Neutral Territory and across the Keiskamma River. The Governor, Sir Benjamin D'Urban, arrived by sea with several thousand regular troops and on the 10 May 1835, the Kei River was declared the eastern boundary of the Colony, and the newly acquired territory between the Keiskamma and Kei Rivers was declared the Province of Queen Adelaide. Several new forts were erected and the military headquarters was established at a spot next to the Buffalo River called King William's Town after the current British monarch.[67]

Governor D'Urban in order to secure the new province, ordered the construction of a number of additional fortifications at strategic points throughout the new province. Forts Warden, Wellington, Hardinge, Hill, Beresford, Murray, White, Cox and Waterloo, were all temporary forts comprising thatched wattle and daub huts surrounded by earthen ramparts, much work for the entire contingent of Sappers at the Cape. D'Urban's strategy was to dominate the wagon routes and to have a physical presence amongst the defeated amaXhosa.[68] In a major setback for the colonial project, D'Urban's proclamation of the Province of Queen Adelaide was rescinded. He had exceeded his authority in extending the colonial boundary and was out of touch with developments in England. Lord Glenelg, the new Secretary of State for the Colonies, refused to sanction his arrangements and a new Lieutenant-Governor, Sir Andries Stockenstrom, was instructed to negotiate new frontier arrangements with Ngqika, Ndlambe and the Gqunukhwebe based on previous treaties, with the boundary reverting to the Keiskamma River. The Mfengu, were settled in the old Ceded Territory as a buffer between the Colony and the Xhosa and were protected by Fort Peddie. The British now focused on establishing new lines of fortifications in the former Ceded Territory, along the Kat River and Winterberg, and along the Fish River.[69] Several additional detachments of the Corps of Sappers and Miners along with their Royal Engineer officers were sent out to the Cape and employed in the construction of large new infrastructural works, comprising forts, barracks, roads and bridges.[70]

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67 Hockly, *The Story of the British Settlers of 1820 in South Africa*, p.123.
68 D.A.Webb, 'Kraals of Guns; Fortifications in the Wars of Resistance and Dispossession in the Eastern Cape 1780-1894', (SA History Online website, chap 2), p.1.
69 Webb, 'Kraals of Guns', (chap2), p.5.
70 CAD ACC 1523, G.G.Lewis, *Report upon the Eastern Frontier of the Cape of Good Hope, (1837)*.

After the 1834-35 conflict large numbers of Dutch burghers, most from the eastern frontier, decided to leave the Cape Colony from 1836 in the Great Trek. New pastures were sought beyond the reach of what they considered the injustices of British rule, and where they could rule themselves without interference. Other causes were their need for more land, restricted by the new land tenure system, capital losses due to the devaluation of the Rix dollar and the introduction of quitrent, the loss of slaves with little or no compensation, a resulting shortage of labour and frontier insecurity, together with Britain's perceived inability to prevent invading amaXhosa. As previously loyal and effective combatants in the 'commando' system they assisted the British military in times of conflict and hostilities against marauding amaXhosa, for which their departure was sorely missed.[71]

The seventh frontier war of 1846-47, commonly called the 'War of the Axe', broke out on the Cape's eastern frontier, ten years after the repeal of the Province of Queen Adelaide. Several episodes led to its eruption, the alienation of amaXhosa land, guerrilla tactics, incidences of murder, drought, cattle raiding and treachery, all contributed to undermining Stockenstrom's fragile 'treaty system.' As the amaXhosa to the east of the Fish River pressed for territory to offset the loss of their dispossessed lands of the Zuurveld, the British authorities strengthened the defences on the frontier even further. In 1844, at the instigation of Lieutenant Governor Hare, the new governor, Sir Peregrine Maitland, took the decision to construct a new fort at Block Drift on the Tyume River. The action of sending Lieutenant John Stokes RE to survey and set out a new fortification to the east of the Tyume River, was a great provocation to the Ngqika under chief Sandile. At the same time an amaXhosa man stole an axe at Fort Beaufort, which caused a great commotion when Sandile refused to hand over the culprit. As a result Hare and Maitland assembled a large military force at Post Victoria and set out to attack Sandile's Great Place near Burnshill mission. The plan failed when a 120 wagon train was ambushed near Burnshill and 65 wagons were captured by the amaXhosa. The British force under Colonel Henry Somerset withdrew in disarray back to its base. This was the impetus that the amaXhosa needed as they invaded the Colony once more. Post Victoria was attacked, farms and homesteads were looted and torched, cattle were driven off and the refugees streamed back into Graham's Town. Far from punishing the Ngqika, Maitland found himself repulsed and on the defensive.[72]

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[71] C.Venter, *The Great Trek*, (Cape Town: Don Nelson, 1985), pp.16-22.
[72] Webb, 'Kraals of Guns; Fortifications', (Chap 3), p1.

Bitterness caused by the Mfengu encroachment on their lands drew the Gqunukhwebe under Phalo, the Ndlambe and a number of smaller Rharhabe chiefdoms, into the war, while Maqoma was the only Rharhabe leader of significance who did not join the fighting. The British cavalry caught the amaXhosa in the open at Gwanqa, where the sword-wielding dragoons were able to achieve a bloody consolation victory. Communication was severed between Graham's Town and Fort Peddie, as the amaXhosa ambushed the wagon trains. Continued amaXhosa guerrilla tactics in the thick bush, combined with a severe drought curtailed the movement of British troops. With the drought broken, the amaXhosa returned to their lands to plant crops as they were not prepared to continue to fight. The recalled Maitland repealed martial law and declared that the war was almost over. His replacement, Pottinger, was forced to continue hostilities until the last remnants of amaXhosa were starved into submission. Sir Harry Smith, the new governor concluded the formal peace on 23 December 1847.[73]

On Harry Smith's appointment as Governor of the Cape Colony, he proclaimed the colonial protectorate of British Kaffraria[74] on 17 December 1847, as part of the Cape Colony, with King William's Town as capital.[75] East London had been established at the mouth of the Buffalo River in April 1847 to serve as a port for British Kaffraria. In January the following year it was annexed to the Cape Colony to solve a customs problem, which the military government was not equipped to control. The annexation was meant to be of short duration, to least until Letters Patent[76] were published which would have officially created a civil administration in British Kaffraria as a Crown Colony and to collect customs revenue. Political machinations by three consecutive High Commissioners delayed publication until March 1860 when British Kaffraria became a separate Crown Colony. During this protracted delay, East London's uncertain legal status caused many compounding problems that diverted trade away to Port Elizabeth and Graham's Town. Once the Letters Patent were eventually promulgated, East London struggled to recover lost opportunities. In addition, due to economic depression British Kaffraria was forced to be incorporated into the Cape Colony on 17 April 1866.[77]

The eighth frontier war of Mlanjeni broke out in December 1850 and lasted until March 1853, the causes being the Xhosa grievances from loss of their lands, restrictions and

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[73] Webb, 'Kraals of Guns; Fortifications', (Chap 3), p.1.

[74] British Kaffraria was the land to the east of the Keiskamma River in the south and the Klip Plaat and Black Kei Rivers to the north

[75] Webb, 'Kraals of Guns; Fortifications', (Chap 4), p.2.

[76] Letters Patent; a type of legal instrument in the form of a published written order or public proclamation issued by a government granting a right to a portion of land under its control.

[77] K.P.Tankart, 'Strangulation of a Port: East London, 1847-1873', *Contree*, 23 (1988), pp. 5-11.

limitations placed on the chiefs, their traditions, customs and the friction between the Ngqika and the military settlements along the Tyume valley. The prophecies of Mlanjeni, the amaXhosa seer, occurred in the context of the strain placed on amaXhosa society by Harry Smith's high-handed treatment of traditional leaders, the activities of the authorities in subjugating amaXhosa society, and the physical presence of the military forts as a constant reminder of their servitude.[78] The spark that finally ignited the fire was Smith's attempt to capture Sandile by sending a large military patrol from Fort Cox on Christmas Eve of 1850. Sandile's Ngqika warriors, many armed with muskets, successfully ambushed the column in the Boma pass, a narrow defile along the Keiskamma River. The next day the Ngqika attacked and destroyed the hated military villages in the Tyume valley. They also ambushed and wiped out a British patrol escorting wagons from Fort White to King William's Town at Debe Nek. On 31 December, Smith escaped from Fort Cox to King William's Town, disguised as a Cape Mounted Rifleman.[79]

The hostilities escalated when warriors of the Ndlambe chief, Siyolo, and Maphasa's Thembu north of the Amathole Mountains entered the war. In addition, large numbers of Kat River Khoekhoe and inhabitants of the Shiloh and Theopolis mission stations also took up arms against the British. The large-scale desertion of Khoekhoe Cape Mounted Riflemen, who joined forces with the amaXhosa, increased the number of invaders. The Line Drift Post was captured and burnt by deserting Cape Mounted Rifle Khoekhoe and invading amaXhosa, while Kat River Khoekhoe and amaXhosa attacked Fort Beaufort, Fort Brown and Fort Hare and were repulsed. The amaXhosa and Khoekhoe also raided the west of the Colony, burning farms and ambushing wagons and driving off large numbers of stock. The Khoekhoe and amaXhosa succeeded in capturing Fort Armstrong and Elands Post in the Kat River valley. In most cases they made off with all the cattle, sheep and goats. The Thembu and Khoekhoe seized Shiloh Mission and besieged the village of Whittlesea. In response, the British mobilised several thousand combatants to defeat the amaXhosa and Khoekhoe invaders. The fighting degenerated into a bitter and unrelenting struggle, which saw the systematic destruction of kraals and crops and the brutal killing of the vanquished.[80]

Smith continued the campaign by invading the lands of Sarhili and the Gcaleka, seizing thousands of head of cattle by using the pretext that they had looted some of the

[78] Webb, 'Kraals of Guns; Fortifications', (Chap 4), p.1.
[79] Stapleton, *Maqoma, Xhosa Resistance to Colonial Advance,* p.153.
[80] Webb, 'Kraals of Guns; Fortifications', (Chap 4), p.1.

traders' stores in Gcalekaland and that Sarhili had ignored Smith's instruction not to harbour Khoekhoe rebels. Several Xhosa chiefs to the south, such as Phato of the Gqunukhwebe, remained neutral during the conflict. For Smith the outbreak of the debilitating and expensive war was a personal disaster, as in 1852 he was recalled as High Commissioner, while his successor, Sir George Cathcart, was only able to proclaim peace in March 1853.[81]

In April 1856, after almost eighty years of intermittent conflict between the British and the Xhosa, a young Xhosa girl by the name of Nongqawuse delivered a prophetic message which was to have dire consequences for the amaXhosa. She informed her uncle Mhalakaza, a spirit-medium, that spirits came to her near the Gxarha River, saying, 'Tell that the whole community will rise from the dead; and that all cattle now living must be slaughtered...' On 18 February 1857, the sun would turn red and a great wind would blow all the white settlers into the sea, but first, as an act of faith, they should kill all their cattle and destroy all their crops so that a new, great nation would arise from the sea. This message became the potent prophecy central to the amaXhosa Cattle-Killing Movement of 1856-57, one of the 'most extraordinary stories in human history', a pivotal moment that broke the back of amaXhosa resistance and ushered in a new era of colonial expansion and domination.[82] The amaXhosa paramount chief Sarhili was convinced of the truth of her prophecy and ordered his subordinate chiefs and those under British rule to slaughter their cattle. Over a period of ten months the Gcaleka and other amaXhosa clans killed their livestock (it is estimated that the Gcaleka killed some 300 000 to 400 000 head of cattle) and burned their crops until they had nothing left. The resulting famine saw the population of British Kaffraria decrease from 105,000 to fewer than 37,500 between January and December 1857. The destruction of the power of the principal chiefs and of the social structure of the amaXhosa people was suddenly achieved. This was an objective that successive governments had been trying to achieve with ever increasing intensity. The British authorities took full advantage of the opportunity to reinforce their occupation of the region. Thousands of starving and destitute amaXhosa were forced by circumstance to seek food and employment in the Colony.[83]

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[81] Webb, 'Kraals of Guns; Fortifications', (Chap 4), p.2.

[82] J.B.Peires*, The Dead Will Arise: Nongqawuse and the Great Xhosa Cattle-Killing Movement of 1856-7,* (Johannesburg: Ravan Press, 1989), p.79.

[83] N.Mostert, *Frontiers, the Epic of South Africa's Creation and the Tragedy of the Xhosa People*, (London, Jonathan Cape, 1992,) p.122.

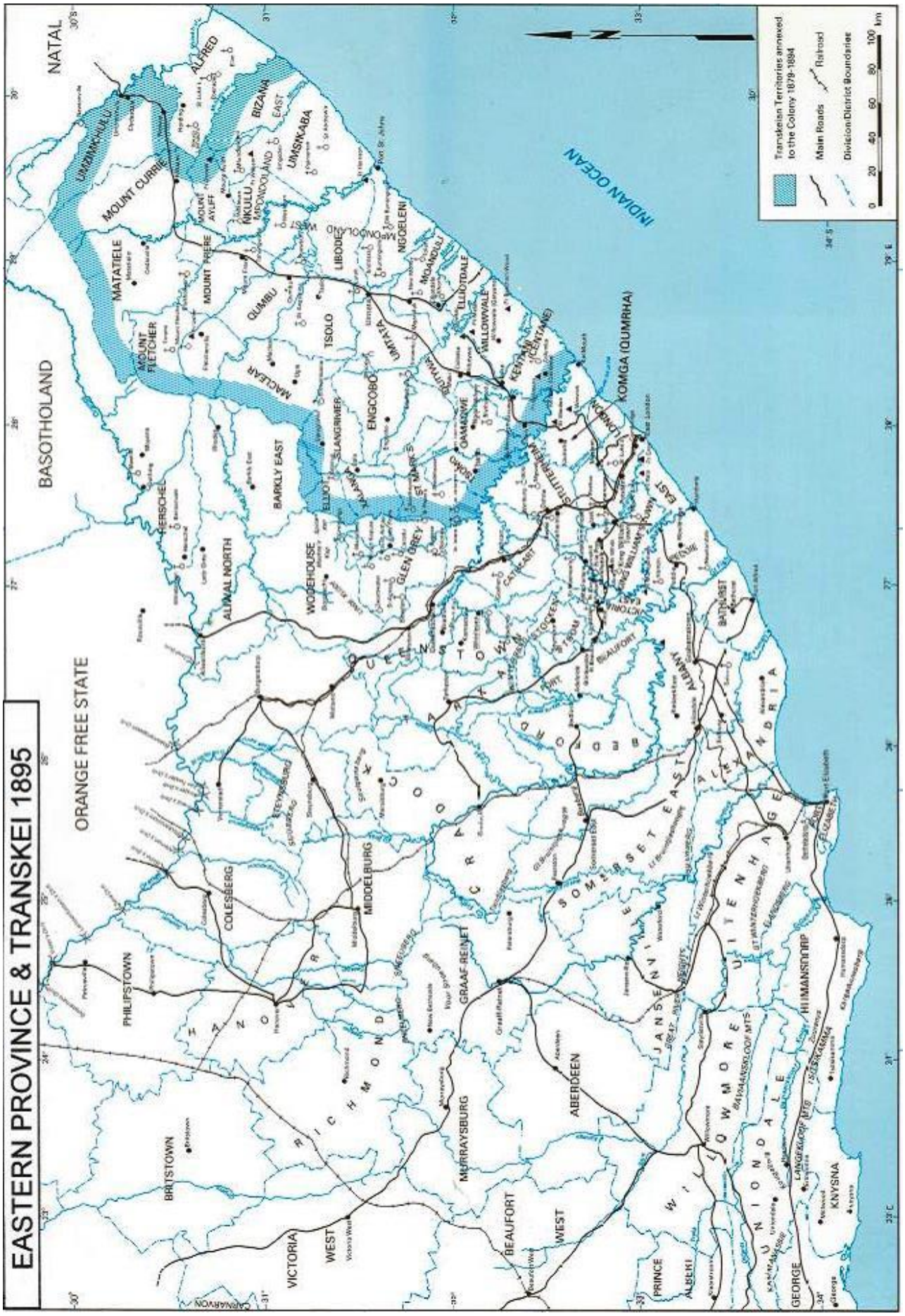

Fig 2: Map of the eastern half of the Cape Colony and the Transkeian Territories, 1895

A significant number of individual Germans immigrated to the Cape during the VOC Company rule, especially during the eighteenth century, to become assimilated into the Dutch culture, as may be seen by the names of Kruger, Muller, Meyer, Botha, Reitz, Koch, Kuhn, Brand, Wiese, Maritz and many others. When Sir George Grey became Governor of the Cape Colony and High Commissioner of British Kaffraria in 1854, he was confronted with a large amaXhosa population crowded into Kaffraria, under conditions that necessitated the maintenance of a strong military force at an exorbitant cost. The idea of strategic settlements on the frontier as a means of defence and of reducing military expenditure was reconsidered. His initial scheme of having 1000 immigrants settled in Kaffraria was rejected due to a lack of applicants; however, with the conclusion of the Crimean War, many British German Legion mercenaries had been demobilized and could not return to Germany. The Colonial Office eventually sent 2,362 men in six transport ships and disembarked at East London in January and February 1857. They were settled in new villages with German names such as Berlin, Frankfort, Wiesbaden, Potsdam, Braunschweig, Marienthal, Hanover, Hamburg, Breidbach and Stutterheim, including King William's Town and Keiskammahoek. The German Military Settlers were not a great success as most of them were unwilling to farm the tiny parcels of land allocated to them and most volunteered for foreign conflicts and departed from the Colony.[84] A second contingent of 1,600 German agriculturalists arrived between July 1858 and February 1859. After many initial problems, such as the lack of capital, implements and transport, the agricultural settlers became a successful settler population in British Kaffraria where they increased the labour pool and set about turning the barren veld into fertile agricultural lands and providing much needed enterprises as farmers and craftsmen. New roads, drifts and causeways across rivers were constructed linking up the various German settlements.[85]

After the Cattle Killing episode of 1857 the independence of the amaXhosa to the east of the Kei River was systematically eroded as the advance of colonialism slowly expanded into the trans-Keian territories. After 1872 this colonial dispossession was driven by the Cape and not the Imperial Government. The approach adopted by the Cape Government was to establish magistracies over the various independent chiefdoms and extend colonial influence through these resident agents where rule through these magistrates (or government agents) became the administrative basis of governing the new territory. With the exception of the 1877-78 war where the

[84] E.L.G.Schnell, 'For Men must Work, an account of German immigration to the Cape with special reference to the German Military Settlers of 1857 and the German Immigrants of 1858', (PhD, Rhodes University, 1954), pp.50-101.
[85] Schnell, 'For Men must Work' pp. 157-176.

independence of the amaXhosa was undermined, the advance of colonial expansion was thus somewhat more subtle with the twin forces of the missionaries who established mission stations throughout the region, and the Cape's growing mercantile capitalism, as dozens of colonist owned trading stations were built all over Transkei.[86]

The ninth frontier war, the War of Ngcayecibi, flared up after a brawl between some Gcaleka and Mfengu at a wedding feast. Like previous wars, the causes of the conflict lay in the processes of forced removal and overcrowding affecting both the Ngqika and Gcaleka. The Gcaleka were confined to a reduced portion of their former territory. Not only had they been deprived of extensive portions of their land after the Cattle Killing, but large parts had been given to the Mfengu. The Ngqika located on land immediately east of the Amatholes, had seen large sections of their territory opened up to white famers and also to Mfengu. A severe drought in 1877 aggravated the tension, which brought further hardship and suffering. A fight broke out after the feast between Mfengu and Gcaleka, which escalated into the war. The war between the Colony and the Gcaleka opened with a humiliating defeat of a colonial force at Gwadana. Later the flawed tactic of launching massed attacks on the colonial forces, instead of proven guerrilla tactics of the past, resulted in the annihilation of the Gcaleka army. The conflict extended into the Cape Colony when Sandile's Ngqika entered the fray. The superior fire-power and the introduction of imperial forces eventually brought the conflict to an end. The colonial victory opened up the transKeian territory to the annexation of large swathes of land.[87]

EASTERN CAPE COLONY TRADE AND INDUSTRY

The cultivation of grapes, first introduced by the French Huguenot settlers, expanded into a burgeoning export trade and by 1817 wine exports from the Cape Colony to England were in high demand. Figures showed that without this new export trade the Cape would have been hopelessly insolvent since out of a total export of colonial produce from the Cape in1820 valued at 1,764,035 rixdollars (£117,600), wine accounted for 1,095,600 rixdollars (£73,000), more than 62%.[88] After the Cape became a permanent British Colony in 1806, the import trade grew rapidly resulting in the annual average imports for the period 1815 – 1822 reaching £337,000 compared

[86] Webb, 'Kraals of Guns; Fortifications', (Chap 6), p.2.
[87] P.Gon, *The Road to Isandlwana, the Years of a Imperial Battalion*, (Johannesburg, Jonathan Ball, 1979), pp.93-98.
[88] D.W.Rush, 'Aspects of the Growth of Trade and the Development of Ports in the Cape Colony, 1795 – 1882', (MA Thesis, University of Cape Town, 1972), p.15.

with £105,000 for the period 1807 – 1814. These figures are significantly greater than the corresponding annual average exports of £210,900 end £85,054, respectively. By 1822 Cape wine represented 10.4 per cent of the wine consumed in Britain.[89] Until 1825 the Cape trade was basically consumptive with only a little wine exported in exchange, the reason being the small domestic market concentrated around Cape Town and its environs.[90]

The decade following 1820 witnessed several developments which were to have a significant impact on the economic development in the Cape Colony. The first was the establishment of an economic growth point in the eastern part of the colony with the arrival and enterprise of over 4 000 British Settlers in the new district of Albany. Secondly, when the anticipated agricultural basis of the settlement proved inadequate, the settlers switched to a pastoral economy based on woolled Merino sheep. After the settler farmers experienced major economic setbacks, they turned to the introduction of woolled sheep to boost their flagging fortunes.[91] During the Dutch occupation, the introduction of several pairs of Spanish Merino sheep led to successful trials where they bred three rams to 300 Cape ewes.[92] It took five cross-breeding cycles to produce pure wool, and thereafter the wool quality improved rapidly as by 1817 the experiment was complete.[93]

In 1822, wine amounted to 47% of total exports from the Cape Colony while wool was a mere 0.6%. By 1830, wool had risen to 0.7% and wine had fallen to 43%. By 1850, wine had fallen to 6% of total exports and wool had grown to 45%. Exports of Cape wine fell from £106,858 in1822 to £35,890 in 1850. The virtual collapse of the wine trade can be ascribed to the lowering by Great Britain of duties on continental wines in 1825 and the raising of duties on Cape wine in 1831. Wine did not feature again as a significant export commodity during the nineteenth century.[94]

The trade that the settlers began to develop after 1830, resulted in the establishment of a second entrêpot at Algoa Bay, separated by some 600 miles by land and 500 miles by sea, from the port at Cape Town. The growth in trade can be attributed to the economic input of the 1820 Settlers who had an immediate impact on Eastern Cape trade. Trade

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89 D.J.Van Zyl, *Kaapse Wyn en Brandewyn 1795-1860*, (Cape Town, Haum, 1975), p.127.
90 Rush,' Aspects of the Growth of Trade', p18.
91 Rush,' Aspects of the Growth of Trade', p.23.
92 The Cape sheep, a hardy, indigenous, fat-tailed breed with no fine wool qualities, bred mainly for their mutton.
93 E.H.Burrows, '*Overberg Outspan: A Chronicle of People and Places in the South Western Districts of the Cape'*, (Cape Town, Maskew Miller, 1952,) p.18.
94 Rush, 'Aspects of the Growth of Trade', p.27.

is a critical component of economic growth in newly settled societies, which in turn makes transport routes along dependable roads essential for their growth and survival.

Wool exports leapt from 62% of colonial produce exported from the Cape in 1850 to 75% by 1860, reaching a peak of 82% in 1868. In monetary terms, the value of wool exports increased by a massive 406% - from £285,610 in 1850 to £1,446,510 in 1860, thereafter peaking at £1,994,054 in 1866. Wool's dominance would be short lived as the export of diamonds soon outstripped wool within a decade.[95]

Initially insignificant amounts of wool was exported to England from the Cape between 1822 and 1830. This soon changed as the contribution of the Eastern Cape farmers in the wool export trade saw total exports of raw wool from the Cape Colony grow from 12% in 1830 to 38% in 1840 to 74% in 1850 and to 85% from 1855 to 1870. Port Elizabeth's exports exceeded those from Cape Town for the first time in 1854, while her total trade did so two years later, as shown in the trade tables in the Cape of Good Hope Blue Books and Statistical Registers.[96] The number of calling ships grew thirty-one times by 1850 and imports grew sixty one fold and exports by sixty-nine times, all due to the burgeoning Eastern Province wool trade. The arrival of the German Settlers to British Kaffraria in 1856/8 was a further stimulus to the wool trade, as this new inland settlement led to the establishment of a further land/sea transit point at the mouth of the Buffalo River and the eventual building of the port of East London.[97] On a trip between Port Elizabeth and Graham's Town in 1874, General Cunynghame met 150 large wagons each drawn by a span of sixteen pairs of oxen, 32 in all, each loaded with 22 bales of wool, each load having an estimated value of £700, translating into £105,000 worth of wool in one day on its way to Port Elizabeth.[98]

Between 1850 and 1870, the bulk of the export trade from the ports of Cape Town, Port Elizabeth and East London comprised of shipments of wool. From the Eastern Province, East London continued to account for increasing exports of wool while Port Elizabeth went through a small decline in wool exporting in the face of greater competition from East London. As more ships began to call off the Buffalo River Mouth, the need for

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95 A.W.O.Bock, 'The Foreign Trade of South Africa since 1807', (DComm, Stellenbosch University, 1930), p.31.

96 J.Inggs, 'Liverpool of the Cape, Port Elizabeth Trade 1820-70', *South African Journal of Economic History*, 1, 1 (1986), pp.87-89

97 Rush, 'Aspects of the Growth of Trade', p38.

98 Gen A.T.Cunynghame, *My Command in South Africa, 1874-1878*, (London, Macmillan, 1879), p.44.

farmers in British Kaffraria to send their wool to Algoa Bay for sale and export became unnecessary.[99]

The prosperity of the town of Uitenhage was boosted when a number of wool-washeries were established on the banks of the Zwartkops River. Washing wool, was a process that required constantly moving water to carry away the large deposits of grease, lanolin, and dirt that accumulated on sheep. The first factory was erected in 1843 by FH Lange, while the extreme softness of the local river water soon led others to follow his example: Peche in 1846, Christian Heugh and John Lear in 1849, Niven in 1861, Marshall and Appleby in 1865, Thomas Gubb (Riverside Woolwash) in 1866, and Henry Inggs (Springfields Woolwash) in 1867. Uitenhage's "*Snow White*", as the washed wool became known, became internationally known, and in due course the town became the main centre of wool-washing for the Cape. Wool-washeries therefore played an important role in the economic and structural development of the town, and by 1875 ten such concerns had been established in its vicinity, involving a capital investment of £200,000. About 100,000 bales of wool were washed annually and exported through the Port Elizabeth harbour. Eventually the industry made extensive use of steam machinery and provided employment for a large number of unskilled labourers. Wool-washeries were also established in other centres, by 1860 there were thirteen wool-washeries in the Eastern Cape - apart from Uitenhage and Port Elizabeth, Cradock, Colesberg and Victoria East were other sites.[100]

The economy of the Cape Colony during the nineteenth century, like that of many developing areas, was fundamentally based upon the production for export of a fairly narrow range of agricultural primary raw materials. Apart from timber for wagon making, local resources for the development of a manufacturing industry were limited. The basic pattern of imports to the Cape Colony therefore comprised of four main items: fuel supplies (coal), manufactured goods for the consumer market, primarily textiles and supplementary foodstuffs and industrial products (machinery, transport and railway materials after 1870).[101]

The Cape Colony Census of 1865 indicated that agriculture occupied over three quarters of the economically active population.[102] Trade expanded throughout the

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[99] Rush, 'Aspects of the Growth of Trade', p.39.
[100] J.Inggs, 'Port Elizabeth's response to the expanding economy of Europe 1820-1870', *SA Journal of Economic History*, 3 (1988), p.79-83.
[101] Rush, 'Aspects of the Growth of Trade', p.40.
[102] G.20-1866*, Census of Cape Colony*, Memorandum, p.IX

colony as the country towns, with relatively small numbers of residents, became important commercial retail and wholesale import centres for the farming community; with shops, hotels, boarding houses, transport and mail operators, professional practices for doctors and lawyers, churches, banks, educational institutions, hospitals, local and central government offices. The larger towns developed limited manufacturing enterprises, from flour mills and tanneries to wool-washeries and wagon-makers. Two other important groups were those transacting property deals and the editors of local newspapers. For the market in agricultural land, stock, property, insurance and shares was to a large extent in the hands of local businessmen, advertising themselves as general agents and auctioneers, some of whom were also legally qualified.[103] Businessmen in the Eastern Province, being proficient in both Dutch and English, were essential as middlemen between landowners and farmers and sources of credit, legal sanction and information, and between buyers and sellers. The diversity of their contacts and clients, in their towns and in the farming community of the surrounding farms and their access to capital resources, often gave them great political influence.[104]

Local newspapers were important sources of both news and economic activity of the area in which they operated. The *Graaff Reinet Herald* counted some 34 newspapers in the Cape of 1871, of which 24 were outside Cape Town and Graham's Town. Newspapers were themselves local business enterprises dependent on local revenues from sales and advertisements, they were launched through local economic activity and were catalysts in sustaining it. Their advertisements contained various commercial and business information, such as market prices, goods and services, properties, auctions, municipal and government tenders, on which they depended for the bulk of their income. Local and international news, together with editorials, related political and other developments elsewhere in the Colony and the rest of the country, to their readership.[105]

Ostrich feathers had a long history as a minor Cape export. Before 1860, wild birds were simply shot, slaughtered and plucked, a retroactive process leading to a reduction in numbers. The growth of the European fashion industry and the shortage of feathers combined to raise the price and the interest of progressive farmers. Between 1857 and 1864 wild ostriches were beginning to be captured and tamed, to be reared in captivity.

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[103] A.J.Purkis, 'The Politics, Capital and Labour of Railway Building in the Cape Colony, 1870-1885', (PhD Thesis, Oxford University, 1978), p.27.
[104] Purkis, 'The Politics, Capital and Labour of Railway Building' p.28.
[105] Purkis, 'The Politics, Capital and Labour of Railway Building' p.29.

In 1865 there were only 80 tamed and domesticated ostriches in the Cape colony when the total export of wild ostrich feathers was 17,522 lbs valued at £65,736. The dry and warm inland conditions of the Eastern Cape were found to be ideal for ostrich farming. In 1869 Arthur Douglass introduced incubators to hatch the eggs in large numbers, coupled with the introduction of irrigated lucerne (alfalfa) lands raised the reproductive rates of ostriches. Later the importation and cross-breeding of North African Barbary ostriches further enhanced the quality of the feathers and plumes.[106]

The exported weight of 2,700 lbs of feathers valued at 115,590 rix-dollars (£8,670) in 1821 may be compared with a later exported mass in 1858 of 2,013 lbs valued at £12,660; an increase of almost 50%. Realizing the potential, the farmers of the Oudtshoorn district pioneered the domestication of ostriches in the 1850s. Feathers were in great demand and earned between £20 and £30 for the plumage per bird, which normally could be plucked five times before the feather quality deteriorated. In 1870 the export of feathers increased to 28,786 lbs value at £91,229. Five years later in 1875 the export had increased to 49,569lbs valued at £304,933 from a total of 21,751 domesticated ostriches. [107]

Table 2.1 The value of the export of wool, ostrich feathers and diamonds from the Cape Colony 1869-1875 was as follows: (£1,000).[108]

YEAR	WOOL	OSTRICH FEATHERS	DIAMONDS
1869	1,602	70	25
1870	1,670	87	153
1871	2,191	150	403
1872	3,275	158	1,618
1873	2,710	160	1,648
1874	2,948	206	1,313

In 1875 Oudtshoorn district possessed 2,159 ostriches while Riversdale had 2,892 however by 1891 Riversdale had only increased to 3,958 birds, while Oudtshoorn had 27,000 birds. Oudthoorn's climate, soils and water made it the 'feather capital' of South Africa. In 1880 feathers of 13,065lbs valued at £883,632 were exported, when breading

[106] A.S.Mabin, 'The Making of Colonial Capitalism: Intensification and Expansion in the Economic Geography of the Cape Colony, South Africa 1854-1899', (PhD, Simon Fraser University, Canada, 1984), p.10.
[107] Klein Karroo Landbou Ko-operasie, (Oudtshoorn, brochure, 1987)
[108] *Cape Blue Book 1869-1875*: and R.Turrell, 'Capital Class and Monopology: the Kimberley diamond fields 1871-1889', (PhD University of London, 1982), Appendix II.4.

pairs cost £300. This state of affairs induced a mania for ostrich farming. The ostrich feather export peak was in 1882 when 253,954lbs at a value of £1,093,989 was achieved, the first ostrich boom, thereafter a steady decline occurred.[109]

The 1881 recession suffered by the Cape followed the collapse of prices, diamond shares and resulting bankruptcies, was followed by the collapse of wool and ostrich feather prices.[110] The price of ostrich prices reduced from £5-8s per pound in 1880 to £2-6s in 1885.[111] The price drop was due to drought, impaired quality and northern hemisphere depression. After 1886 conditions improved and prices slowly returned to normality. The ostrich population increased from 79,000 in 1904 to 110,000 in 1911, as the second ostrich feather boom occurred from 1902 until 1914 when the bottom suddenly dropped out of the market, due to over-supply and the changes in fashion, leaving many previous millionaires bankrupt.[112] Refer to table 2.2:

Table 2.2 Selected Cape Colony Exports 1880-1887 (£1,000).[113]

YEAR	WOOL		OSTRICH FEATHERS		DIAMONDS	
	lb (000)	£(000)	lb (000)	£(000)	carats	£(000)
1880	42,468	2,430	163	884	3,140	3,368
1881	42,771	2,181	194	894	3,090	4,176
1882	41,690	2,062	254	1,094	2,660	3,993
1883	38,029	1,993	247	931	2,414	2,742
1884	37,270	1,745	233	966	2,264	2,807
1885	34,433	1,426	251	585	2,440	2,490
1886	47,454	1,581	289	546	3,135	3,505
1887	44,758	1,676	269	366	3,500	4,242

THE OX WAGON TRANSPORT INDUSTRY

Shortly after arriving at the Cape, Jan van Riebeeck of the Dutch East India Company (VOC), had the first ox wagon manufactured out of local timber, in order to transport large timber beams, felled from nearby forests, to the new fort at Table Bay. In 1657 Van Riebeeck acquired the services of two wagon makers to supplement the carpenters and smiths who were engaged in repairing imported wagons and carts. The wagon industry remained in the hands of the Company until 1750, when the high demand for

[109] A.Douglass, *Ostrich Farming* in J.Noble(Ed), Handbook of the Cape of South Africa, (Cape Town, Juta, 1896) pp.297-305
[110] Mabin, 'The Making of Colonial Capitalism', pp. 181-185.
[111] W.H.P.Gresswell, *Geography of Africa South of the Zambesi*, (Oxford University Press, 1892), p.235.
[112] J.Burman, *The Little Karroo*, (Cape Town: Human & Rousseau, 1981), pp. 107-108.
[113] *Cape Blue Book 1869-1875*: R.Turrell, 'Capital Class and Monopology', Appendix II.4.

wagons and carriages made it a free-enterprise industry.[114] With time, craftsmen free burghers set themselves up as masons, blacksmiths, carpenters, wagon makers and other ancillary trades. This was to be the humble beginning of the ox wagon building industry that would peak at the end of the nineteenth century. In 1679, the Company set the price of a complete wagon at 280 Rix Dollars (£56), a wagon carriage without body, sides or yokes at 200 Rix Dollars (£40) and four wagon wheels at 120 Rix Dollars (£24). These were the prices the free burghers had to pay in order embark on their new enterprises, such as transport riders, farmers, pastoralists and 'trekboers'.[115]

Twenty nine free burghers worked as blacksmiths and wagon makers during the period of 1657 – 1707. Initially they battled to make a living as they depended on their clients who were struggling fellow free-burghers. During the first half of the eighteenth century the artisan industry was still mainly in the hands of the Company. Their craftsmen had first choice of available wood to the detriment of the free woodworkers, which put a curb on the development of wagon making. As all transport was animal drawn, wagon-making became an important industry at the Cape.[116] Johan Hendrik Esbag arrived at the Cape in April 1774 where he was employed by the Company as a wagon-maker. In 1776 he was promoted as second in charge of the wagon-makers and in 1778 until his death in 1796 he was the chief Company wagon-maker.[117] As the numbers of free burghers and their dependence on transport increased, a huge demand for ox wagons was placed on the Company, who controlled the industry. In order to meet the demand, they were forced to increase standard wages and encourage more apprentices to the industry. The wagon industry continued to grow as the population increased and more roads were constructed.

By the end of the eighteenth century, Cape Town was not the only wagon building centre, as the main routes to the hinterland passed through Paarl and Swellendam, stimulating their wagon making activities. As a result wagon making became the largest and most important industry during the nineteenth century.[118] By 1838, it was reported that in the Cape Colony, five out of every six tradesmen were either wheelrights or wagon makers.[119] After 1850 the economy flourished with the increased consumer population, the building of new roads, improvements to agriculture, banking and the

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114 J.Malan, Rytuie van Weleer, (Cape Town: Van Schaik, 2004), pp.55-57.
115 J.Burman, *Towards the Far Horizon- the Story of the Ox-Wagon in South Africa*, (Cape Town: Human & Rousseau, 1988), p. 20
116 H.Van der Merwe, 'Die wamakersbedryf van die Paarl to 1893', *SA Journal of Cultural History*, 7, 4 (1993), p.65.
117 A.Linder, *The Swiss in Southern Africa, 1652-1819,* (Basel: Afrika Bibliographien, 1997), p.85.
118 H.Van der Merwe, 'Die wamakersbedryf van die Paarl to 1893', *SA Journal of Cultural History*, 7, 4 (1993), p.65.
119 W.C.Harris, *The wild sports of Southern Africa*, (London: John Murray, 1838), p.53.

discovery of diamonds, which in turn stimulated the wagon making industry. The wagon making centres of the Cape Colony expanded towards the Eastern Cape frontier, at places such as Paarl, Swellendam, Graham's Town and King William's Town.[120] The lower end of Swellendam was described as a hive of activity comprising workshops of blacksmiths, wagon makers, woodworkers, a tannery, and a cooperage, where they produced six brand new wagons per month, costing £120 for a large buck wagon capable of hauling a load of 10,000 pounds.[121]

Before the advent of the railways in the 1870s, the Eastern Cape was dependent on the humble ox wagon. The volume of ox wagons were to increase enormously. In 1854 it was reported that 4000 wagons entered Port Elizabeth loaded with wool during the three shearing months.[122] During 1856 wagons were using the Sundays River pont at a rate of almost 1000 wagons per month, while four years later 1200 wagons per month were using the Rawson Bridge across the Swartkops River outside Port Elizabeth.[123] Ox wagon travel was painfully slow as the 315 miles return trip from Graaff-Reinet to Port Elizabeth took up to two months.[124] The attempts by merchants who dominated the trade of the colony to have the colonial government improve the roads, construct bridges and mountain passes, were only partially successful partly by reason of military requirements on the frontier. By 1860 the colonial government was spending £120,000 per annum on roads and bridges.[125]

Large-scale European immigration during the mid-nineteenth century was the impetus for the transport manufacturing industry to produce more wagons. The larger wagon and carriage works employed blacksmiths, wainwrights, carpenters, wood turners, wheelwrights, joiners, painters and decorators, tanners, upholsterers, harness makers, canopy makers and engaged suppliers of imported steel, timber and local indigenous woods. The range of vehicles shown in the various trade catalogues indicated the diverse nature of demand, models ranging from cape carts to trolleys; from carriages such as spiders, landaus, phaetons, hansoms and broughams to heavy transport wagons. The wagon builder catered for the transport needs of everyday life. There were utility vehicles such as ambulances, fire engines, public transport vehicles like the spring wagon, cape cart, refuse carts, delivery carts, hearses, the family-sized wagons

120 Van der Merwe, '*Die wamakersbedryf van die Paarl',* p.65.
121 M.E.R, *Oorlogsdagboek van 'n Transvaalse Burger te Velde 1900-1901*, (Kaapstad, Tafelberg, 1947), pp.15-16.
122 Eastern Province Herald, 21 November 1854, p.2.
123 Inggs*,* 'Liverpool of the Cape, Port Elizabeth Trade 1820-70'*,* p.97.
124 Eastern Province Herald, 4 May 1861, p.2.
125 A.Mabin, 'Rise and Decline of Port Elizabeth', *Journal of African Historical Studies*, 2, 2 (1986), p.282.

(*kakebeenwa*) for *nagtmaal*, sanitary wagons known as night wagons and long distance travel heavy-duty wagons (*bokwa*), wool wagons, hay wagons, water carts and doctor's 'comfort' carriages, all appeared in the illustrated catalogues.[126]

Almost every town and village in the Cape Colony eventually had a wagon-maker or blacksmith, as wagon and carriage-making turned into a thriving industry. For example, at its height, there were 47 wagon makers in Paarl alone, with firms such as JP Retief & Co and PB De Ville & Co the leaders. The valley between Paarl and Wellington, where the first wagon-maker set up his forge and workshop in the time of Governor Tulbagh, became known as Val de Charron, or Wagenmakersvallei. The Paarl wagon making industry adopted names of the various wagons and carts that went by the names of the Boston; Victoria; Jubilee; Java Spider; Doctor's Gig; Doctor's Comfort; Grasshopper; Beauforter; Vrystater; Ceres Buggy; Pickstone's Favourite; Voortrekker; Wanderer and Wellingtoner.[127]

In 1835 Captain James Edward Alexander wrote a tribute to Cape wagon wheels which he found superior to the wheels then used by the British artillery:

> Dutch wheels are made of three or four kinds of wood…the nave, yellow-wood; for the spokes, assegai; for the felloe, red els or white pear. There are many more spokes than in our wheels, in all fourteen for a large and ten for a small. The tyre is put on in one piece and hot, so as to draw and bind the whole of the wheel firmly together. The wagon, too, is long and elastic and it is quite astonishing to an uninitiated observer what intense effort is employed in the building of Cape wagons without injury.[128]

The Cape tent wagon was nothing more than the wagon in common use in the Low Countries of Europe when the first settlers came to South Africa, except that the wheels were somewhat higher. When the first wagon makers set to work in the colony, they modelled the axle and *schamel, draaiboard* and tongue, *disselboom* and long wagon, precisely as they had done in the fatherland. The rivers and the sand flats necessitated higher wheels, then long journeys called for enlargement of the vehicle, but the model remained unaltered in all other respects down to the days of iron axles and patent brakes.[129] Initially the roads were nothing more than tracks across the veld and a journey in bad weather from Cape Town to Caledon could take up to thirteen days! Travelling in those days could be quite dangerous and hazardous – as the roads were

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126 Van der Merwe, '*Die wamakersbedryf van die Paarl*', p. 66.
127 Burman, *Towards the Far Horizon*, p.153.
128 Maj Gen Sir J.E.Alexander, *A Campaign in Kaffir Land*, 1, (1837), p.348 … In 1835 he took part in the 6th Frontier War as aide-de-camp and private secretary to the Governor Sir Benjamin D'Urban,
129 G.Cory, *The Rise of South Africa*, (London: Longman Green, Vol 1, 1929), p.54.

mostly poor, and especially after crossing a severely steep and rocky mountain pass or fording deep rivers with muddy beds, wagons regularly needed repairs.[130]

As the frontier moved eastwards, so did the wagon-makers and by the 1830s Graaff-Reinet was producing wagons in numbers to meet the requirements of the future *Voortrekkers*. Gerrit Maritz was one of the best known and wealthiest wagon-makers of Graaff-Reinet and took seven of his own wagons on the Great Trek. Graham's Town became a centre of wagon-making in the latter half of the 19th century and the 'Grahamstatter' wagon was much sought after. By the end of the century there were about fourteen firms still engaged in the industry: Brookshaws, Britten, Barnes, Glover, Hancock, Hawkins, Inglis, Juby & Son, Jorden, Kempstone Wagon Works, Orgil, Smith, Stanton and John Wedderburn.[131] Robert Bodily, a wealthy wagon-maker from Bushman's River, in 1857 sold his wagons for £75 each.[132] An advertisement by Charles Grubb, a wagon-maker for the previous ten years, announced a partnership with Mr John Orsmond in 1849 as 'wheelright smith & wagon maker' in a firm called Grubb & Co in Market Square, Graham's Town.[133]

Oudtshoorn, achieved great success with its ostrich feather boom and as a town along the wagon route to the eastern frontier also developed a robust wagon-making industry, having 25 firms at one stage building wagons. They included the firms of W & R Boswell, PH Coetzee, Cole & Meyer, G Curtis, Deas Bros, G Edmeades, MW Eager, Fraser & Co, Galvin & Son, GT Green, Harmsen & Van der Westhuizen, Kolver, Melville Brown & Sons, H & A Meyer, Oudtshoorn Saw Mills & Wagon Works, RB Paterson, F Petersen, J Polson, SF Redelinghuys, RB Saunders, Warrens, A Webster and A Young & Son.[134]

King William's Town also developed a thriving wagon-making industry, which was dominated by Robert Symons of the Buffalo Wagon & Carriage Works. Robert Symons (1853-1923), emigrated from England in 1857. As a fourteen year old he took a job as a blacksmith's apprentice in King William's Town, eventually becoming a blacksmith on the East London-Queenstown railway.[135] In October 1878 Symons founded his own firm, eventually moving out 'into the veld' to build a large workshop in what is now Buffalo Road. By 1902 he had 80 employees and when he ceased wagon-building,

130 Burman, *Towards the Far Horizon*, p.69
131 Burman, *Towards the Far Horizon*, p.148
132 *From the life history of Jane Pittam Bodily*, www.rawlins.org website
133 Graham's Town Journal, 11 August 1849
134 The Curator, CP Nel Museum, Oudtshoorn.
135 M.Symons, *'Symons Brown History'*, (Private papers, website, 2009)

became the local agent selling Model T Ford motorcars. Symons used a variety of woods in his wagons, apart from indigenous yellowwood, stinkwood, ironwood and pear usually used in South African wagons he imported Australian hardwoods, mahogany, birch and hickory for his wagons. The second largest wagon-maker was the Scotsman, William Grey Glennie, who started the firm Bon Accord Wagon Works in the1870s and which continued until World War Two.[136] Third in importance was Burgess & Co Steam Wagon Works, founded by the Canadian J.T.Burgess, who boasted that he could turn out a wagon a day, every day of the year. Ririe Brothers from Scotland were blacksmiths who also produced wagons from 1882. While the oldest firm in King William's town was G.Randell & Co which started in 1864. Behnke Brothers, the only German firm of any size only commenced operations in 1901 and soon had 30 employees.[137] Robert Ballantine & Co of Keiskammahoek operated a sawmill and from 1893 made 16ft buck wagons and other carts, using wood from the nearby Amatola forests.[138]

As the need to continuously supply the military settlements, towns and villages of the interior with provisions, materials and equipment as the eastern frontier was expanded further and further into the hinterland, the transport rider and the travelling salesman (*smous*) became an integral member of the supply chain. While the narrow, covered '*kakebeenwa*' was the staple mode of transport of the '*trekboer*', heavier loads required larger and stronger wagons, the so-called '*bokwa*'. The *kakebeenwa* had basic dimensions of 0,85metres (2ft 9in) wide x 4,60metres (15ft) long, where the wooden axles restricted the carrying capacity to a load of 800kg using 10 oxen. The later transport buck wagon (*bokwa*) had basic dimensions of 5,5 to 6,5 metres (18ft to 21ft) long x 1,5 to 2,0 metres (5ft to 6ft 6in) wide and was able to carry loads up to 4500kg with its iron axles and using sixteen oxen.[139]

The introduction of the railway service from the mid-1870s to the Eastern Cape faced stiff competition from the comparatively inexpensive ox wagons. Transport riding (*togry*) did not collapse, on the contrary, the Cape Government Railways (CGR) were forced to engage in tariff wars with the wagon transport industry. When the rail tariff between the CGR and KWT Chamber of Commerce reduced from 1s to 9d per 100 lbs the ox wagon rate dropped between 5d and 7d per 100 lbs, to undercut the railway competition.

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136 Burman, *Towards the Far Horizon*, p.150.
137 Burman, *Towards the Far Horizon*, p.151.
138 M.J.Wells, 'The effect of the wagon building industry on the Amatola Forests', *Bothalia 11,* 1&2 (1973), pp.153-157.
139 B.Joubert, 'A Historical Perspective of Animal Power use in SA', (*Animal Traction Development*, (2003), p.131.

Observations at Kei Bridge in the early 1900s showed that on average twenty four wagons (twelve in each direction) crossed daily, the average load was slightly more than three tons. Annually, almost 8,500 wagons carried more than 25,000 tons to and from the Transkei. Wagon transport became dominated from between 80% and 90% by amaXhosa wagon owners and transport riders. The relentless efforts of the Government and the CGR by various nefarious methods, was surpassed by the outbreak of East Coast Fever in the Transkei, killing hundreds of cattle, resulting in the closure of Kei Bridge to wagon transport and the death knell to wagon transport in 1910.[140]

While rough torturous mountain passes required tremendously challenging skills of the ox-wagon driver, with the constant use of the braking system descending steep sections and the ability to keep the wagon securely on its four wheels, the crossing of rivers presented another problem that was just as hard to overcome. George Thompson in 1824 summed it up well when he said:

> It is more difficult to render the rivers passable than the mountains…..at one season of the year, when the rains set in and when the dry beds of summer are filled with furious torrents that carry all before them, wagons have been known to be stranded for six weeks before one of these winter torrents subside…141 .

While on a trip to the Kimberley diamond fields, Dr Guybon Atherstone made the following remarks, while trying to cross the Riet River, a tributary of the Vaal River:

> At Riet River we found nine wagons outspanned, while the drivers gazed vacantly at the muddy swollen river. We also outspanned and, for an hour or two watched the beacon rocks which were just beginning to show a perceptible ripple, when a cart appeared on the opposite bank and dashed through the eddying torrent without hesitation. Higher and higher the water rose in the cart – up to the seat – as with breathless interest we watched the driver guiding his struggling horses safely through the flooded river, Then, measuring his water marks on our own cart, and piling our luggage high out of reach, on the seats, and cap-tent, we got through the deepest and most dangerous part safely; but there our horses stuck and refused to move – one by one we had to be carried out on the shoulders of stalwart natives, and only then, when the cart was empty save for the driver, was it with great difficulty got though.[142]

He continues with his narrative on the journey :

> At the Modder River next day we had an even more narrow escape from being upset into the swollen river and washed down – one wheel, getting over a sunken rock, just as we were out of the strongest current, and nearly across, tilted us up to the over-balancing point, when portly van Wyk lent the whole of his great weight and just – but only just – restored our equilibrium!! When, oh when will our rulers see the economy of bridging our

[140] G.H.Pirie, 'Slaughter by Steam: Railway Subjugation of Ox-Wagon Transport in the Eastern Cape and Transkei, 1886-1910', *International Journal of African Historical Studies*, 26, 2 (1993), pp. 322-340.
[141] G.Thompson, *Travel and Adventures in South Africa, 1823-24*, (London: Henry Colburn, 1827), p.89.
[142] Dr Guybon Atherstone papers, Cartwright letters, *A Lecture delivered at the Queen's South African Jubilee Exhibition,* (Grahamstown, 18 Jan 1888)

> rivers? Life, time and property is wantonly wasted year after year, when a toll of a few shillings would pay for a remedy. They make 'Bridge Acts' to tempt speculators but dare not act themselves for fear of the expense. 'Public Works'! they exclaim, quite horrified – 'who'll pay for them?' If such is the material of which our Parliament is made, how can the country progress, without brains, without steam?[143]

Apart from the difficulty and danger of making river crossings, most times the wagon trains were forced to simply wait for the water level to recede, which could take many days. These idle days were often taken up in game hunting and games such as '*jukskeigooi*', wrestling or the game of muzzle loading when two '*skeis*' were placed 100 yards away and one man had to run and kick over one while his opponent loaded and fired at the other.[144]

TRANSPORT DELAYS AFFECTING TRADE

The natural rugged topography of the Eastern Cape comprises the east-west trending Cape Folded Belt of the Cape Super Group geological formation, which forms a series of parallel mountain ranges, 100km wide that extends along the southern and south eastern coastlines as far as Port Elizabeth. Further east the Great Escarpment continues, eventually forming the Drakensberg Mountains of Lesotho and Natal. These two groups of mountain ranges constituted a severe barrier to transportation, which required the construction of several mountain passes. In addition, the rivers have carved relatively steep, incising narrow, deep-sided gorges as they discharge their fast flowing waters to the Indian Ocean seaboard.[145]

The vagaries of the colonial climate, such as drought, intermittent and seasonal rainfall, limited the surface water resources and forage for oxen and horses along transport routes, with livestock also being subject to the ravages of animal diseases. On the other extreme, heavy rainfall turned the sun-baked soil of the dusty roads, in most cases simple tracks across the veld, into mud-baths, churned up by the wheels of dozens of wagons. The long delays at raging, flooded rivers, seriously affected the transportation of wagon-loaded goods across the entire region. These obstacles were compounded when the farmers who owned land abutting or local authorities failed to maintain the roads in good repair.[146]

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143 Dr Guybon Atherstone papers, Cartwright letters, *A Lecture delivered at the Queen's South African Jubilee Exhibition,* (Grahamstown, 18 Jan 1888)
144 G.Tylden, 'The ox-wagon'*, Africana Notes and News*, 12, 2 (1956), p.46.
145 A.B.A.Brink, *Engineering Geology of Southern Africa*, (Pretoria, Building Publications, Vol 2, 1981), pp.168,169.
146 Purkis, 'The Politics, Capital and Labour*,* p.43.

Proper transport roads were non-existent. A wagon convoy took up a great deal of road, often several yards wide, as badly rutted and holed sections were simply bypassed. In limited cases the track might have been roughly cut away on the high side of a steep slope, but generally it was only at the drifts that much had to be done. The approaches had to be cut away to let the wagons descend into the stream and ascend the other side, often with 32 bullocks to each wagon. If, as often happened, there was a deep hole in midstream at the only affordable place, it took a driver and a sharp witted leader to swing 32 yards of span and wagon round that hole in deep fast running water. That was the length of sixteen oxen and an 18 foot wagon.[147]

Erratic and unreliable wagon transport caused severe financial problems. This may be ascribed to the following constraints. As per normal, the financial advances from London to consigning agents and exporters of wool and produce from the colony would normally take the form of bills drawn on London banks. Quite simply, if the wool and produce were delayed in transit, these bills would often fall due before the London creditors had the proceeds from the sale of the wool and produce in London with which to meet the bills. As a result, the consigning agent and exporter from the colony would be put under tremendous pressure from his British correspondent. At the same time, the colonial merchant would normally be indebted to the same correspondent on account of the imports consigned to him from Great Britain, and the same transport problems would delay the delivery and sale of those imports to colonial customers. To pay off mounting debit balances in London became a huge problem, loans from colonial banks were expensive as local interest rates were always much higher than in Great Britain. The discovery of diamonds at Kimberley, with its almost insatiable demand for imports from abroad, raised major economic problems, with a simultaneous huge wool clip waiting to be transported to the ports. The breakdown or serious delays by the slow-moving wagon transport thus placed a severe strain on the chains of mercantile credit. Both trader and consumer suffered from the high cost of inefficient transportation of imports and exports and other goods traded within the colony.[148]

Transport delays upset commercial calculations. For example, the wool markets in London and Port Elizabeth were volatile. The prices paid for wool purchased from growers or inland speculators were based on the latest market intelligence, and while the wool clip was held up inland, the market could change. Delayed transport, including the weekly mail coaches, also upset commercial calculations through its effects on the

147 Tylden, 'The Ox Wagon', p.44.
148 Purkis, 'The Politics, Capital and Labour', p43.

postal service. Not only were invoices, banker's bills and remittances lost or delayed, so was news of the market and related instructions sent in the post from Great Britain or the ports. These were all compelling reasons for the improvements to the roads, bridge construction and telegraph implementation.[149]

CONCLUSION

The purpose of this chapter was to set the scene for the remainder of this study starting with the Dutch occupation of the Cape and its expansion and development as a colony, followed by the long term British occupation and the introduction of their methods of administration. As the initial settlement expanded towards the east, crossing mountains and rivers, conflict with local amaXhosa tribes arose, leading to nine frontier wars taking place along the eastern frontier. In order to bolster the frontier, the 1820 British settlers followed by the German settlers of 1857 were established along the eastern boundary. Numerous military forts and posts were built to contain and subjugate the amaXhosa people. Some of the military posts developed into towns, centres of mercantile business with burgeoning civilian populations, requiring the constructing of interlinking roads and bridges. Trade, commerce and industry was introduced starting with building construction, wagon making and specialist farming pursuits, such as agricultural produce, as well as raising cattle, woolled sheep, and ostriches. The new colonists were soon to petition the government to improve the roads, the mountain passes and to provide ferries and ponts to cross rivers throughout the colony. Initially infrastructural development was dominated by the Royal Engineers, who were thoroughly trained in both military and civil engineering and were thus eminently suited to pioneer the early road and large-scale bridge building operations throughout the Eastern Cape Colony. Roads played a central role in the colonial expansion. Initially they were required to provide safe and rapid passage to the military and for conveying their commissariat to the numerous outlying forts and posts, thereafter to civilian and commercial development as military posts and forts became towns.

[149] Purkis, 'The Politics, Capital and Labour', pp.44-45.

CHAPTER THREE - THE CONTRIBUTION OF THE ROYAL ENGINEERS TO ROAD AND BRIDGE BUILDING IN THE CAPE COLONY

Transportation technology was one of the essential developments of British expansion in its overseas colonies during the 19th century. During this period officers of the Corps of Royal Engineers completed many building construction projects for the army and a number of government departments. Royal Engineers made a significant contribution to the implementation and growth of advanced building technology.[1] Engineer officers received thorough theoretical knowledge from their education at the Royal Military Academy at Woolwich and the Royal Engineer Establishment at Chatham, earning the right to be called 'scientific soldiers'.[2] It has been shown how British civil engineers moved into foreign lands from the late 1830s applying their leading technology with military engineers far advanced of their civil engineer compatriots.[3] In particular, colonial enterprises in the Caribbean, India, Canada, Australia and Africa were spearheaded by the military and their Royal Engineer accomplices. Military engineers were a deliberate instrument of British imperial authority. As agencies of British imperial domination, the military engineer's duties were prescribed by many factors such as the problems of working in remote, undeveloped foreign territories.[4] This chapter will show how the Royal Engineers contributed to the development of the Cape Colony and will highlight their achievements with specific reference to their road and bridge building undertakings. In addition, they were often called to act as architects for the design and construction supervision of both military and civilian buildings.

In 1795 a small detachment of Sapper artificers under the command of Capt George Bridges RE arrived at the Cape to carry out the construction of fortifications, barracks and coastal surveys and to compile such plans and maps as were necessary for the defence of the settlement. In 1806 Bridges was succeeded by Capt James Carmichael Smyth RE an able engineer and administrator who also acted as colonial secretary for a term. When Smyth left the Cape in 1808 he was succeeded by Capt Henry Smart RE as Commanding Royal Engineer.[5] In the course of their colonial assignments, these Royal Engineers applied their practical and theoretical skills to encompass both military and

1 J.Weiler, Colonial Connections: Royal Engineers and Building Technology Transfer in the 19th century, *Journal of Construction History*, 12 (1996), pp.3-15.
2 M.S.Thompson, 'The Rise of the Scientific Soldier as seen through the Performance of the Corps of Royal Engineers during the early 19th Century', (PhD thesis, University of Sunderland, 2009), pp.37-51.
3 R.A.Buchanan, 'The Diaspora of British Engineering', *Technology & Culture*, 27:3 (1986), pp.505-507.
4 Weiler, Colonial Connections, p.16.
5 E.Liebenberg, '*Mapping for Empire: British Military Mapping in South Africa', 1806-1914*, p.301, in History of Military Cartography, 5th Symposium of ICA Commission in History of Cartography, 2014

civil engineering projects. In the process these scientifically trained military engineers introduced modern methods of both design and construction at the Cape. Most of these officers and, later, artificers of the Corps of Sappers and Miners were eventually transferred to the eastern frontier where they designed and built several fortified posts, access roads and bridges, including buildings and other public works. [6]

A brief history of the origins of the Royal Engineers and their education follows in order to clarify their role in the development of the colony. From the fifteenth century, both engineers and artillery officers fell under the Board of Ordnance, while in 1767 the Corps of Engineers received the Royal Warrant authorising the title of 'Royal Engineers', an officer only corps. In the same year, the Corps of Royal Military Artificers was formed, comprising privates and non-commissioned officers, who were later re-titled as the Corps of Royal Sappers and Miners in 1813 by the Duke of Wellington. Until 1856 the Corps of the Royal Engineers was under the control of the Master-General of Ordnance of the Board of Ordnance. He was responsible for the supply and issue of all arms, ammunition and artillery, including the construction and maintenance of fortifications both at home and abroad. He commanded both the Royal Artillery and the Royal Engineers which were not part of the army and therefore not under the control of the Commander in Chief. The Royal Engineers were responsible for the design and construction of fortifications and for developing the methods needed to attack and defend them. The Corps consisted entirely of commissioned officers who were chosen for their competence and professionalism, unlike the rest of the army where men could purchase commissions. Recruits were chosen when they were boys of 13 years old. They were selected by the Master General of Ordnance and had to pass an entrance examination in written English, mathematics, French, geography, history and drawing. This meant that only those privately educated had any chance of acceptance. New recruits were sent to the Military Academy at Woolwich where the curriculum was in three parts: Fortifications, Mathematics (mechanics) and Drawing. Upon graduation they received their first commission and were sent to Chatham for further training. Royal Engineer officers were not deployed as units, instead they were used as skilled staff attached to other military companies. Their motto, "Ubique" means 'Everywhere'. The Royal Engineers supervised men known as 'the Corps of Sappers and Miners'; they were the skilled artisans (artificers) and labourers who undertook the physical work of building and construction. In 1856 the Board of Ordnance was abolished and the Royal

6 W.R.Porter, *History of the Corps of the Royal Engineers,* (London: Vol 1, 1889), p.8.

Engineers became part of the British army under the Commander in Chief and from then on included both officers and other ranks. Every single Royal Engineer officer at the Cape passed through the above educational curriculum.[7]

Whitworth Porter in his study of the Royal Engineers states that modern engineering emerged in the military in the form of the Sappers, '….a body of experts who made it their profession to supply the scientific needs of an army..'[8] Civil engineering on the other hand evolved as all non-military engineering and occurred primarily due to the need to separate the non-military engineering aspects such as canals, bridges, harbours, public roads and passes, dams and roofs of large buildings from the military engineering aspects of fortifications and military installations, both defensive and offensive. Initially a number of Royal Engineers were co-opted into assisting the public sector, as will be outlined below. The job description of a principal engineer covered all the aspects of the Royal Engineer's training which also encompassed the current disciplines of architects, land surveyors and planners.

> '….he ought to be well skilled in all parts of mathematics, more particularly in stereometry, altimetry and in geodesia, to take the distances, heights, depths, surveys of land, measure of solid bodies and to cut any part of ground to a portion given, to be well skilled in all manner of foundations, in the scantlings of all timber and stone and of their several natures and to be perfect in architecture, civil and military….' [9]

ROYAL ENGINEERS AT THE CAPE COLONY

Officers from the Royal Engineers, never more than a handful at any time, made a significant contribution to the development of infrastructure at the Cape.[10] Their deployment as individuals at various locations and attached to regiments of the line throughout the colony tended to reinforce their 'invisible' role in undertaking their specialist tasks. Several Royal Engineer Napoleonic war veterans, such as Elphinstone, Holloway, Lewis, Marshall, Mudge, Smyth and Wortham, were involved in temporary bridge building, erecting pontoons, repairing sabotaged bridges, building fortifications, siege works and other 'invisible' tasks during the Iberian Peninsula campaign.[11] The role of an officer in the Royal Engineers was unique in the British army at the time. Like their fellow officers in the Royal Artillery, they fell under the direct command of the

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7 Thompson, 'The Rise of the Scientific Soldier', pp.37-51.
8 Porter, *History of the Corps of the Royal Engineers*, p.8.
9 Porter, *History of the Corps of the Royal Engineers*, p.49.
10 In his publication of the *History of the Corps of Royal Engineers*, Major General Whitworth Porter has tended to overlook their role in the Cape Colony in spite of their many achievements, in W.Porter, *History of the Corps of the Royal Engineers*, pp.24-43.
11 M.S.Thompson, *Wellington's Engineers, Military Engineering in the Peninsula War 1808-1814*, (Barnsley: Pen & Sword Books, 2015), pp. 1-2.

Board of Ordnance, which was an independent branch of the army. The number of Royal Engineer officers was so small that they often worked alone and thus had to be well trained and experienced in their professional duties. The title of Commanding Royal Engineer (CRE) was conferred on the most senior ranked Royal Engineer of the deployment. At the Cape there was an overall CRE based in Cape Town, reporting to the Governor, and a local, lesser ranked CRE based on the eastern frontier at Graham's Town with well-defined responsibilities.[12] The monthly returns of all troops stationed at the Cape during the period 1810 to 1827 indicates between 12 and a maximum of 30 Sappers & Miners and three Royal Engineer officers out of a total of between 2,700 and 4,000 troops.[13]

During the first occupation of the Cape by British forces in 1795, which lasted for seven years, Governor Lord Macartney received a list of instructions from the Imperial Crown dated 13 December 1796, which included the following order under article 23:

> You shall cause a survey to be made of all the considerable rivers, landing places and harbours within the limits of the said settlement, in case the same shall not already have been done, and to report to us through one of our principal Secretaries of State, how far any further fortifications be necessary for the security and advantage of the rivers, landing places and harbours.[14]

The first group of Royal Engineers to be posted to the Cape were Captains George Bridges, James Carmichael Smyth and Henry Smart. Their first task was the accurate mapping of the Cape as the Dutch had repatriated all their Cape Colony maps to the Netherlands. In addition to surveying and mapping the prominent topographical features, landmarks, rivers, mountains, roads and coastal surveys, the design and construction of fortifications was essential, tasks for which they had been thoroughly trained. Shortly after taking charge at the Cape in 1795, Major General Craig extended the line of French built fortifications by building batteries and blockhouses above the old French lines. They included the King's Blockhouse on Devil's Peak, the Queen's (formerly the Duke of York's) and the Prince of Wales Blockhouses. In addition, a Martello Tower was also built at Simon's Town.[15]

Following the second British occupation in 1806, the first detachment of the Corps of Royal Sappers and Miners landed at the Cape Colony comprising one sergeant, two corporals and seventeen artificers of the Plymouth Company under Captain J.C.Smyth

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12 Thompson, *Wellington's Engineers*, p. 3.
13 G.M.Theal, *Records of the Cape Colony*, Vols 2-35, (London: William Clowes, 1902).
14 Theal, *Records of the Cape Colony*, Vol 2, p.14.
15 T.Couzens, *Battles of South Africa,* (Cape Town: David Philip Publishers, 2004), p.53.

RE. Part of the expedition under Gen Sir David Baird they had been sent to the Cape to secure the Colony from the Dutch Batavian Republic. The artificers landed on the 4 January 1806, but Gen Baird would not permit them to take part in the military assault on Gen Janssen's defenders and sent them instead to the Castle where their services would be more useful. After the successful British occupation, several small detachments of the corps of various strengths were stationed in the Colony at Cape Town and at posts and forts far inland and along the eastern frontiers. Smyth was later succeeded as Commanding Royal Engineer by Captain Henry Smart, who was the sole Royal Engineer at the Cape until 1818.[16] In October 1818, Major William Cuthbert Holloway RE was sent to the Cape as Commanding Royal Engineer. His duties were to continue the survey and mapping work and to prepare plans and specifications for various public works.[17]

In response to the end of the Napoleonic wars, the overall peace establishment of the Corps of Sappers and Miners was reduced from 24 companies to 12 companies of 752 men by a royal warrant of March 1819. The organisation of each company was fixed at the following personnel: 1 colour-sergeant, 2 sergeants, 3 corporals, 3 second-corporals, 2 buglers and 51 privates to total 62 men. On 24 July 1819 a reinforcement of thirty men landed at the Cape, under Lieutenant James Rutherford RE. To supplement the garrison on the eastern frontier, the detachment marched 700 miles to their destination. In places where civilian artisans could not be found at any rate of pay, the Sappers carried out the various infrastructural jobs and works of defence. On one occasion, they constructed a temporary bridge over a flooded river. The bridge was erected in six hours to allow a force of about 2,000 horse and foot, a battery of guns with ammunition wagons, 100 baggage wagons with commissariat, all crossing in three hours, resulting in glowing praise from Holloway, who wrote: '….without the assistance of these sappers the river could not have been passed without much delay, loss of property and perhaps loss of life…… both on the frontier and at the seat of government they were always found of the utmost benefit…*'* [18]

As the military posts, forts and settlements evolved into towns, the military were in charge of the development, administration and maintenance of the towns during their

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[16] T.W.J,Connolly, *History of the Corps of Royal Sappers and Miners*, Vol 1, (London: Longman, Brown, Green & Longmans), 1855, p. 147.

[17] Major William Cuthbert Holloway RE (1787-1850) was commissioned in 1804 and served in Ireland, Madeira and in the Spanish Peninsula campaign against the French under the Duke of Wellington where he was wounded at the 3rd siege of Badajoz in 1812. He returned to the UK, was made a major in 1817 and sent to the Cape; from S.Lee (Ed), *Dictionary of National Biography,* 1901 supplement Vol II (London: Macmillan, 1901) p.437.

[18] Connolly, *History of the Corps of Royal Sappers and Miners*, p. 234.

formative years. Initially they would usually set out a grid layout pattern for the roads and erven of the settlement as it was a layout that could be easily replicated and which suited the notion of the division and ownership of land and which was within the technical surveying abilities of the era. The towns of Graham's Town, Fort Beaufort, King William's Town and East London are examples where the Royal Engineers were involved in the initial design and layout of the streets, in a grid pattern. Importantly the Royal Engineer surveyors were the first to carry out the ordinance survey of South Africa, starting from around Cape Town in the early 1800s, which still forms the basis of the land registration system of South Africa.[19]

Major Holloway had hardly settled at Cape Town when the fifth (Nxele's) frontier war of dispossession broke out on 22 April 1819 with the attack on Graham's Town. Governor Lord Somerset sent Major Holloway, in charge of 400 reinforcements and supplies to join Lieutenant Colonel Thomas Willshire of the 38th Regiment, then commanding on the frontier. Upon his arrival Holloway immediately and personally set about erecting defence works around Graham's Town which consisted of four earthen redoubts and improving the defences of the numerous outlining posts, while Lieut Ives Stocker RE carried out the necessary strengthening of the posts in the vicinity of the Algoa Bay to Graham's Town road. In a later report to the Board of Ordnance, Holloway lamented the absence of a company of Sappers and Miners to oversee and to build the numerous fortification works.[20] On his return to Cape Town he submitted a lengthy report into the state of the roads, passes and river crossings of the colony.[21] The on-going labour and supervision problems on the road between Cape Town and Simon's Town resulted in the Royal Engineers taking control of all the roads of the Peninsula in 1825.[22]

At this stage the only two places where wagons could cross the mountain range running northwards from False Bay in the south for 35 miles parallel to the shore of the Atlantic Ocean, was over the Roodezand Kloof and Hottentots Holland Kloof. The Landdrost and Heemraden of Stellenbosch and Caledon agitated for a pass over the Fransche Hoek Kloof as the single, narrow track built by S.J.Cats in 1819 was too steep and dangerous. In September 1822 Holloway, land surveyor W.F.Hertzog and Lieut Wattris set out the new alignment of the pass. The resulting pass which was built wide enough to accommodate two wagons, had to have sections blasted with gunpowder out of the

[19] L.G.Robson, 'The Royal Engineers and Settlement Planning in the Cape Colony 1806-1872: Approach, Methodology and Impact', (PhD Thesis, University of Pretoria, 2011), pp.241-266.
[20] C.G.Coetzee, *Forts of the Eastern Cape, Securing a Frontier, 1799-1878*, (Fort Hare Press, 1995), pp.74-75.
[21] Holloway to Earl Bathurst, 7 December 1824, Theal, '*Records of the Cape Colony'*, Vol 19 p.241.
[22] CAD CO 4854, R.Plasket to the Commanding Royal Engineer, 17 Jan 1825, p.373.

solid rock side walls, high fills contained by massive dry-stone packed retaining walls and several drains and culverts. The gradient was kept to a steady 1 foot in 15. The length of the road through the pass was approximately 6 miles and included two single span timber deck bridges between stone masonry abutments across the Whyte and Jan Joubert's Gat streams. The foundations and abutments of these two bridges cost a combined total of £2,260 while the total cost of the pass was £8,390.[23] For a decade the latter bridge served its purpose until in January 1834 civil commissioner Van Ryneveld complained that the bridge was decayed and dangerous. Maj Michell and John Skirrow[24] inspected the bridge and concurred. Michell's final estimate to replace the timber deck with a 18ft 3in stone arch supported by the existing stone abutments amounted to £324.[25]

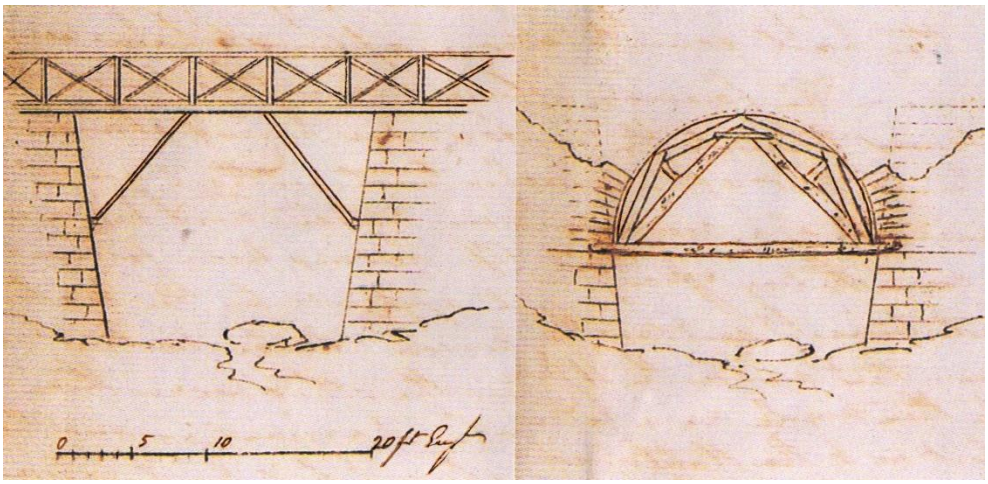

Fig 3: Michell's proposal for replacing the Jan Joubert's Gat Bridge

One of the reasons which prompted Governor Somerset to begin the work was to keep two companies of soldiers of the Royal African Corps, a penal battalion, employed before embarkation to Sierra Leone. He also wanted them kept away from civilians as it was necessary to keep them from committing acts of violence and depredations against the local inhabitants. The remote encampment at Fransche Hoek served the purpose and where the men rendered most useful service in building the pass. They were able to carry out the work at a much reduced rate of pay when compared with the lowest rate for civilian labour of one and a half Rix dollars (3s. 3d) per day, exclusive of rations.[26]

[23] Holloway to Maj Ryan, 11 May 1827, in Theal, '*Records of the Cape Colony'*, Vol 28 pp.141-143.
[24] John Skirrow, British civil engineer and architect was sent to the Cape in 1825 to supervise the construction of the Royal Observatory. In 1828 he was appointed government architect and assistant civil engineer in the office of the Surveyor General, CC Michell. In 1842 he designed a wooden bridge over the Liesbeeck River.
[25] CAD CO 425 No.425, Michell to Bell, 1 Sept 1834.
[26] The Royal African Corps was composed of military offenders from various British regiments, pardoned on condition of life-service in Africa or the West Indies. The regiment was one of several penal corps or "condemned

By September 1823 the work was well in hand but it had been found that the cost of completion would be more than at first estimated. The initial expenses had been borne from the treasury of Stellenbosch district. At this point the Governor wrote to England requesting an additional sum of £2,500 from the public treasury, for which he was castigated for exceeding the sum of £200 without prior approval.[27] The reasons advanced for under-estimating the cost were as follows: when Holloway and Hertzog made their route survey no serious obstacle was anticipated from the favourable appearance of the ground. As so often happens, when the excavations were being undertaking, large outcrops of solid rock were exposed, requiring blasting with gun powder by specialist miners, and the construction of high dry-stone packed retaining walls, some 18 to 25 feet in height. Out of the six miles of road, about four miles required retaining walls. The changes required the services of civilian artisans at higher rates of wages. The additional funds were eventually made available and construction of the Fransche Hoek Pass was finally completed by the end of 1825.[28]

In 1826 Maj Holloway instructed Lieut Cowper Rose RE to undertake a thorough investigation of building a 'hard road' across the Cape Flats. Rose presented a report in March 1826 outlining a detailed plan in which he presented four separate routes starting from the Liesbeeck River at Rondebosch or from the Salt River to the stone bridge at Stellenbosch, distances varying from 18 to 25½ miles with an estimate of £8,399 that proved too costly at the time. An important portion of the report was the location of suitable gravel surfacing material given that the route was over moving, undulating Aeolian sands.[29]

In 1826, Lieut Cowper Rose RE presented a report into the possible improvement to the existing Hottentots Holland Kloof crossing involving a large volume of rock blasting using gunpowder at a cost of £2,200. '…I do not mean to state that this sum will render the ascent gradual or that double the amount would make the Hottentots Holland Kloof equal to the worst part of the Fransche Hoek…' [30]

When Sir Lowry Cole assumed the position as Governor of the Cape to succeed Major General Bourke in 1828, he lost no time in turning his attention to the bad state of the

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battalions" raised from about 1804 which were recruited from deserters and prisoners from the hulks who could change their prison sentences for service in the RAC. Not to be confused with the King's African Rifles regiment.

[27] Letter from Earl Bathurst to Lord Charles Somerset, 19 January 1824, from '*Records of the Cape Colony'* by GM Theal, (Vol 17, Cape Town: Saul Solomon, 1897), p.7.

[28] Letter from Lord Charles Somerset to Earl Bathurst, 23 June 1824, and Report and Estimate by Lieut J Mudge RE, 18 June 1824, from '*Records of the Cape Colony'* by GM Theal, (Vol 18, Cape Town: Saul Solomon, 1897)' pp.1-8.

[29] Rose to Holloway 9 March 1826 in Theal, '*Records of the Cape Colony'*, Vol 26 pp.39-41.

[30] CAD CO 255, No.14, Rose to Holloway 30 Jan 1826.

Hottentots Holland Kloof road. After a site inspection, he instructed the newly arrived Surveyor-General, Civil Engineer and Superintendent of Works, Major Charles Cornwallis Michell, who had arrived on 21 October 1828, to stake out a new route over the mountain range and prepare estimates of cost of the work. His estimate was £2,672 and the work was again to be carried out mainly by soldiers of the 72nd Regiment and a team of convicts.[31]

In February 1830 after Cole had informed the Secretary of State of the construction, he was also severely censured for engaging in the work without British Government approval, after which he summarily suspended work. This in turn caused a great upheaval amongst the local population, Cape Town merchants subscribed £900 to ensure that the pass was completed, where upon he was permitted to continue. The following was Cole's motivation to the London authorities.

> '…I am not aware of any measure that would tend so materially to the general improvement of this widely extended Colony, or prove so universally acceptable as the improvement of the various mountain passes at the same time that by multiplying and improving its internal communications, it would extend its trade and consequently increase its wealth and the public revenues. You are probably aware that this country consists for the most part of extensive plains, divided by long ranges of rugged mountains over which there are but few roads and those few such as in any other country would be deemed impassable by a vehicle of any description. The internal trade of the Colony and even public justice is thus impeded and as long as this evil is permitted to continue so long will this Colony remain in its present semi-barbarous state and in poverty. The means of the inhabitants are totally inadequate to remedy the evil and it can therefore only be accomplished through the Public Treasury…'[32]

The pass, called Sir Lowry's pass, which finally cost £3,094, was opened to traffic on 6 July 1830. Heavily-laden wagons could descend the mountain without having to apply their iron brake shoes, an operation that normally ploughed up the gravel roads. Michell then overcame the next obstacle when he completed the five mile long Houw Hoek pass down to Bot River, which was opened in February 1832.[33]

After being at the Cape for almost six years, the following is what Major Michell had to say about bridges,

> '….I must not omit mentioning, that we are entirely destitute of bridges. We have, it is true, a few tolerable ferry boats (about five or six at the utmost; little enough for so extensive a country); the best of these are at the Berg, Breede and Gamtoos rivers; but there are many streams, such as the Eerste, Palmiet, Bot and Buffelsjaght, &c., which, although they contain little water in summer, yet in the winter season acquire sufficient magnitude and impetuosity to be impassable for many days together. And it is only those persons who have experienced the miseries of 'outspanning' on their

[31] G.Richings, *The Life and Work of Charles Michell*, (Cape Town: Fernwood Press, 2006), p.126.
[32] CAD, GH 23/9, No.23, Letter Governor Cole to Murray, 22 February 1831.
[33] G.Richings, *The Life and Work of Charles Michell*, p.127.

> banks, drenched to the skin whilst waiting four or five days for the waters to run out, who can fully estimate the advantage and comfort that would be derived from the construction of a few bridges on spots judiciously selected…'[34]

Fort Beaufort was established by order of Lord Charles Somerset and the specific site, on the banks of the Kat River, was selected during August 1822 by Lieut Col Maurice Scott of the 6th Regiment and Lieut Rutherford RE.[35] The permanent buildings which comprised a barrack for 250 men and offices, stabling for horses, a hospital, commissariat store and powder magazine, were arranged on the sides of a square, under the supervision of Lieut Rutherford RE, according to an approved plan drawn up by Major Holloway.[36]

Captain Charles Jasper Selwyn RE (1792-1847) was appointed the Commanding Royal Engineer of the Eastern Cape Frontier in February 1834. He disembarked at Cape Town, where he spent six weeks being orientated about his future responsibilities by Lieut Col Lewis RE, the Commanding Royal Engineer of the Cape Colony and also conferred with the Governor Sir Benjamin D'Urban. He finally arrived in Graham's Town in July 1834 to assume his duties as Commanding Royal Engineer of the frontier. Scarcely five months after his arrival, 12,000 amaXhosa mobilised by Chiefs Maqomo and Tyali, invaded the colony on 21 December 1834, the beginning of the 6th Frontier War (Hintsa's War). Col Henry Somerset appointed Capt Selwyn as the Town Commandant and with Lieut Col Richard England of the 75th Regiment was charged with the defence of Graham's Town, erecting barricades around Church Square, transforming it into a '*laager*', to which hundreds of settlers fled for protection.[37]

Governor D'Urban, on hearing the news sent Lieut Col Harry Smith to Graham's Town to take control of the situation. Smith preceded to Graham's Town and took control of the situation by declaring martial law and after several months stabilised the situation. The sixth Frontier War was one of the most tragic and devastating episodes in the history of the eastern Cape Colony.[38]

D'Urban instructed Lieut Col Lewis at the conclusion of hostilities, to draw up a plan for the military to launch a rapid response to any further attacks from across the Fish River boundary and to build a number of strategically placed military forts joined by suitably constructed roads to defend the frontier. This comprehensive and detailed report

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[34] Letter Maj C.C.Michell to Mr G. Thompson, 25 Aug 1834, *Journal of Royal Geographical Society*, 6, (1836)
[35] G.E.Cory, The Rise of South Africa, Vol.II (London: Longman Green, 1926), p.147.
[36] C.G.Coetzee, '*Forts of the Eastern Cape'* , p.238.
[37] P.Barnes, *Charles Jasper Selwyn, Where Duty Leads, Officer Commanding Royal Engineers Graham's Town 1834-1842,* (Private, 1979), p. 8.
[38] See Chapter 2 for more details

contained several proposals, complete with cost estimates for the construction of several permanent forts and posts, signal towers, roads and bridges. The fortifications recommended included ones at Cawood's Farm (old Kaffir Drift Post), Trompetters Drift Post, 'Commattuys' Drift Post, Fort Brown, Botha's Post, Fort Beaufort, Fort Armstrong, and Post Retief, the so-called Lewis Line of Fortifications.[39]

Capt Selwyn while based in Graham's Town, designed and had constructed several military installations in the village, these included Fort Selwyn (or Selwyn Battery), a star shaped fort built of stone rubble masonry on Gunfire Hill, the Provost military prison, the Cape Mounted Rifles and Fort England barracks, the Royal Engineer's depot, repairs to the Drostdy building and Drostdy Arch. He also had a hand in the construction of the Woest Hill Pass on the road to Southwell and the road on the steep hill leading up from Howison's Poort. He also worked on a new line of the road between Algoa Bay and Graham's Town and reduced the gradient up Swartkops Hill from one in eight to one in fourteen, "…..a saving in the number of oxen, exclusive of the wear of the wagon with a heavy load". He also superintended improvements in High Street, having proper levels taken and drawing up a concise plan of the work to be done and also had a well sunk on East Barrack Hill.[40]

Capt Selwyn implemented Lieut Col Lewis's recommendation that communication with Fort Beaufort and Fort Peddie be improved by a series of signal towers with Fort Selwyn as base. A series of towers were built to relay signals by means of semaphore using signaling masts mounted on 30ft high stone towers. Their purpose was to signal to each other and to soldiers at the Fish River drifts the news of cattle theft or impending amaXhosa incursions. These posts were positioned no further apart from each other than for signals to be read employing telescopes and consisted of the Beaufort Line and the Peddie Line. The essential position was to be Governor's Kop, nine miles east of Graham's Town, as it had excellent views of the surrounding countryside. Thus the Beaufort line was from Fort Selwyn via Governor's Kop to Graskop, Botha's Post, Dan's Hoogte and Fort Beaufort, whilst the Peddie Line was from Fort Selwyn via Governor's Kop to Frasers Camp, Piet Appel Tower to Fort Peddie. However the system did not prove successful owing to mist and other visual problems.[41]

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[39] CAD ACC, No. 1523, G.G.Lewis, *'Report upon the Eastern Frontier of the Cape of Good Hope'*, 18 March 1837.
[40] Graham's Town Journal, 4 December 1840.
[41] H.Hall, 'On Telegraphic Communications', *Cape Monthly Magazine*, Vol VI, (Nov 1859), pp. 257-266.

Capt Selwyn's greatest achievement was the construction of a military road between Graham's Town and Post Retief, via Fort Beaufort, later called the Queen's Road. This 75 mile road had to descend the Ecca Pass, cross the Fish River at Fort Brown, ascend Koonap Hill, cross the Kat River over the Victoria Bridge, pass through Fort Beaufort and ascend the Winterberg to finally reach Post Retief military barracks. Maj Selwyn[42] was also in charge of the festivities when the foundation stone was laid in November 1840 for the Victoria Bridge over the Kat River at Fort Beaufort which was completed in 1843. A second, all timber bridge was built over the Great Fish River at Fort Brown, between 1840 and 1845. Maj Selwyn left the Cape on 12 July 1842, to be transferred to Exeter in the UK, and as a Lieutenant Colonel, to Canada, where he died 12 December 1847, age 55 years. He was succeeded as Commanding Royal Engineer on the frontier by Major Hale Young Wortham RE, another Napoleonic War veteran.[43]

The necessary funds for the construction of all the 'military' roads mentioned above came from the "….apparently inexhaustible fountain, the military chest".[44] This was in direct contrast to the economic and budgetary limitation imposed upon Cape governors by the British Government. Their resources provided were small while their responsibilities were great. The decisive directive in British Colonial policy in the 19th century was the mandate of the budget. The British Government viewed the Cape Colony as a naval base and as such, roads and transportation was a local matter to be funded from own resources. Another difficulty in applying Imperial policy to military funding was that responsibility fell on several departments. Apart from the Colonial Office, there was the Treasury, the Board of Ordnance and the Commander of the Horse Guards. The administrative bureaucracy increased substantially after the Napoleonic Wars. On matters of military construction, five sets of correspondence were required between the Colonial Office and the Governor, Ordnance and the Master General of Board of Ordnance, the Colonial Office and Treasury, the Colonial Office and Ordnance, and finally the Treasury and Ordnance. The result was confusion as no one office or individual had the power of the final decision while much slow moving correspondence circulated around the offices to the detriment of the projects that needed the authority and finance.[45] An example of these delays was the construction of barracks for troops at the Cape. Requisitions first made in 1828 were authorised in 1837 and by 1844 only a third had been implemented, of which Fort Beaufort barracks was

[42] Captain Selwyn was promoted to the rank of Major on 28 June 1838.
[43] Barnes, *Charles Jasper Selwyn, Where Duty Leads,* p. 8.
[44] G.Cory, *The Rise of South Africa*, (London: Longmans Green, Vol IV), pp.243-244.
[45] J.S.Galbraith, *Reluctant Empire, British Policy on the South African Frontier 1834-1854*, (Los Angeles: University of California Press, 1963), p.25.

the largest. Another example was at Fort Willshire where the medical officer reported in 1821 that the roofs of the barracks and hospital needed repair. He made the same report with increasing emphasis in 1828, 1830 and 1833, after which the fort was abandoned.[46]

THE LEWIS REPORT AND THE QUEEN'S ROAD

Over a period of twenty-five years succeeding governors who included Cradock, Somerset, Donkin, Bourke, Cole and D'Urban instructed several Royal Engineers to undertake detailed investigations along the eastern frontier and to report on the suitability of the terrain and on locations of potential future fortifications. These army officers were Lieut Col John Graham (1812), Lieut Ives Stocker (1817), Capt. W.C.Holloway (1819, 1828, 1830 & 1831), Lieut Richard Rutherford (1822), Lieut John Hope (1829), Gen Sir Lowry Cole (1829), Lt Col Robert Thomson (1833), Maj C.J.Selwyn (1836), Lieut Butler (1837), Lieut Montgomery Williams (1837), Lieut Richard Nelson (1837) and finally Lieut Col G.G.Lewis (1837). Amongst their many recommendations, they indicated the need for improved roads between forts and posts and suggestions of locations for bridging the many rivers for which cross sections were surveyed and framed.

Before Governor D'Urban was recalled in January 1838, he commissioned Lieut Col G.G.Lewis[47] to draw up a report which was submitted in March 1837. The 'Lewis Report' was far reaching in that it presented comprehensive recommendations and a new approach to fort building, upgrading and establishing new fortifications. In addition, a formal treaty was concluded with amaXhosa chiefs in an attempt to bring stability to the Colony.

In March 1836 Lieut Col Lewis was posted to the Cape as Commanding Royal Engineer. In October he was sent to the eastern frontier where he covered over 1000

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[46] Galbraith*, Reluctant Empire,* pp.23-24.

[47] Lewis, Griffith George (1784-1859) was educated at the Royal Military Academy at Woolwich, He was commissioned into the Royal Engineers as a Lieutenant in 1803. After service against the French in southern Italy from 1805 to 1811, he was sent to Spain to serve under the Duke of Wellington. After being promoted Captain in July 1813 he was twice wounded at the siege of Sebastian while constructing a siege battery, and in the assault of the breach on 21 July he was so severely wounded that his left leg had to be amputated above the knee. Promoted brevet Major, he was invalided back to England. A stint in Canada resulted in a final six months in 1828 on the construction of the Rideau Canal from Ottawa to Kingston. Here he would have been exposed to stone masonry canal lock and bridge design and construction methods. Lt Col John By R.E. designed and supervised the construction of the Rideau Canal between 1827 and 1832, 126 miles and 47 locks, with numerous stone arch bridges. Lt Col Lewis was Commanding Royal Engineer on the island of Jersey between 1830-1836, where he designed and built five Martello towers, before taking up the same position for six years at the Cape between March 1836 and August 1842 succeeding Lieut Col Robert Thomson. He returned to England eventually retiring as a Lieutenant General…. Ref. R.H.Vetch, *Dictionary of National Biography, 1885-1900,* Vol 33 and H.G.Hart, *New Army List, being the Regimental Officers of the Army*, 1844

miles during seven separate journeys of inspection. In March 1837 he presented a lengthy report to the Inspector General of Fortifications, Gen Mulcaster regarding many aspects of the Eastern Frontier. This exhaustive report comprising 115 pages and seventeen appendices covered such items as a general description of the Eastern Frontier, from the Winterberg Mountains to the coast, geographically and demographically and observations of the existing defences. There were far-reaching recommendations for the frontier defences comprising permanent posts and forts, roads, bridges and signal towers. Included were appendices from various persons regarding all aspects of military establishments, including cost estimates, force complements, recruitment, buildings and many others.[48] Governor D'Urban endorsed this report and its recommendations, adding many comments. The enduring legacy of the report may be seen as the so-called 'Lewis Line' of fortifications. As summarised in paragraph 88 of his report, they were Hans Erasmus Post on the Zwart Kei River, Post Retief in the Winterberg, Fort Armstrong, Fort Beaufort, Botha's Camp, Double Drift, Committee's (spelt Commattuy's) Drift, Trumpetter's Drift, Fort Brown, and Tomlinson's Post on the Koonap River.[49] All these forts and posts had to be connected by roads, another task for the 'sappers'.

The need for the construction of proper roads and bridges was a recurring appeal, especially from the Commissariat Officers whose wagons were being destroyed by the punishing rough terrain over which they had to travel to deliver supplies to the various fortifications.[50] Lieut Montgomery Williams R.E. in his report on the Fish River was instructed to mark out the roads between the various posts.[51] Lieut Col Lewis provided the following motivation for the construction of Queen's Road:

> '…Next in importance for the defences and buildings for the proper accommodation for the troops and horses, is the construction of good military communication from Post to Post. His Excellency the Commander-in-Chief has authorised expenditure for tracing a new line and improving the communications from Graham's town to Fort Brown and Commattuy's drift for the purpose of securing the expenditure of transport over the execrable roads now over Botha's Hill, one of the most frequented as leading to most of the principal posts as also the still worse road to Commattuy's drift, which has been subject to long complaints from the senior officer of the Commissariat. It is convenient also that the other direct roads should be improved and that communications should be made laterally from post to post…' [52]

Sir Benjamin D'Urban who had personally experienced the poor condition of the frontier road system, early in 1837 authorised expenditure of £474 for roads, to include

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48 CAD, ACC 1523, Lewis G.G. '*Report upon the Eastern Frontier of the Cape of Good Hope'.*
49 Lewis Report, Paragraph 88
50 Lewis Report, Paragraph 84
51 Lewis Report, Appendix No.7
52 Lewis Report, paragraph 84.

the tracing of a new line from Graham's Town to Fort Brown '…..the key to all the Posts from the junction of the Kat and Fish rivers to the Winterberg.' [53]

In his report of 18th March 1837, Lieut Col Lewis framed an estimate of £3,000 for bridges, £4,474-12-5 for military communications and £1,500 for signal towers for a total of £8,974-12-5 out of a grand total of £172,745-4-10 of which £16,500 was in progress.[54] Several connecting roads between his proposed new military posts included the following: from Botha's Camp (Post) to the Queens Road, to Tomlinson's (Koonap) Post, and to Double Drift Post; from Committee's Post to Double Drift Post, to Fort Brown, and to Trompetter's Drift Post and Driver's Farm; from the latter to Clay Pits and from Fraser's Camp via Buffalo Fountain to Bathurst village. He also made provision in the above amount for a bridle path from Trompetter's Drift to Sand Drift, continuing to the old Kaffir Drift Post.[55]

The rural nature of the eastern frontier economy and the emphasis that the colonial authorities placed on economic development of the region, made it necessary that it was reached by adequate access roads. The building of roads between the main commercial centres such as Port Elizabeth and Graham's Town and the other frontier towns was an important priority.[56] The position of the authorities, as outlined by Lieut Col Lewis, '...without roads and bridges, however great the riches and resources of a country may be yet its commerce must languish, and the industry of its inhabitants become paralysed from the difficulty and uncertainty of the transport of its produce and its enhanced value, when at length it reaches a market. Roads and bridges are to a country what veins and arteries are to the human body'.[57]

Lieut John Hope RE in his report of 1829 outlined the condition of the eastern frontier roads which was followed by the Lewis report in which he said, '…the civilisation of a country is in some respects indicated by the goodness of the roads, it is feared that the Cape of Good Hope must rank rather low'.[58] Governor Napier was convinced of the necessity of adequate roads and did not hesitate allocating funds from the military budget for this purpose.[59]

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53 Lewis Report, paragraph 84.
54 Lewis Report, paragraph 90.
55 Lewis Report, paragraphs 55-76.
56 N.J.Jooste, 'Die Geskiedenis van Fort Beaufort, 1822-1843', (MA thesis, Randse Afrikaanse Universiteit, 1986), p.151.
57 The Cape Frontier Times, 2 December 1840.
58 Lewis Report, Appendix 3.
59 The Graham's Town Journal, 21 February 1838 & Report to the Legislative Council, 19 January 1838.

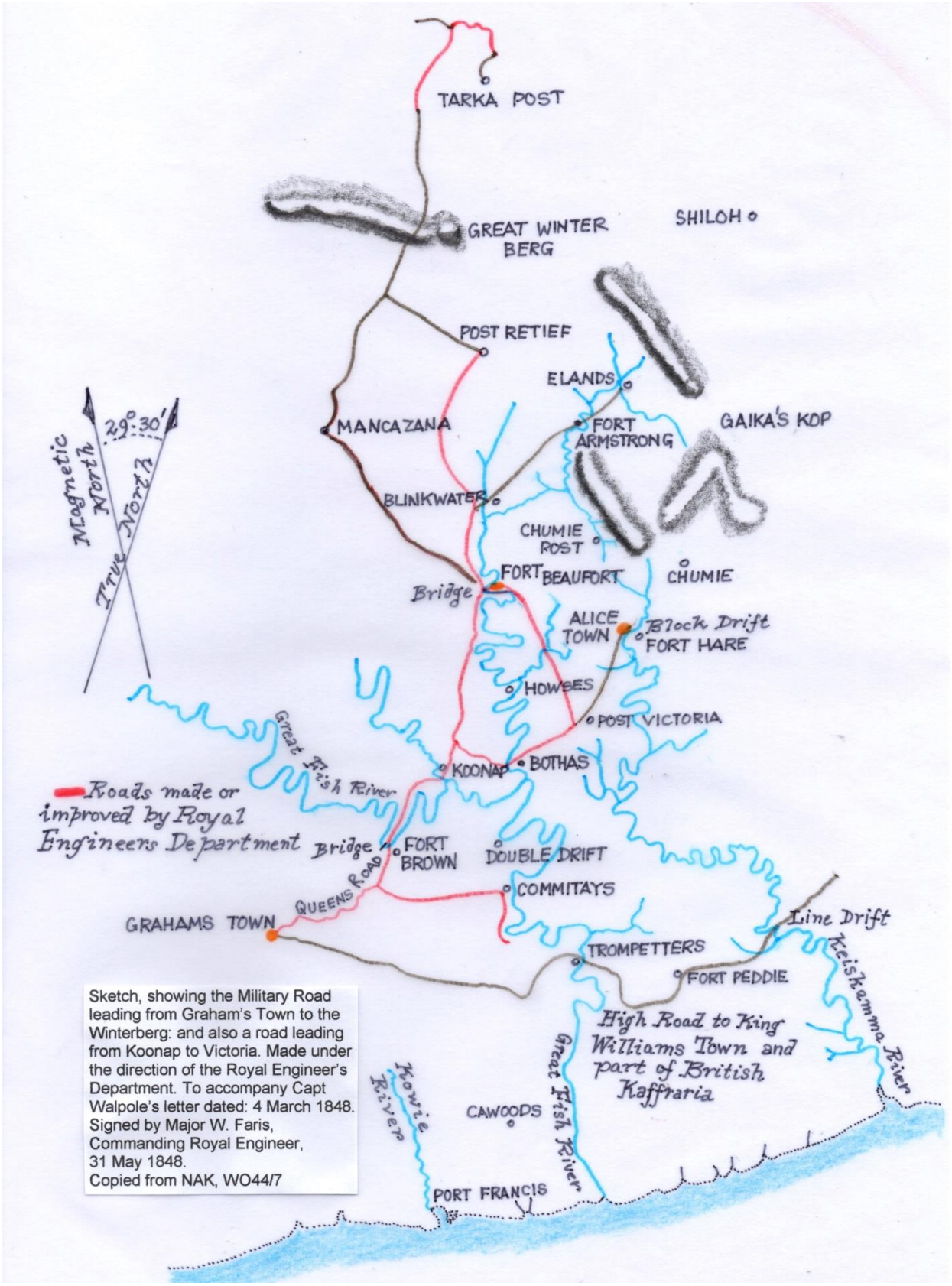

Fig 4: Copy of Royal Engineer sketch showing the Queens Road

The construction of the Queen's Road was to the advantage of the Winterberg farmers who would benefit economically from the project. The field commandant of the Winterberg, Piet Retief agitated for the speedy construction of the section from

Blinkwater to the Winterberg. The governor approved the request especially in the light of the farmers offering to assist the Royal Engineers.[60] When completed the road was lauded by the transport operators and businessmen who travelled from Port Elizabeth to Fort Beaufort, as one of the best on the frontier.

An integral part of the road network was the erection of bridges. Between Graham's Town and Fort Beaufort the two most difficult rivers to cross were the Fish and Kat rivers.[61] The Lewis report, which was welcomed by the rural community, stated that the lack of bridges affected the communication line with Graham's Town due to floods.[62] The Cape Frontier Times editorial of 11 November 1840 stated '… the (Victoria) bridge will be of unspeakable advantage not only to those residing in the increasing village of Fort Beaufort, but a convenience to the inhabitants of the district generally as offering a safe and commodious ingress and egress…'

In 1837 construction commenced on the new military road from Graham's Town to Hermanus Kraal, later to be called Fort Brown, a distance of 20 miles. This project was under the design and superintendence of the Royal Engineers, Maj Selwyn being the responsible officer. Andrew Geddes Bain[63] was employed by Selwyn as an assistant engineer on 20 April 1837, to be in daily charge of the works.[64] The labourers were mainly Khoekhoe soldiers, the disbanded men of the Cape Mounted Rifles who had been in a state of mutiny, the cause being an apparent lack of food, clothing and equipment. The murder of Ensign Crowe of the 72th Regiment, by members of these mutinous CMR, led to a court martial and death by firing squad of two ringleaders. The mutinous state of the regiment resulted in Governor Napier dividing it into six companies of the most reliable men, while the remaining four companies were drafted in to work on the new road, for which an initial £680 was allocated. The Ecca Pass section was cut out of the east side of the very steep mountain which forms one side of the thickly-bushed Ecca valley, where three miles of the road descends about two thousand feet.

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60 FBF 6/1/1/1, Capt A. Armstrong to Retief, 9 May 1836, p.33.
61 Lewis Report, Appendix 6.
62 The Graham's Town Journal, 12 September 1840.
63 Andrew Geddes Bain (1797-1864) came to the Cape in 1816, worked as a saddler in Graaff Reinet , where he supervised the construction of a road through the Oudeberg and van Ryneveld passes. During the Frontier War of 1834-5 Bain served as Captain in the Graaff-Reinet Mounted Burghers and later in the Fort Beaufort Levies when he was in charge of Fort Thompson on the Tyumie River. He was employed by the Royal Engineers (1837-45) building the Queen's Road from Grahamstown to Fort Beaufort and another military road through Pluto's Vale to Breakfast Vlei. Under the Central Road Board he was made a Road Inspector in 1845. He completed Mitchell's Pass to Ceres (1848) and later Bain's Kloof (1854) and finally the Katberg Pass between Fort Beaufort and Queenstown, a four year task completed in 1864. Bain made an intensive study of Geology and Palaeontology sending numerous fossil finds to London.
64 Cullen Library, Wits, Letter of Appointment Selwyn to Bain as an Assistant Engineer, 20 April 1837,

The road crosses the Brak River before reaching Fort Brown, on the banks of the Fish River.[65]

Fig 5: The Ecca Pass from the London Illustrated News 1840

In July 1839, Selwyn had to intervene in a disagreement between Bain and Carroll the miner, about building a certain dry-stone retaining wall. At a hearing, also attended by overseer Fraser, it was found that there were no grounds for the complaint by Carroll.[66] In October 1840 Maj Selwyn approved Bain's selection of the route of the road through the Blinkwater valley, passing the krantzes (cliffs) leading up to Post Retief.[67]

The road from Graham's Town, declared the Queen's Road in 1839 on the accession of Victoria to the British throne,[68] crossed the Fish River at a drift close to Fort Brown, evading the Vygekraal crossing, and followed the new line of road along the ridge and the adjacent, vertical krantz south of the Koonap Post. The road then crossed a drift in the Koonap River at Tomlinson's Post and continued up to the Koonap Heights past Leeuwfontein and Dans Hoogte to Fort Beaufort. The section ascending the Koonap Heights had to be blasted out of the steep mountain side with black powder and again beyond Fort Beaufort where it scaled Blinkwater Hill and the Katberg forest. From there the road climbed up to Post Retief Barracks, a total distance of 75 miles. A secondary, separate leg of the road continued through Pluto's Vale Pass to Committee's Drift on

[65] G.E.Cory, *The Rise of South Africa*, p.244.
[66] Jagger Library, UCT, Memorandum, Selwyn to Bain, 2 & 5 July 1839, Bain Collection.
[67] Jagger Library, UCT, Letter Selwyn to Bain, 28 October 1840, Bain Collection.
[68] By General Order of Sir George Napier in 1839 on accession of Queen Victoria to the throne in 1837.

the Fish River and on to Breakfast Vlei. The Queen's Road was the pride and wonder of the frontier and Bain received much praise for his share in its construction as these lines from an old journal indicate:

> "In the Highlands of Scotland it sometimes is said,
> If you'd seen these fine roads just before they were made,
> You would lift up your hands and cry "Bless General Wade,"
> If the Ecca you'd seen 'ere the road was projected,
> And its hills and its hollows all duly prospected,
> You'd surely bless Bain, who the line here directed,
> And its gradients and curves all so deftly inspected,
> And the old fashioned ruts and the sharp turns rejected;
> And all the weak points in its walls soon detected,
> And our safety and comfort in no place neglected.
> 'Stead of breaking your neck, and perhaps too, your wagon,
> Not a yard of its length need you now put your drag on,
> Then bless you! dear Bain, the best of road-makers,
> We may travel this path without fearing neck – breakers;
> May so smooth be thy way, not e'en fearing bone breakers,
> As we travel along without the least pain
> Let us think of the maker and cry "God bless thee, Bain"[69]

The actual progress of construction of the Queens Road may be gauged by the several progress reports and annual estimates of the budget. A report dated December 1838 outlined an amount of £680 to be expended on the road between Tonlinson's Post on the Koonap River and Fort Beaufort, in addition to budgets for the completion of forts at Double Drift, Forts Brown, Peddie and Armstrong.[70] Another report of 1841 had the following three items from the bill of quantities: "for excavating in clay, forming and levelling the road including clearing away the bush @ 1s:0d per cubic yard", a second item: "for excavating through rock and clay including forming and levelling the road @ 1s:6d per cubic yard", while a third item was to "construct dry masonry retaining walls @ 1s:6d per cubic yard". These items were specifically for completing the road from Fort Beaufort to Kat River Poort and from Springs to Post Retief (£275), and from the 'flat house to Fort Beaufort (£404-14-6), as outlined in the (quote:) "Report and Estimate for Works and Repairs at Posts in the Eastern Frontier Cape of Good Hope where Military Buildings are situate, but not transferred to the Ordnance. Amounting to £8,597-4-4¼ under the Authority of His Excellency, the Commander in Chief 1841-2", signed by CJ Selwyn, Major Commanding Royal Engineer and counter-signed by Col GG Lewis.[71] Another estimate and request to extend the road between Post Retief and Tarka Post of

[69] Jagger Library, UCT, Henry Hall, *Royal Engineer's Department, Foreman Clerk of Works*, Bain Collection,
[70] NAK WO44/5 Abstract of Services ordered for 1839-40, December 1838.
[71] NAK WO44/6, Estimate & Report, 5 Nov 1841.

£900, over a distance of 27 miles was approved, however on the condition that the funds were to be provided by the Colonial budgets, the road was never built.[72]

In order to complete the Queen's Road, two very important bridges had to be built, one over the Great Fish River at Fort Brown and the other at the entrance to the village of Fort Beaufort over the Kat River. The former was necessary to keep up a constant communication with both banks of the river when in flood and made impassable for weeks, and to support the northern part of the frontier. Therefore it was considered best to place the bridge under the military protection of Fort Brown, discarding totally the idea of a bridge at Vygekraal Drift on the farm of van Rooyen. Lewis favoured a wooden bridge of sneezewood with very high stone piers to bring the abutments above the highest floods which could be anything up to thirty or more feet.[73]

Apart from carrying out their engineering duties when accompanying regiments of the line, many of the Royal Engineers were involved in various engagements with the amaXhosa. In June 1851 Capt Tylden RE in charge of a force of levies withstood thirteen attacks at his Whittlesea Post against an overwhelming force of 'Tamboekies and Hottentot Rebels' during the 1850 campaign. In May 1852 Capt Moody RE in charge of a party of Sappers was ambushed while escorting several wagons of ammunition up Koonap Hill. They retreated to the ruins of the Koonap Post after seven were killed and nine wounded out of a party of thirty.[74]

In June 1846 Lieut Owen RE and a company of 90th regiment constructed a flying bridge of boats across the mouth of the Fish River and erected a field-work on the right bank, in order to establish an open line of communication to Fort Peddie.[75]

KAT RIVER BRIDGE AT FORT BEAUFORT

The Kat River Bridge at Fort Beaufort was the first of three vital bridges to be built on the Queen's Road. While stationed on the eastern frontier from Dec 1835 to Dec 1838 Lieut Richard Nelson RE designed a timber bridge over the Kat River at Fort Beaufort based on a Prussian model seen while touring Germany. Nelson's proposed bridge was to have three 60 ft timber arches resting on four semi-circular ended ashlar stone abutments and piers. The three arches, framed girders, struts, wale pieces, bracing, joisting and railings would consist of yellow wood, while the decking would be of white

72 NAK WO1/438, Letter Napier to Lord Stanley, 2 May 1844 and reply 3 June 1844.
73 Coetzee, *Forts of the Eastern Cape*, p.332.
74 Porter, *History of the Royal Engineers,* p.25.
75 Connolly, *History of the Royal Sappers & Miners*, p.457.

and red els (alder) timber. The bridge was to sustain 150 to 200 lbs per ft, and had to accommodate two passing wagons. In addition to the comprehensive works specification, construction drawings and schedule of quantities, a detailed cost estimate was presented that amounted to £14,045. Unfortunately, as this sum far exceeded the authorized amount, Nelson's proposal was rejected.[76]

The stone arch bridge across the Kat River at Fort Beaufort, comprising three arches, was designed by Lieut Col Griffith George Lewis and not by Maj Selwyn, while the construction was under the direct superintendence of Capt John Walpole RE and not by Andrew Geddes Bain, as commonly assumed and recorded in the literature.[77] The bridge comprised of a segmental circular centre arch of 60 ft span with a rise of 13 ft, and two side flood arches 14 ft wide. The piers of the main arch were 16 ft thick, and the two abutments each 25½ ft wide; the bridge was 20 ft wide and exclusive of the wing walls, was 171 ft long. The 4 ft 6 in high parapet walls were 1 ft 8 in thick, leaving a roadway 16 ft 8 in broad, to accommodate wagons and carts in a single lane.

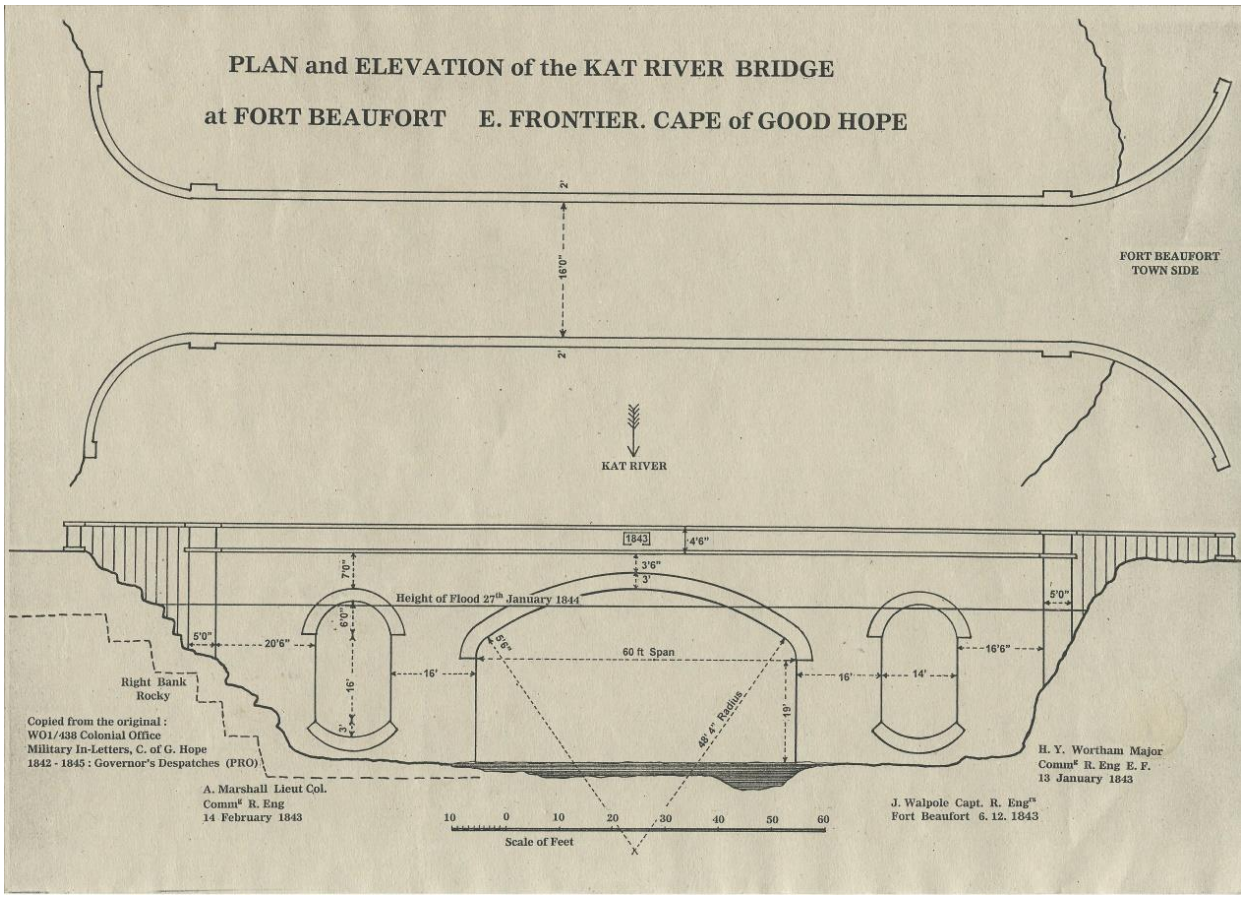

Fig 6: Plan of Kat River Bridge 1843 WO1/438

[76] R.J.Nelson, 'Report on Beaufort Bridge', *Prof. Papers of the Corps of Royal Engineers*, Vol VII, (1845)
[77] National Monument Citation No. 2264, 18 December 1970 & Heritage site No. 9/2/028/0009 description

The quoins and tail bonds were cut and dressed, while the rest of the face work was large rubble work in courses more or less regular; the backfill consisted of large and small stones well grouted. This bridge was the first to use imported 'Roman' cement in the colony, in preference to locally-made and inferior lime cement.[78] The voussoirs stones of the main arch were all of a uniform depth of 3 ft, and the spandrels of the main arch were filled with solid masonry to within a foot of the string-course. The parapet coping stones, 6 in deep, were secured together with ⅝-in iron dowels, which, before insertion, were coated with white lead and oil.[79]

The foundations of the right (south) abutment and pier were installed on solid sandstone rock formation, from which all the rock of the bridge was quarried; while the construction of the foundations of the left abutment and pier, on the alluvial deposits of the town side, proved difficult as the rock was only encountered 10 to 12 ft below the river bed. The centering (staging) for the main arch, also designed by Lieut Col Lewis, was made of local yellow wood. The footings for the centering trestles were formed of large slabs of stone laid in excavations about 5 ft wide, 6 ft deep, and upwards of 20 ft long. These footings proved of sufficient stability without going right down to the bedrock, the bed of the river comprising of gravel and shingle.[80]

Three days after the keystones of the main arch were set, the centering was struck very slowly taking over six hours. Initial deflection and movement was observed with alarm, however this proved to be of little consequence as the compressive equilibrium of all the stones was soon achieved. Amongst the stone masons were some indifferent workmen and often the arch stones were not accurately shaped as required, and the mortar bedding was often very unequal. Notwithstanding, it was with a sense of achievement that when the centering was lowered, the settlement of the arch crown did not exceed 1¼ in.[81]

[78] Lime cement was made by burning seashells in a lime kiln and adding the slaked lime to sand.
[79] J.A.Walpole J, *A* 'Description of the Bridge across the Kat River, at Fort Beaufort', *Prof Papers of the Corps of Royal Engineers*, Vol VII, (1845).
[80] Walpole, 'Description of the Bridge across the Kat River, at Fort Beaufort'.
[81] Walpole, 'Description of the Bridge across the Kat River, at Fort Beaufort'.

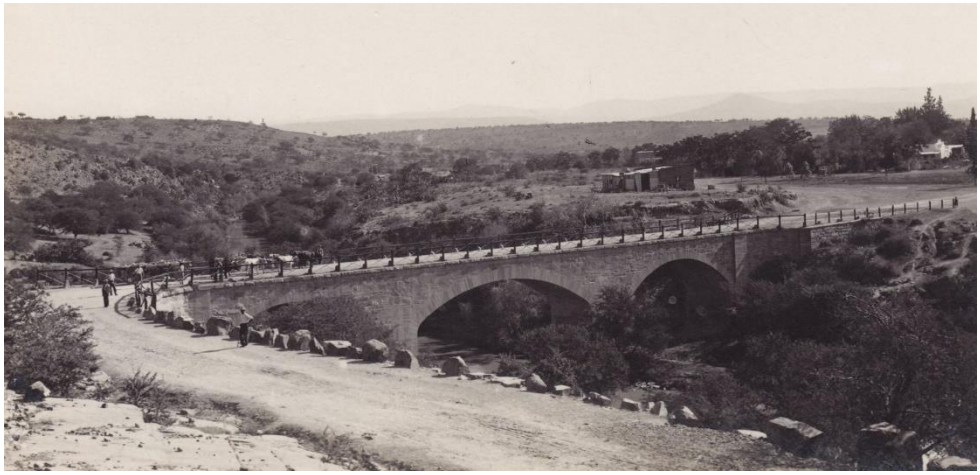

Fig 7: Victoria Bridge over the Kat River, Fort Beaufort 1843

The foundation stone of the bridge was laid with much ceremony on 25 November 1840.[82] It was a festive day in Fort Beaufort. Soldiers of the 75th Regiment and the Cape Corps formed in open order down both sides of the main street, as the official procession wound its way to the banks of the Kat River where the bridge was to be built. First came the band of the 75th followed by a number of visiting Freemasons, specially invited by Maj Selwyn, who, as a mason himself, felt it his duty to the craft to show his colours and have the stone laid with masonic honours. The Governor Sir George Napier and Lady Napier accompanied by Maj Selwyn and the Lieutenant Governor Colonel Hare followed. After these came the Governor's staff and the staff and officers of the Fort Beaufort garrison. Assembled at the stone, Lady Napier performed her part of the ceremony, saying, 'I name this bridge the Victoria Bridge,' to honour the new queen after her recent accession in 1837. In his speech, Maj Selwyn pointed out that this foundation stone for the first bridge of any permanent character across any river in the frontier districts was the first to be laid. The construction of the bridge commenced in July 1840, and was completed on the 5 December, 1843. The want of competent workmen at different times meant that work was at a standstill for a period of six months due to the lack of funds.

Fortunately the river never rose in flood whilst the centering was in position, the first flood occurred on the morning of the 27 January 1844, when the river rose twice as high as it had ever been seen before. The head water at the bridge was only 4 ft below the crown of the main arch, the bridge became an immense obstruction to the river, reducing the waterway to about one half. Capt Walpole concluded with the following optimistic statement that 'This flood has well tried the equilibrium of the arch and the stability of the work and not a doubt can exist of Victoria Bridge, rock-like, resisting here

[82] The Graham's Town Journal, 3 December 1840

after the mightiest torrents that may descend from the Katberg'. He was to be proved wrong on several occasions during the next fifty years. The stone parapets were washed away in the flood of 5 February 1848, when the water flowed 15 ft over the bridge's roadway and was also severely damaged on 6 December 1874, when half of the right hand abutment was washed away. The reason for the severe damage during flooding was that the small arch openings in the bridge restricted river flow, leading to the bridge being overtopped. This deficiency in the design was rectified by the widening of the outer two arches from 14 ft to 40ft when the extensive repairs were carried out in 1876.[83]

In his frontier report of March 1837, Lieut Col Lewis allocated an amount of £3,000 for bridges (paragraphs 53, 84 & 90), while in a supplementary report of 3 October 1839 he estimated an amount of £2,000 for the Kat River bridge, which the Governor D'Urban had ordered on 13 January 1837,[84] while the foundation stone was laid by Lady Napier on 25 November 1840.[85] In another report dated 28 February 1843 outlining work carried out between July 1840 and December 1843, for which a detailed bill of quantities was presented, outlining the quantities of stone masonry cut and placed, timber supplied and erected for falsework, backfilling the spandrels, approach road construction, all for an additional amount of £1,768 2s 6d, signed by Capt Walpole, Maj Wortham, Lieut Col Marshall, Col Lewis and approved by Governor Napier.[86]

Maj Selwyn presented a supplementary estimate of £1795 15s 5d for additional work which could not be initially foreseen when the original estimate was framed. His reasons were the poor and very deep foundation conditions of the left (north) alluvial bank comprising erodible soil and water ingress by the rising river and the need for large amounts of additional stone masonry. The right hand (south) abutment was founded on solid rock, right next to the stone quarry for the rest of the bridge masonry. An additional expense was brought about by the return to England of the experienced and efficient 2nd company of Sappers and their replacement by the 10th company, whose fewer masons were less experienced, resulting in the need to hire expensive civilian masons whose daily production was poor in comparison.[87] Col Lewis then compiled a letter to Governor Napier explaining that he first framed his estimate in 1836 while on the frontier and that Maj Selwyn's above account was correct regarding the additional unforeseen

83 Walters, *Bridging the Eastern Cape*, p.56.
84 Lewis Report, paragraph 90.
85 The Graham's Town Journal, 3 December 1840.
86 NAK WO44/5, Abstract showing the Quantities & Description, Labour, Materials and Stores charged to the Kat River Bridge, Fort Beaufort, (28 February 1843).
87 NAK WO44/5 Letter Selwyn to Lewis, 6 May 1842.

works, high wages and inefficient labour. Selwyn also had to commence construction of the bridge without experienced personnel apart from Col Lewis. The fact that Governor Napier had stopped the work would add to the expense. In the end Lord Stanley approved the above additional amounts and the bridge building could be completed.[88]

FORT BROWN BRIDGE

While the Queens Road originally crossed the Fish River at a drift at Vygen kraal, the bridge was finally sited at Fort Brown two miles upstream, because the Fish River there had deeper sides and a narrower channel during floods, making for a higher and shorter bridge which was located closer to a military garrison. When in flood, the Fish River tended to rise so high that traffic could not cross, causing up to 40 to 50 wagons being delayed on either side at the Vygen kraal drift. Lieut Col Lewis's choice was a wooden bridge at Fort Brown, while Maj Selwyn preferred Vygen kraal Drift. In the event, Lieut Col Lewis secured his chosen site whilst acceding to Maj Selwyn's insistence that high stone piers be used. The design called for four 50ft spans of teak timber arches, positioned on three 50ft high stone piers, with stonework abutments each having two 15 ft side arches. The original timber bridge over the Fish River at Fort Brown was built by the Royal Engineers between 1840 and 1845, under the supervision of Maj Hale Young Wortham RE, and using James Mewett as the civilian sub-contractor for the erection of the bridge and using his draught oxen for transporting materials to site.[89]

In Lieut Col Lewis's Frontier Report [90] of March 1837 the building of a wooden bridge on stone piers was proposed and for which £5,199 14s 11d was allocated for its construction.[91] In 1843 Lieut Col Marshall submitted a report to the Inspector General of Fortifications with a statement of expenditure up to 31st December 1842. The sum to complete the Fish River bridge was £6,511 9s 10d, where a balance of £2,410 4s 9¼ was still unexpended of the allocated grant of 5645 16s 5d of 1st February 1842.[92] Lieut Col Marshall, who had succeeded Lieut Col Lewis, reported that additional funds would be required to complete the bridge. There was a huge shortfall in excavation volumes, stone masonry, timber and iron components, while coffer dams for the piers had to be constructed, a lime kiln and workmen's huts had to be built, and two wagons had to be used to cart the quarried stone blocks from Dunbar's Krantz, five miles away.

88 NAK WO44/5 Letter Lewis to Napier, 14 May 1842.
89 C.9-'61 Petition to the Cape Legislative Council, 1861.
90 Lewis Report, paragraphs 63, 84, 85 & 90.
91 NAK WO44/5 Letter Lewis to Napier, 3 October 1839.
92 NAK WO44/5 Letter Marshall to Mulcaster, 28 February 1843.

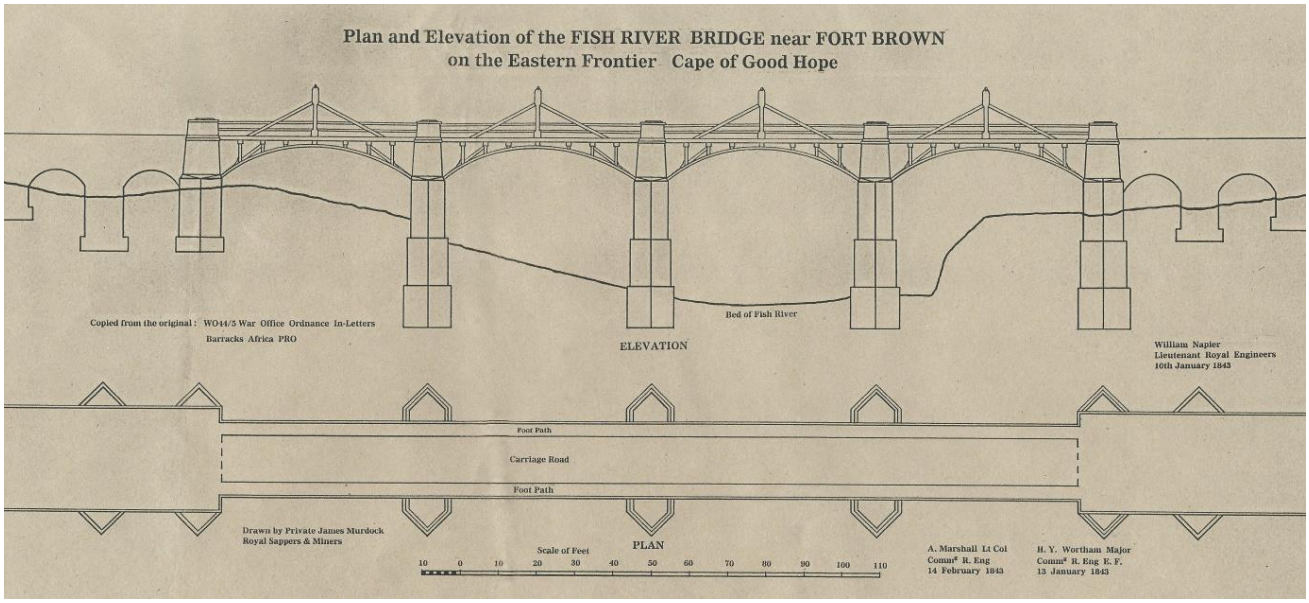

Fig 8: Fort Brown Bridge over the Great Fish River 1845

In addition, the estimates had made no allowance for derricks, windlasses, scaffolding and steam pumps, and large delays had been experienced due to repeated floods that filled excavations and swept away scaffolding, while the removal of key military artisans and work parties to attend to military matters, had exacerbated the situation.

Col Lewis, now in Dublin, was asked to explain the huge shortfall by the Inspector-General of Fortifications, Gen Mulcaster. Col Lewis gave a very detailed response, outlining the inability to anticipate the great difficulties currently encountered. The increased size of the foundations, in excavations and additional masonry, the increased price of timber from 4/- to 8/- per cubic foot, the remoteness of the site, and all the multiplicity of never ceasing demands made upon the Royal Engineers Department. After much consideration with correspondence going back and forth to various departments of government in London, Governor Napier finally received the approval of £6,511 to complete the Fort Brown Bridge.[93]

93 NAK WO44/5 Letter Lewis to Mulcaster, 24 July 1843.

Fig 9: Fort Brown Bridge over the Great Fish River, Thomas Baines

On 18 October 1844, after heavy rains in the interior, the Fish River rose thirty feet above the river bed, which was one foot nine inches above the springing of the teak arches and six feet three inches higher than any flood since the commencement of the bridge. The left bank was badly scoured by the surging river, completely exposing the abutment and the nearest pier. Maj Wortham presented a report and cost estimate in which he recommended that the bridge be increased in length by the addition of another 50ft span and another stone masonry pier and provided a list of teak scantlings to be obtained from England. The detailed bill of quantities provided a total of £1,282 20s 11½d to repair and enlarge the bridge. The report was accompanied by several sketches and plans produced by Lieut William Jervois RE.[94] Jervois had been sent to the Cape as a nineteen-year-old subaltern where he was employed on several works, commencing with the Queens Road, the Fish River Bridge at Fort Brown, the construction of several stone masonry frontier forts, mainly as a draughtsman and later as a land surveyor and map maker.[95]

The repairs were approved and completed, while the total final cost to build the Fort Brown bridge amounted to £13,439 17s 1d, arrived as follows: £5,645 16s 5¼d initially approved, £6,511 in a supplementary estimate and finally £1,282 10s 9½d, far from the £5,199 as originally estimated by Col Lewis.[96]

[94] NAK WO55/891 Letter Wortham to Marshall, 31 October 1844.
[95] T.Crick, *Ramparts of Empire, The Fortifications of Sir William Jervois RE 1821-1897*, (University of Exeter Press, 2012), pp.1-11.
[96] NAK, WO44/5 Letter Burgoyne to Marshall, 31 July 1845.

The severe flood of December 1874 totally destroyed the bridge. All the bridge timbers were washed out to sea and retrieved along the Port Alfred coast. During the flood the river rose 22ft above the bridge bearings which were 37ft above the normal run of the river and spread over a width of 400 yards. In 1876 the destroyed bridge was reconstructed by the Public Works Department with Joseph Newey designing and supervising the remedial work to comprise of straight timber girder truss spans built on the existing stonework piers which were also raised.[97]

KOONAP RIVER BRIDGE

Almost ten years after the construction of the Queen's Road and its two main river crossings at Fort Brown and Fort Beaufort, there still remained one significant river crossing to complete, that of the Koonap river drift at Tomlinson's Post. It was reported in October 1853 that some forty wagons were assembled on the banks of the Koonap River waiting from six to ten days for the river to subside, with the parties subjected to the greatest discomfort and waste of time. An aggregate of all the material losses over many years could comfortably have paid for a substantial bridge. A year later when on one of his many road inspections, Andrew Geddes Bain remarked that seven wagons and several horsemen were stranded on both banks of the Koonap River. While he acknowledged the crippled state of the Central Road Board's finances, he suggested that some type of pontoon or ferry be installed.[98]

Lieut Col Lewis had previously selected the site six miles above the junction of the Fish and Koonap rivers, and planned its construction, to comprise of three straight girder truss timber spans, a central span of 67ft and two side spans of 49ft supported by piers and abutments were of dressed sandstone. Construction was delayed for almost twenty years, initially the military declined, citing the lack of funds after the two punishing wars of 1846/47 and 1850/53 and thereafter the fact that as the security threat had passed with the military garrison being transferred from Fort Beaufort to King William's Town, it would only benefit the civilian population for which the Colonial Government would need to pay for its construction. Construction eventually commenced on 11 January 1858 by a party consisting of an officer, a sergeant and 20 privates of the 45th Regiment of Foot who were stationed at nearby Tomlinson's Post.[99] Building cottages for the clerk of works and men, a smithy and store; quarrying and dressing a large quantity of stone; excavating foundations and building one pier six feet high and one abutment three feet

97 Walters, *Bridging the Eastern Cape*, p.55.
98 Coetzee*, Forts of the Eastern Cape,* p.350.
99 A.G.Bain, Report to the Central Road Board, 12 February 1858.

high. This work might have been commenced many months previously but for the want of sufficient labour.[100] By mid-October 1858 the construction of the Koonap bridge for an estimated sum of £3,030 was in progress, when it was reported that a quantity of teak girders were lying at the convict station store at Graham's Town waiting to be transported to the bridge site on the Koonap. By Christmas 1858 there was a delay in the work on account of the lack of lime, but was overcome when sufficient quantities were purchased at a cost of five shillings per muid (91kg). Work progressed slowly at first, when in June 1859 it was reported to be increasing fast, especially when seven soldiers from the Koonap Military Post at Tomlinson's were added to the workforce, and immediate control was vested with the Military Post.[101]

Fig 10: Koonap River Bridge at Tomlinson's Post, Thomas Bowler 1861

The final bridge comprised of three teak timber spans, two outer spans of 45ft and a central span of 60ft with a total length of 193ft, was completed at the end of 1859 at a cost of £6,345. The roadway was set at 31 ft above normal river flow level, but this proved to be too low, as during the flood of December 1874, the river rose 12 ft above the timber decking, and spread over a width of about 300 yards, totally destroying the bridge. In 1876 the destroyed bridge was reconstructed by the Public Works Department with Joseph Newey designing and supervising the work to comprise of three straight timber girder truss spans of triangular-lattice configuration built on the existing stonework piers.[102]

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100 G.57-'59 Report of the late Central Board of Commissioners for Public Roads for1858.
101 Graham'sTown Journal, 8 Oct 1853, 14 Sept 1858, 9 Oct 1858 & 25 Oct 1859.
102 Walters, *Bridging the Eastern Cape*, p.55.

CONCLUSION

Soldiers of the various British Regiments of the Line were posted from their initial base at Graham's Town, to establish new posts and forts along the frontier. The Royal Engineers as 'scientific soldiers', were the only technologically trained personnel able to undertake these specialist tasks and were thus entrusted with the many tasks of designing and superintending infrastructural development. They faced the constant challenge of too few officers and especially artificer sappers for the specialist construction work required. The bureaucratic 'red tape' imposed by London delayed and frustrated most developments. In spite of these constraints and working under harsh African conditions, the Royal Engineer officers carried out their duties in an exemplary manner, many of them later rising to high rank in the Corps of the Royal Engineers. After the seventh frontier war of dispossession ended in 1847, the main military garrison was transferred to King William's Town and the Royal Engineer involvement tapered off as the Colonial Civil Engineer Department began to assume greater responsibility. The Board of Ordnance, the custodians of the military budget, insisted that further funds be sourced from the colonial treasury as the proposed new works were mainly for the benefit of civilian transport. The colonial government was now compelled to take charge, creating three significant organisations that were to dominate road and bridge building for the future: the Central Road Board and the Colonial Civil Engineer's Department which later evolved into the Public Works Department of the Cape of Good Hope.

CHAPTER FOUR – ROAD BUILDING AND THE CENTRAL ROAD BOARD AT THE CAPE COLONY, c. 1843-58

This chapter will argue that the construction of roads and bridges was crucial for the development and expansion of the transport network in the colony. The previous chapter suggests that there had been some progress made along the eastern frontier through the efforts of the Royal Engineers. Still twenty five years after the Dutch East India Company's (VOC) occupation of the Cape, little had been done to improve the opening up of roads and the betterment of communication into the hinterland from Cape Town. The rugged inland mountain ranges presented obstacles that were extremely difficult to circumvent, as these peaks isolated the settlers who had relocated to the inland districts, then referred to as the '*Overberg*'. Their livelihood and income was severely restricted by their inability to easily access Cape Town markets with their agricultural produce. This situation continued until 1843, when John Montagu, 'the road-making Colonial Secretary', initiated a system of public works that was to improve communication with concomitant positive benefits to the community.[1] Prior to 1843 the district landrosts were authorised to appoint an overseer of roads, and they in turn could call upon the farmers of the district to furnish a number of their slaves to undertake repairs to the roads.

The Central Board of Commissioners for Public Roads in the Cape Colony, abbreviated to the Central Road Board, which was established in 1843,[2] lasted for fifteen years until it was finally dissolved in 1858. It was the first successfully organised and funded agency to build proper roads in the Cape Colony. It was able to complete several major civil engineering works of which the following were the more significant projects. A 'hard road' over the sandy Cape Flats from Salt River to Eerste River, Montagu Pass, Michell's Pass, Bain's Kloof Pass, Howison's Poort, Zuurberg Pass and the construction of permanent roads from Cape Town to Graham's Town, to Beaufort West, and to Clan William and the bridging of numerous rivers. At the time it was abolished, the Central Road Board had almost 1,650 miles of road under its control and was responsible for the erection of fifteen bridges along the Great Eastern route, in addition to three pontoons and the erection of nine bridges between Cape Town and Beaufort West.[3]

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1 J.Noble (Ed), 'Colonial Roads, Routes and Modes of Travel', *Cape Monthly Magazine*, 47,8 (May 1874, Cape Town, Juta), p.289

2 Ordinance No.8 of 1843, 'An Ordinance for Improving the Public Roads of the Colony', which established the Central Board of Commissioners for Public Roads in the Cape Colony, the Central Road Board, (CRB)

3 C.G.Botha, 'The Central Road Board 1843-1858', *Cape Times,* (23 January 1931).

ROAD BUILDING PRIOR TO THE CENTRAL ROAD BOARD

In 1823 Lord Charles Somerset, the Governor of the Cape, wrote to the Secretary of State as follows: 'One of the great evils under which this colony has laboured has been the extreme difficulty of communication with the interior, in consequence of the impracticality of the passage across the ridge of mountains which separate this peninsula from the remote provinces; it has therefore been one of my principal objects to encourage the amelioration of the present passes, termed kloofs in the language of the country….'[4] During the preceding century the provision of safe roads was one of the factors that retarded the progress of prosperity of the inland country districts. With a few local exceptions, what Somerset had outlined was the actual situation on the ground, which did not improve significantly as far as the whole colony was concerned until twenty years later. It was only until the Central Road Board was established in 1843 that his wishes materialised and from then on we are able to track the actual work of rudimentary road making in the Cape Colony. When he penned this report, work had already begun on a mountain pass above Fransche Hoek valley. After the construction had begun the project came in for severe censure from the Colonial Office in London for incurring additional expenditure without prior approval, which, after several exchanges of dispatches, finally gave approval to '…a measure which cannot but reflect credit on your Government…'[5]

Previously, in 1817, Lord Charles Somerset had visited the locality around Worcester where two years later, he was to initiate the laying out of the town commemorating the name of his older brother, the Marquis of Worcester. His intention was to establish a sub-magistracy in the Breede River valley. A substantial line of communication to this fledgling town and the surrounding farmers would thus be necessary to ensure its future development and prosperity.

At this time Somerset could rely on the advice of the Commanding Royal Engineer at the Cape, Major W.C.Holloway RE, who was able to advise him as to the best way to carry out his scheme. Holloway soon found out that there were only two existing passes over the seemingly impenetrable mountain ranges over which the interior could be reached, namely, through Roodezand Kloof near Tulbagh and the Hottentots Holland Kloof. To reach the Roodezand Kloof, the seasonal Berg River had to be crossed, while the Hottentots Holland Kloof was extremely steep and treacherous, especially when

[4] Letter from Lord Charles Somerset to Earl Bathurst, 11 September 1823, in G.M.Theal, *Records of the Cape Colony*, (Cape Town: Government Printer, Vol XVI, 1903), pp.262-263

[5] C.G.Botha, 'The Central Road Board 1843-1858', *Cape Times*, (4 October 1920).

wet. This meant that the only possible alternative was the cattle pass over the Fransche Hoek Kloof, which was more central and could be constructed at less expense. The Governor appointed two commissions to examine the advisability of making a pass at Fransche Hoek. Maj Holloway and the land surveyor W.F.Hertzog, finally traced out the road. By September 1823 the work was well in hand but it had been found that the cost of completion would be more than at first estimated. The pass was finally completed by the end of 1825 and Major Holloway's report indicated that two permanent timber bridges over two streams costing £2,260 were also constructed, out of a total of £ 8,390 for the whole project.[6]

When Sir Lowry Cole assumed the position as Governor of the Cape to succeed Major General Bourke in 1828, he lost no time in turning his attention to the bad state of the Hottentots Holland Kloof road. Maj Michell staked out a new route over the mountain range and prepared estimates of cost of the work. His estimate was £2,672 and the work carried out mainly by soldiers of the 72nd Regiment.[7] The pass, called Sir Lowry's pass, which finally cost £3,094, was opened to traffic on 6 July 1830. Michell then overcame the next obstacle when he completed the five mile long Houw Hoek pass down to the Bot River, which was opened in February 1832.[8]

SEPARATISM AND THE DEVELOPMENT OF THE EASTERN CAPE COLONY

Between 1823 and with the introduction of self-government to the Cape Colony in 1872, the concept of Eastern Cape separatism played a significant role in the politics of the Cape Colony. For five decades this movement towards eastern separatism was repeatedly revived by a succession of leaders and interest groups. Eastern separatism was basically a demand for 'justice' in its struggle to promote its interests against the entrenched power of the governor and his officials based in distant Cape Town. [9] Political separatism had its origins during the rule of the Dutch East India Company (VOC) when in 1795, farmers of the new district of Graaff-Reinett rebelled against the authority of the VOC offialdom for imposed restrictions and lack of protection.[10]

As we have seen the 1820 Settlers were placed in the Zuurveld by the British authorities to provide a buffer between the densely settled amaXhosa to the east and the sparsely

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6 Letter from Lord Charles Somerset to Earl Bathurst, 23 June 1824, and Report and Estimate by Lieut J Mudge RE, 18 June 1824, from *Records of the Cape Colony* by Theal, (Cape Town: Saul Solomon, Vol 18, 1897), pp.1-8.

7 Richings, *The Life and Work of Charles Michell*, p.126.

8 Richings, *The Life and Work of Charles Michell*, p.127.

9 B.A.le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* (Cape Town: Oxford University Press, 1981), p.xi

10 le Cordeur, *The Politics of Eastern Cape Separatism,* p.1.

inhabited trekboer communities to the west. They were a body of people that represented a cross section of English society, from professional, military, business, artisan and labouring classes. However, they shared in common the characteristically English quality of evaluating and reviewing authority, the democratic character which was their birth right. Accustomed to a wide measure of individual freedom allowed by democratic institutions in England, they became most unhappy and rebellious towards restrictions placed only on them as outlined in their emigration agreements. In addition Governor Somerset's authoritarian government came as a shock to these new immigrants to Albany as it was both autocratic and manifestly ineffectual.[11]

The breakdown of the 1820 emigration scheme brought about financial ruin for some of the leaders, while crop failures, the punishing climatic conditions, tiny 100 acre plots, unsuitable soil conditions for cultivation, the high costs of transport, the restrictions on movement, the absence of markets and employment opportunities, led to the petition of March 1823, with 171 signatories, despatched to the Secretary of State in London. [12] Later their reaction and those of the surrounding areas took the form of demands for preferential treatment. They demanded security, freedom to pursue their various economic pursuits, reliable communications and efficient and fair administration. Most of these requirements were absent in the eastern districts of the colony.

The first specific proposals for political separation of the eastern districts were presented by the official commission of enquiry under J.T. Bigge.[13] They were appointed to the Cape in 1823 to investigate how to revise and liberalise the old colonial policies in the aftermath of the Napoleonic wars which had introduced a new world order. The commission was eventually to spend three years at the Cape with its terms of reference increasing as it was called upon to investigate an increased number of issues. Its initial brief was to investigate the general administration of the colony and the control exercised by the governor, the judicial system, the relations between the colonial government and the amaXhosa and the circumstances of the recent settlers. After their investigations of the grievances of the Albany settlers, the commission recommended the division of the colony into two separate parts, with the eastern districts forming a separate province, as had been recently done in Canada and Australia. The colonial

[11] A.K.Millar, *Plantagenet in South Africa – Lord Charles Somerset,* (Cape Town: Oxford University Press, 1965), p. 132.
[12] Millar, *Plantagenet in South Africa,* p.149.
[13] The three Commissioners were J.T.Bigge, W.M.G.Colebrooke and W.Blair.

office acting on the recommendations, appointed a Lieutenant Governor for the eastern districts in the person of General Richard Bourke in 1826. [14]

By separatism the Albany settlers did not propose to withdraw the eastern districts from the western districts, rather they had more modest goals. They demanded efficient and equitable administration in the form of permanent resident government and security provided by military authority on the frontier. They demanded freedom to pursue their various economic endeavours and reliable communications such as adequate roads. They justified their demands by accusing the central government of ignoring their needs. Separatism was thus an issue of local versus central power, ideas adapted continuously in response to changing events and for which they were not prepared to pay too high a price.[15] The politically active people were newspaper editors such as Robert Godlonton of Graham's Town and John Paterson of Port Elizabeth, merchants such as John Chase and gentleman farmers such as Thomas Philipps. Graham's Town merchants condemned the lack of frontier defences by the authorities, while making their fortunes out of the frequent wars. The settlers conveniently clamoured for more services while the major issues were purely economic; access to land and water rights, plentiful supply of cheap labour, laws to establish 'proper' relations between master and servant, to suppress 'squatting' and 'vagrancy', in other words to elevate the interests of settlers over indigenes.[16]

The restoration of peace after the 1835 war heralded a period of colonial economic expansion. The spectacular increase in wool production resulted in wool exports through Algoa Bay in 1842 exceeding those through Table Bay by a substantial margin.[17] Together with the 'Xhosa trade' the foundation was laid to make Graham's Town the economic hub of the region. Banks were established to provide loan capital to facilitate the export and reciprocal import of goods. In spite of the local economic windfalls, Cape Town still dominated the economic system of the colony. As late as 1846 the eastern provinces contributed only 27% towards colonial revenues. The reality was that the easterners became all too conscious of their economic subordination to the west.[18]

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[14] Letter from the Commissioners of Enquiry to Earl Bathurst, 6 September 1826, from '*Records of the Cape Colony'* by GM Theal, (Vol 27, Saul Solomon, Cape Town, 1897), pp.342-397.
[15] le Cordeur, *The Politics of Eastern Cape Separatism,* pp. 9-11.
[16] T.E.Kirk, 'Self-government and self-defence in South Africa: the inter-relations between British and Cape politics, 1846-1854', (PhD thesis, Oxford University, 1972), pp.61-62
[17] See chapter two for the section of Eastern Cape trade
[18] le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* pp. 123-129.

Deficiencies of the transport system and the accompanying public services threatened the revival of the developing economy. Improved roads, bridges, fords, ferries and properly constructed mountain passes, in conjunction with port facilities were urgently required. The need to transport the increasing wool clip to the coast together and to rapidly deploy military forces in the aftermath of the 1835 war was paramount. Surveyor general Michell together with Governor Napier recommended the construction of a comprehensive road network.[19]

The colonial secretary Bathurst's instructions to reduce expenditure on services were due to the colonial debt which stood at a quarter of a million pounds after the 1835 war which together with chronic poverty over the rest of the colony painted a bleak picture. The only worthwhile road construction was the Queens Road between Graham's Town and Fort Beaufort undertaken between 1837 and 1842 by Andrew Geddes Bain.[20] The busiest road carrying between 10,000 and 12,000 wagons per annum was between Port Elizabeth and Graham's Town. Howison's Poort road and Woest's Hill road outside Graham's Town were initially funded by private subscriptions.[21]

The arrival of John Montagu as the colonial secretary in 1843 and the reforms he promptly instituted turned the economic situation around within 2½ years. The government was now able to embark upon major public works schemes. The establishment of the Central Road Board coordinated the building of roads, bridges and mountain passes. One of the main objectives was to build a reliable road between Cape Town and Graham's Town. To the disappointment of the easterners, Montagu's initial priority was the public works projects of Cape Town and the western districts.[22]

The recently launched *Graham's Town Journal* newspaper in January 1844 condemned the 'autocracy' of the Central Road Board which held its sessions 'at the extreme verge of the most distant and narrowest point of the colony, 700 miles in length'.[23] Similarly, the *Colonial Frontier Times* newspaper protested at the removal of Albany's convicts to work on the Cradock Kloof Pass, thereby depleting the Howison's Poort scheme of most of its valuable labour.[24]

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19 le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* p. 130.
20 See chapter three for the works of the Royal Engineers
21 le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* p. 130.
22 le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* p. 131.
23 Graham's Town Journal, 18 January 1844
24 Cape Frontier Times, 6 June 1844

Montagu's tour of inspection of the eastern districts at the end of 1844 informed him of all the major projected schemes. Construction work in the eastern districts which commenced in 1846 was interrupted by the seventh frontier war. In spite of the Board achieving a large amount of success in having numerous roads, passes and bridges constructed and repaired, several of the more influential areas of the colony complained that they were not being catered for. In 1847, the eastern province expressed their dissatisfaction and clambered for a separate Road Board for the east. They disputed the local property rates and tolls collected, of which little was spent in their region. For example, of the £117,416 disbursed by the Board from 1844 to 1846, only £6,305 had been spent in the east. What they conveniently omitted was the amount of money spent by the Military in building and maintaining roads and bridges along the Fish River frontier.[25]

Expenditure figures by the Central Road Board in 1847 indicated that since its inception, the east had only contributed 8¾% of its total revenue and it had spent £452 more than it had received from the eastern districts. Between 1844 and 1846 only £6,305 was spent in the eastern districts out of the Board's £117,416 budget. In 1845, a certain district contributed £1,632 in rates while nothing was spent on their roads. The easterners kept complaining about the poor state of the Port Elizabeth- Graham's Town road.[26] The bulk of the road tax collected came from Cape Town where the 975 land owners who together owned the 5,000 odd houses and buildings, paid a quarter of the total raised throughout the colony, were vehement in their condemnation of the measures, citing the poor state of the roads around the town.[27] The Central Road Board's discrimination against the east was more illusionary than real. Ultimately Montagu was advancing the interests of the whole colony something many easterners grudgingly had to admit. However the separatist movement continued in fits and starts until it finally faded away when representative government was introduced in 1853 together with the institution of the Public Works Department with its adequately staffed composition.[28]

[25] Coetzee C.G, *Forts of the Eastern Cape, Securing a Frontier, 1799-1878*, (Alice: Fort Hare Press, 1995), pp.325-351.
[26] G.C.Botha, '*The Central Road Board, 1843-58'*, *Cape Times*, 23 January 1931.
[27] The Cape Town Mail, The total population was 27,000 residents, 6 May 1848.
[28] le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854,* pp. 130-134.

THE CENTRAL ROAD BOARD

In 1841, after nearly 20 years at the Cape, Colonel John Bell, the Colonial Secretary, retired and returned to England. He was replaced by John Montagu who was appointed colonial secretary in September 1842, finally arriving at the Cape in April 1843, to find a poverty-stricken colony with an annual income which barely exceeded expenditure.[29] After the devastating sixth frontier war of 1836 the colonial debt amounted to £182,851. Montagu immediately strictly enforced the regulations dealing with the collection and expenditure of public revenues, by collecting arrear taxes and land rents, and calling in loans. His prior experience in business, banking and public administration helped as he turned the financial situation around within two and a half years, thereby allowing a programme of public works to be implemented.[30]

Montagu gained control over fiscal affairs, confining the treasurer-general's duties to the disbursement of public money. He raided colonial funds, such as the guardian fund, the storm fund and the 'prize negro' fund, which were reserved for specific purposes. He tackled the large-scale circulation of promissory notes. He amended the rules of revenue collection and enforced them ruthlessly. Most important the windfall discovery of guano deposits on the Ichahoe islands off the west coast brought in £80,000 in licence fees. On the expenditure side, Montagu cut deeply into the discretion of officials, requiring that no expense be incurred without written authorisation.[31]

Montagu's next priority once he had stabilised the financial position of the colony, was to devise a scheme for the improvement and construction of public roads within the colony. New roads would be to the advantage of all, as land values would increase and the sale of Crown lands would be facilitated. The ease of travel along proper roads would lead to the general improvement in trade, which would profit all and encourage immigration. In July 1843 Montagu sent out a circular to Civil Commissioners of all the divisions of the colony, asking for information regarding the length and general condition

[29] John Montagu (1797-1853), joined the army in February 1814 as an ensign in the 52nd regiment and fought at Waterloo. In 1824 he was appointed secretary to Lieutenant Governor George Arthur of Van Diemen's Land (Tasmania) and assumed all the clerical duties of the office. His positive enthusiasm and efficiency paved the way to his promotion as colonial secretary in 1835. He had several business interests, speculating in land deals, the directorship of a bank and others. As Van Diemen's Land was the largest Australian penal colony, he introduced his 'convict probationary system' having rejected the separate penal station method, for the 'ticket-of-leave' system to introduce convicts back into society in stages. Montagu was dismissed as the colonial secretary by Governor Franklin, based on spurious allegations, and after a successful appeal, the colonial secretary, Lord Stanley, exonerated Montagu from all the charges brought against him by Governor Franklin, who in turn was recalled. *The Australian Dictionary of Biography*, (Vol 2, Australian National University, Canberra, 1967)

[30] J.J.Breitenbach, 'The Development of the Secretaryship to the Government at the Cape of Good Hope under John Montagu 1843-1852', (MA thesis Rhodes University, 1958), pp.35-48.

[31] W.A.Newman, *Biographical Memoir of John Montagu*, (*Harrison, London*, 1855), pp.31-49 and letter Montagu to Napier, 27 October 1843.

of the main roads in each district, the number of miles needing repair, the estimated cost per mile, the numbers of wagons annually travelling the roads and the possibility of placing tolls which could not be evaded and other matters. The detailed comments from the circular made a significant contribution to his draft of Ordinance 8 of 1843.[32]

The Legislative Council on 22 November 1843 passed Ordinance No.8 of 1843, "for improving the Public Roads of the Colony:

> Preamble - Appointment of Central Board. 'Whereas the existing state and condition of the public roads of this colony are such as to render the transport both of persons and produce, over and along the same, alike difficult, dilatory, and expensive; and whereas the co-operation of the general government, and of the public at large, in the early creation, and judicious expenditure, of whatever funds may be required, in order to put the said roads into a permanently serviceable state, will be the course most immediately advantageous, as well as, ultimately, the cheapest; and whereas, by the regular and well directed application of as much convict labour as it may be practicable to afford, and of as much of the colonial revenue as can, from time to time, be granted, to the opening of rocky passes, the filling up of ravines, the formation of firm roads through heavy sands, the construction of bridges, and other objects of a like nature, the attainment of the important end in view will be much facilitated, and the contribution from the land owners of each respective division of the colony, essential towards putting the public roads in each division into thorough repair, be rendered too light to be justly felt as burdensome; and whereas, in order to provide an efficient system of administration in regard to the custody and labour of the convicts to be placed upon the said public roads, and to the construction, repair, and general arrangement of the said roads, it is expedient that certain boards of commissioners, one central and the rest divisional, should be constituted, and their respective powers and duties limited by law:- Be it therefore enacted by the governor of the Cape of Good Hope, by and with the consent of the legislative council thereof, that, from and after the promulgation of this ordinance, it shall and may be lawful for the governor of this colony to nominate and appoint certain fit and proper persons to form a central board of commissioners, to be styled "The Central Board of Commissioners of Public Roads..'[33]

The Ordinance provided for the creation of the Central Board of Commissioners of Public Roads (to be abbreviated as the Central Road Board), consisting of six persons (three civil servants and three members of the public) appointed by the governor. They were charged with the organization of convict labour on the roads, with the appointment of surveyors, engineers, clerks, toll collectors and the collecting of tolls on roads and across bridges. Its subsidiary powers extended even to the right of encroaching on private property, should the necessity arise. If the Legislative Council was unable to provide sufficient funds, the Central Road Board was to exercise the right extended to them, of imposing a property rate on all immovable property valued at £50 or more. Provision was further made for the establishment of local Divisional Boards, consisting of the Civil Commissioner as *ex officio* chairman and four elected local persons. The

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[32] Breitenbach, '*The Development of the Secretaryship to the Government at the Cape'*, pp. 132-142.
[33] W.Harding (Ed.) *Cape of Good Hope Government Proclamations…and Ordinances passed in Council*, (Cape Town: vol.3, 1845), pp.485-510.

Central Road Board was to send convicts to the branch roads, when they were not required on the main roads. The Divisional Boards had the right to appoint their own administrative staff. Finally the Central Road Board had the right to call upon Divisional Boards to furnish funds and labour when main roads passed through their divisions. Dating back to a proclamation issued in 1813 by Governor Cradock, the government had the right to use and take land and material from land under the loan place or quitrent systems. [34]

John Montagu was the popular choice as the first chairman of the board, with the colonial surveyor general, Lieut Col Charles Michell and the colonial treasurer, Harry Rivers as the two government employees. The remaining three civilian members were J.B. Ebden, F.S. Watermeyer and Joseph Busk. At its first meeting on 7 December 1843, the Board decided that its first task would be the improvement of communications between Cape Town and the eastern frontier. Here the most formidable obstacles were the sandy Cape Flats or Downs[35], Cradock's Kloof pass and numerous river crossings.[36] The Ordinance also made provision for the establishment of local Divisional Boards for the repair and improvement of the branch roads within each division of the colony. These boards were to comprise of the civil commissioner of each division, as chairman, plus four elected local residents. The divisional boards were to use funds collected through tolls and rates to 'superintend, manage, improve and preserve' the existing branch roads of each local division. All new branch roads were to be approved by the Central Road Board, which was also to provide convict labour for work on branch roads.[37]

Less than three months after arriving at the Cape, Montagu sent another circular to all the civil commissioners requesting information regarding the employment of convicts within their divisions. The returns received indicated the disorganisation and shortcomings of the system of penal servitude at the Cape, where convict labour was engaged on works incompatible with the terms of hard labour.[38] In September 1843 a memorandum was submitted by a board comprising Montagu, as Colonial Secretary, William Porter, as Attorney-General and Col Michell, as Surveyor-General, which

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[34] Breitenbach, 'The Development of the Secretaryship to the Government at the Cape', p.142.

[35] The 'Cape Flats' or Downs (*Kaapshe Duinen*) were formed of the low, flat sandy ground lying between False Bay and Table Bay. This vast expanse of fine aeolian sand, like a desert, was easily swept away by the violent south-east winds and carried away from place to place in massive quantities, creating dunes in its path.

[36] G.Richings, *The Life and Work of Charles Michell*, (Cape Town: Fernwood Press, 2006), p.160.

[37] W.Harding (Ed.) *Cape of Good Hope Government Proclamations…and Ordinances passed in Council*, (vol.3, Cape Town, 1845), pp.499-505.

[38] Breitenbach, 'The Development of the Secretaryship to the Government at the Cape', p. 132.

proposed several items in line with Montagu's previous recommendations. In brief, they proposed that all convicts were to be placed under the control of the Surveyor-General in gangs of 80 or 100 and employed exclusively on main roads, opening mountain passes and constructing bridges.[39] In addition, they advised Governor Napier to appoint a Board of Road Commissioners to take over the entire management of communications. Montagu then outlined a detailed scheme of how the Central Board should be staffed and financed, how the convicts should be organised, housed and equipped, all based on a system of sound central control and administration. His recommendations were enthusiastically adopted by the Legislative Council and were incorporated in the Ordinance.[40]

From the information provided, Montagu found that there were 470 convicts scattered throughout the towns and villages of the Cape, doing all forms of menial work and housed in 'lock-ups' (gaols). In addition to his report on the state of the Robben Island penal station, he published a code of rules in January 1844 for the future direction and enforcement of penal discipline in all its branches. Montagu proposed that convicts sentenced to hard labour be employed in road building gangs of 80 to 100, in remote locations, under a strict code of discipline and management, based on the principle of reform through good conduct which could be rewarded with a remission of sentence.[41] Literary classes and religious instruction were introduced teaching inmates to read and write. At each station the convicts of whom the majority had committed crimes such as assault, burglary or stock theft were formed into two classes, the chain gang for violent offenders, which worked in chains, and the road party. Following a visit to the penal station at Robben Island in December 1843, Montagu indicated that no convict should be detained upon the island *'whose crime, conduct and character do not require a more severe degree of discipline and punishment than that which is observed at the convict road station'*. Consequently he proposed to remove convicts, sentenced to hard labour, from their places of incarceration, whose upkeep was a drain upon the treasury, and transfer them to road stations at the disposal of the Central Road Board. There they were expected to engage their labour on road building and where a programme of rehabilitation, education and good behaviour could reward convicts with remissions of sentence.[42]

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39 Memorandum drawn up by Montagu, 16 August 1843, Parliamentary Papers 23 July 1847, p.12.
40 Breitenbach, '*The Development of the Secretaryship to the Government at the Cape'*, pp. 140-141.
41 Breitenbach, '*The Development of the Secretaryship to the Government at the Cape'*, pp. 146.
42 W.A.Newman, *Biographical Memoir of John Montagu*, (Harrison, London,1855), pp.110-117.

Similar to his previous experience at Van Diemen's Land, Montagu successfully introduced a "convict probationary system" whereby convicts were assigned to work parties. His reports resulted in the proclamation of Ordinance No.7, 1844, "for the discipline and safe custody of the Convicts employed on Public Roads" of 28 February 1844. A further ordinance was enacted that all convicts sentenced to hard labour were to be transferred to road stations, where their labour would be placed at the disposal of the Central Road Board.[43]

Before the 'hard road', later named Maitland Road (currently known as Voortrekker Road), was built across the Cape Flats, travellers had found the crossing extremely difficult. The route from Cape Town to Stellenbosch was through 24 miles of loose, drifting sands. 'To call it a road was an absurdity, it was a desert track…..at times this track was perfectly impassable…. deep sands rendered it so heavy and difficult that a wine-wagon required eighteen to twenty oxen to move it slowly through….'[44] After Sir Lowry's Pass was completed in 1830, the need for a reliable road became even more essential. It was estimated that approximately 5,000 wagons drawn by 80,000 oxen were used to transport the Stellenbosch wine harvest to market in Cape Town each year. Work on the 'hard road' commenced in 1843, with the use of convict labour. A raised road or causeway was built across the Flats, raised above the natural level, in some places to a height of 16ft to 17ft over hollows in the terrain. Gravel had to be imported from the Tygerberg Hills to form a hard permanent roadway. However difficulties of keeping the road free from drift sands was to employ the authorities in dozens of schemes, leading to the importation of Port Jackson willow and hackea, vegetation to arrest the winblown sand.[45] The whole twenty four mile stretch of road was finally opened on Christmas Eve 1845, at a cost of £37,164. Wine-barreled wagons drawn by eighteen to twenty oxen which used to take close to 18 hours to cross the windblown sands now completed the journey in half the time. In order to raise revenue, the colonial government had building plots laid out along the 'hard road', beyond Montagu Bridge, the future Voortrekker Road of Parow and Bellville. Michell designed and built a three span teak timber bridge on stone masonry piers and abutments across the Salt River swamp, opened in July 1844 and named the Montagu Bridge. A second bridge over the Eerste River at Brink's Drift, was designed by Major Dundas RE, comprising a teak timber deck supported on eight stone masonry piers, was built by Michell and opened for traffic in July 1845.

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43 W.Harding (Ed.) *Cape of Good Hope Government Proclamations…and Ordinances*, pp.547-552.
44 Newman, *Biographical Memoir of John Montagu*, pp. 161-163.
45 Newman, *Biographical Memoir of John Montagu*, pp. 165-169.

Fig 11: The Montagu Bridge over the Salt River swamp. Thomas Bowler 1844

A third bridge, also opened in July 1845, beyond the 'hard road', was a double 20 ft span sandstone arch bridge across the Lourens River at present day Somerset West, costing £1,752. It was built by civil engineer William Snell Chauncy, who had obtained temporary employment on roads and bridges at the Cape, en-route from Australia to England. Over the Bot River a single 35 ft span teak timber deck on stonework piers was built at a cost of £819.[46]

Fig 12: Lourens River Bridge 1845

[46] Richings, *The Life and Work of Charles Michell*, pp,160-164.

The Central Road Board had also decided at its December 1843 meeting that the pass over the formidable barrier between the town of George and the interior of the Little Karroo, namely Cradock's Kloof, needed to be replaced. Work commenced in 1844 on this five and a half mile pass, of which most of the road had to be blasted out of rock using gunpowder. Henry Fancourt White was the supervisor of the pass construction by 250 convicts, which also included a 30ft single span masonry stone arch bridge over the Keur River, designed by Michell. Construction was delayed for the duration of the seventh frontier war of 1846 and the Montagu Pass was only opened in January 1848 at a cost of £35,799. No less than £1,753 was spent on gunpowder to blast 5½ miles of road through solid rock. Farmers who had previously taken 18 hours with a double draught of oxen over the old treacherous Cradock Pass, were now able to traverse the new pass in two to three hours with a normal draught.[47]

Fig 13: Montagu Pass, George 1848

The Central Road Board initiated another pass, this time over Mostert's Hoek, which was surveyed by Col Michell in 1830. Work commenced on this pass in October 1846 under the newly appointed inspector of roads, Andrew Geddes Bain. Using 240 convicts the work progressed smoothly and was completed in two years at a cost of £22,884 and included the single span timber deck, the Grey Bridge, over the Breede River at the foot of the pass and several stone culverts and stone-packed retaining walls. The pass was opened by the Governor Sir Harry Smith in December 1848 and named Michell's Pass.[48]

[47] H.Marincowitz, 'The Montagu Pass', *George Museum Society*, (1992), pp.5-16.
[48] G.D.Ross, *The Romance of Cape Mountain Passes*, (David Philip, Cape Town, 2003), pp.26,27.

The bridge over the Buffelsjagt River, eight miles from Swellendam, was built between 1845 and 1851. It comprised of an eight span teak timber deck, salvaged from the wreck of the *Robert* in 1847. The nine large ashlar sandstone piers were built by the Cornish stonemason, John Higgo. The builders used gypsum as their cementing agent, to which sugar was added as a retardant and hence the name, the 'sugar bridge'.[49]

While the transport needs of the western divisions of the colony were receiving much attention, the eastern divisions were not given the same level of consideration as the roads between its expanding towns were in a neglected state. The old road between the capital, Graham's Town and Port Elizabeth, a distance of 96 miles, was in parts scarcely passable and always dangerous. From Port Elizabeth, the Swartkops and the Sundays Rivers were crossed by means of pontoons, while the Bushman's and Kariega River crossings were at dangerous drifts. On the outskirts of Graham's Town, Howison's Poort road required a considerable amount of construction along two separate routes. The second improved road set out by Charles Bell in September 1844 included a single 14ft span sneezewood timber deck bridge 37ft high over the '*Groot Sloot*' and another three span timber deck bridge on two stone piers. The Central Road Board report recorded the following quantities: '11,880 yards of wagon road, 18,750 cubic feet of retaining walls, 2,502 cubic feet of parapet walls, 3,150 ft of blasted rock, 10,093 yards of roadway metalled, seven culverts containing 6,300 feet of masonry..' had been executed.[50]

Merchants from Port Elizabeth sent a petition to the Governor in November 1843 calling for a road to be built over the Zuurberg heights to give a direct route from Port Elizabeth to Graaff Reinet, Somerset, Cradock and Colesberg. The answer received was that the Central Road Board, which was about to be formed, would consider the request. It was only in July 1847, after Michell had designed the pass and selected the route that the acting Surveyor General, Robinson was sent to stake out the route. At the completion of the Montagu Pass in December, 1847, the entire gang of 250 convicts was transferred to the Zuurberg, in order to commence a road over what was described as 'another impossible mountain range.' The road party under Inspector H.F.White commenced work in January 1848 at Doorn Nek and after only 8 miles of the road being completed, the convict gang was withdrawn in 1850 and stationed around Port Elizabeth because renewed conflict with the amaXhosa had erupted in the eight frontier war as it was not considered safe to have the convicts working in a hazardous location. The building of

[49] The Curator, Swellendam Museum, 2015.
[50] G.18-'56 Report of the Central Board of Commissioners for Public Roads for 1855

the pass was resumed upon the cessation of hostilities in 1853. In a report dated 27 January 1857, the resident civil engineer, Matthew Woodifield,[51] reported to the Board that '….the main strength of the convict gang has been employed during the year in widening, forming, draining and metalling the road between the first Great Zuurberg ridge above Boontjies River, and the cut between Stroebel's and Wolwekop…' The Zuurberg Pass, 23 miles long, was opened to traffic in 1858, more than 10 years after Fancourt White, the builder of the Montagu Pass, and his convict gang moved onto the site. [52]

Fig 14: Michell's Pass, Ceres 1848

After completing Michell's Pass in 1848, Bain and his construction crew were relocated in order to construct an eighteen mile long pass over the Limietberge which eventually resulted in a large reduction in the time taken to reach the Breede River valley from Wellington. The eighteen and a half mile Bain's Kloof Pass was commenced in February 1849 and took four and a half years to complete by September 1853. At the time the Central Road Board consisted of John Montagu as chairman, Harry Rivers, Charles Bell, Surveyor-General, J.C.Gie, E.J.Jerram, J.M.Wentzel, as commissioners and W de Smidt as secretary. In May 1853, the board made an inspection trip to Ceres, where they decided on the erection of two additional bridges, Grey's Bridge over the Breede River near the Michell's Pass southern entrance and Breda's Bridge over the Dwars River at Ceres village.[53]

[51] Matthew Woodifield (1827-1901) Qualified as a civil engineer after 4 years study at the Putney Engineering College. After a short stint working on railway construction, he joined the office of the Surveyor General at the Cape in 1849. He carried out an extensive survey of the Cape colony followed by a stint as road inspector for the CRB when he supervised the construction of the Zuurberg Pass in 1855. He later became an assistant colonial engineer and commissioner of roads completing several surveys and designs of proposed bridges. He finally worked as an engineer for the Cape Copper Mining Co in Namaqualand, before retiring to the UK.

[52] G.18-'58 Report of the Central Board of Commissioners for Public Roads for 1857

[53] G.17-'58 Report of the Central Board of Commissioners for Public Roads for 1859

Bain's Kloof pass included the timber Darling Bridge over the Breede River on the Ceres side, and the 300ft long timber Wellington Bridge over the Berg River on the west side. Before the Central Road Board was finally abolished by Act of Parliament at the last session of 1858, the following projects were completed: the Grey Bridge across the Breede River near Michell's Pass and Breda's Bridge across the Dwars River in the village of Ceres. In order to open up the road from Cape Town to Springbok, a pass between Piketberg and Citrusdal through Piquinierskloof was built between February 1857 and November 1858 by road inspector, Thomas Bain, and 220 convicts and was called Grey's Pass after Governor Sir George Grey.[54]

Upon Montagu's retirement and departure for England due to ill health, the chairmanship of the Central Road Board was taken over by P.B. Borcherds on 19 April 1853. The new board comprised of Dr Innes and Messrs D.G. van Breda, E Landsberg and F.W. Reitz. In addition, the secretary was W de Smidt and Captain George Pilkington, the Civil Engineer made up the quota. Borcherds had a good idea of the state of the roads from previous positions as Circuit Court Judge, Civil Commissioner, Secretary of Stellenbosch and Chairman of the Divisional Road Board. In September 1853, Borcherds officially opened the Bain's Kloof Pass, which included the Wellington Bridge over the Berg River, and the Darling Bridge over the Breede River. Borcherds retired as the chairman of the Central Road Board in February 1857, remaining as an ordinary member. The Central Road Board was abolished by Act 9 of 1858, 'Bill for Improving the Public Roads of the Colony' to provide for the management of public roads of the colony.[55]

In the final year of the Board's existence, 1858, the following roads had been proclaimed main roads, and were thus under the direct jurisdiction of the Central Road Board, as opposed to branch or minor roads which were the local Divisional Council's responsibility.

[54] W.A.Newman, Biographical Memoir of John Montagu, with a sketch of some of the public affairs connected with the Colony of the Cape of Good Hope during his administration as Colonial Secretary from 1843 to 1853, (London: Harrison, 1855).
[55] P.B.Borcherds, *An Auto-Biographical Memoir*, (Cape Town: A.S.Robertson, 1861), pp.371-413.

Cape Town to Simon's Town	24	miles
Cape Town to Eksteen's on the Zonder End River	118	"
Eksteen's to Duivenhok's River (Heidelberg)	65	"
Duivenhok's River to Hartenbosch River (incl road to Mossel Bay)	98	"
Hartenbosch River to Keurboom's River (incl road to George Town)	78	"
Keurboom's River to Van Staden's River (Western Height)	147	"
Van Staden's River to Sunday's River via Port Elizabeth	48	"
Sunday's River to Post Retief via Graham's Town	136	"
Zwartkop's River to north side of the Zuurberg	54	"
From 14th milestone on Maitland Road to Wellington via Paarl	32	"
From 12th milestone on Maitland Road to Karoo Poort	90	"
D'Urban to Clanwilliam via Malmesbury	145	"
Karoo Poort to Beaufort	200	"
Colesburg to Botha's Drift on Orange River	18	"
Port Elizabeth to Graaff-Reinet via Uitenhage	145	"
Graaff-Reinet to Middelburg	58	"
Middelburg to Colesburg	80	"
Graham's Town to Cradock	95	"
Meiring's Poort	10	"
Total:……..	1641	miles[56]

John Montagu, the 'father of roads' in South Africa, instituted a system of convict labour in the colony that proved a great success in building roads and mountain passes. His efforts to use convict labour to overcome the shortage of labour in the construction of roads were rewarded with the construction of the Cape Downs 'hard road', the Montagu, Michells, Bain's Kloof, Zuurberg and Howison's Poort passes in addition to the construction of several bridges and hundreds of miles of main roads remain as a positive legacy to his indefatigable endeavours.

STATEMENT of principal Works: Mountain Passes, Roads and Bridges, executed by the Central Road Board ,- during the ten years from 1844 to 1853.

Years, when commenced, and when completed.	Description of Works constructed.	Approximate Cost.		
		Convict Labour.	Other Expenses.	Total.
	1.-*Main Trunk Line, Cape Town to Graham's Town*.	£	£	£
	Hard road from Cape Town to Caledon, (including			
1844-1846	Montagu and Eerste River Bridges),	14,174	36,880	51,054
1849-1850	Eerste River Road	..	1,335	1,335
1844-1845	Somerset West to Laurens River,	..	2,774	2,774
1851-1852	Palmiet River Bridge,	..	2,557	2,557
1844-1848	Houw Hoek Pass,	..	5,652	5,652
1845-1846	Bot River Bridge,	..	905	905
1845-1851	Buffeljagt's River Bridge	..	19,746	19,746
1847-1850	Gouritz River to Montagu Pass,	1,324	18,989	20,313
1850-1852	Pontoon and Causeway at the Little Brak River	..	1,714	1,714
1844-1848	Montagu Pass,	26,698	18,527	45,225
1848-1849	Campher's Poort,	1,091	456	1,547
1848-1849	Road round Kleineberg,	..	1,530	1,530
1849-1850	Iron Pontoon, Swartkops,	..	2,118	2,118
1850-1852	Roads at and near Port Elizabeth,	16,368	5,356	21,724
1844	Howison's Poort,	4,359	7,604	11,963

[56] G.17 –'48 Report of the Central Board of Commissioners for Public Roads for 1847

	2.-*Port Elizabeth to Inland Districts.*			
1847	Zuurberg Pass,	24,652	5,242	29,894
1850-1851	Zuurberg to Port Elizabeth,	..	392	392
	3.-*Cape Town to Beaufort.*			
1852-1853	Wellington Bridge,	2,861	1,560	4,421
1848-1853	Bain's Pass,	45,700	10,269	55,969
1852-1853	Darling Bridge,	721	874	1,595
1846-1848	Michell Pass,	13,598	7,015	20,613
1852-1854	Road leading to Worcester,	2,390	13	2,403
1847-1848	Gydow Pass,	..	952	952

DIVISIONAL COUNCILS

The introduction of Representative Institutions in the Cape in 1854 was soon followed by the establishment of Divisional Councils. As a member of the legislative council, Sir Andries Stockenström piloted the passage of Act No. 5 1855 'An Act for creating Divisional Councils in the Colony', which in his view, restored a link between the government and the governed which had been broken in 1828 with the abolition of the Landdrosts and Heemraden.[57]

The councils levied local rates and held wide powers over the administration and construction of roads and schools, each Council comprising representatives of six Districts into which the Division was divided, elected on the same franchise and with the same property qualification as applied to Assembly elections. Those representing country Districts were thus in a majority, and the Divisional Councils were dominated by local landowners. They were fiercely jealous of their control over the raising and spending of local taxation, and the contingent distribution of contracts and of road expenditure affecting property values. Moreover, they had extensive power over local landed resources. By Act 2 of 1860, for example, they could recommend crown lands for sale to the Governor. They also fixed the price, subject to the governor's approval, for the private sale to a local landowner of Crown lands adjacent to his own land: this was a way of protecting local landowners from land speculators from outside who would otherwise bid up the price of strategically-placed pieces of land, in the knowledge that the local landowner would subsequently pay them dearly for it.[58]

The Divisional Councils also did their best to protect local interests in their administration of roads. *The Argus* newspaper summed up the situation by saying that :

[57] C.W.Hutton, *The autobiography of the late Sir Andries Stockenström, bart., sometime lieutenant-governor of the eastern province of the Cape of Good Hope, (Cape Town: Juta, 1887),* p.33.
[58] A.J.Purkis, 'The Politics, Capital and Labour of Railway Building in the Cape Colony, 1870-1885', (PhD Oxford University, 1978), pp.274-279, p.36.

‘The Divisional Councils have undoubtedly done wonders in constructing and improving the cross-country roads of their districts, and we fully admit the importance of the work; but, with a few honourable exceptions, they have not done as such for the main arteries of commerce…’ [59]

Act 10 of 1864, ‘to provide for the construction and maintenance of the main roads of the colony,’ consolidated the powers of Divisional Councils over the maintenance of main roads, bridges and mountain passes, as well as local roads, while the central government was entrusted with the construction of new main roads. But the maintenance of the former was often very expensive, and the wear and tear often caused by through traffic rather than local traffic. Indeed, in some cases, the main thoroughfare passed through the corner of a Division, whose inhabitants would either benefit little or suffer losses because the thoroughfare drew traffic away from their own centres of population.[60]. Divisional Councils therefore constantly sought central colonial government funds for the maintenance of the main thoroughfares, while rejecting stipulations imposed by the colonial government to ensure that Councils bore their share of the burden. Act 10 of 1864 provided for ‘…the tolls taken at toll-bars established on any main road lying within any division and at all ferries upon the line of any such main road, shall belong to the divisional council of such division…’[61] The local interests on the Councils sought to control the expenditure and the tendered contracts, while securing the funds from the general revenues and tolls on through traffic, and very often they succeeded. The councils were also permitted to assess rates upon the immovable properties within such division for the purpose of keeping the main roads in the division in repair and also for making, improving and maintaining divisional roads of such division.[62]

But very often they did not succeed. There were indignant counter-submissions from those who would be subjected to proposed tolls. There were constant battles between local and central colonial government about the costs to be borne by local ratepayers. Essential repairs to main roads were often held up by protracted evasions and bitter recriminations between different local councillors, between different Councils, and between them and the Government. [63] The Divisional Councils were well represented

[59] The Argus, 16 March 1871
[60] The Argus, 9 April 1872
[61] Act No. 10 of 1864, ‘To Provide for the Construction and Maintenance of the Main Roads of the Colony’
[62] Purkis, *‘The Politics, Capital and Labour*’, p.38 & Act 9 of 1858 and Act 10 of 1864.
[63] They fill many pages of correspondence between the Cape Colonial Office and Divisional Councils, e.g. Cape v CO.919 and 938, Letters from Divisional Councils, 1870 and 1871.

in the House of Assembly in Cape Town, where the Chief Inspector of Public Works attributed repeated failure to enact a measure to give wider powers over main roads to his department '…to the influence members of the Divisional Councils have in the Legislature…'[64]

CONCLUSION

In spite of all the many positive achievements of the Central Road Board, there was a steady build-up of complaints made against them over the course of time. The Board had become a victim of its own success. These complaints increased in number until both the public and parliament condemned the Board and sought a change in the administration of the roads of the Colony. In spite of John Montagu's 2,000 mile tour in 1849 to inform the population of the Board's programme for the western, eastern and north western districts which received much praise and acclamation, it was possibly seen as a little too late.

The system of the Board and the existing laws that governed its work was condemned, primarily because the Board was not an elected body and only made recommendations to the Governor, who could ignore them. The Board did not have direct representation with the communities, they had been appointed by the Governor, and simply recommended to the Governor which roads required attention and which roads were main roads. The grievances were not with the officials, but rather with the system and the existing laws. The 1856 Bill to improve the branch roads by the divisional councils proved to be ineffective as well. The complainants felt that the roads should be directly controlled by a government department as the personnel resources of the board were hopelessly inadequate.

The eventual lack of sufficient funding resulted in the unsystematic way in which road and bridge building was carried out in the colony. The demand for roads soon outstripped the available funds and led to the eventual stagnation of the transport network growth. In spite of the initial introduction of the Central Road Board by the Colonial Secretary, John Montagu, which revolutionised the road, mountain pass and bridge building activities of the colony. His initial efforts in reducing the colonial debt, thereby raising sufficient funding and the novel method of introducing convict labour, was key to the success of the venture. However the implementation of the proposed works took much longer due to budgetary and personnel shortages, as they only had

[64] CAD CO933 Letter Chief Inspector of PWD to Colonial Secretary, 25 June 1871.

three sources of income: from tolls levied, from rates assessed and from a limited annual government grant. The many grievances included the time taken to complete projects, while the appropriation of road rates by all landowners was seen by many to be unjust. In addition, the eastern separatists wanted a separate road board of their own. The board's tasks simply became too great and their workload too heavy for its inadequate resources.[65]

Finally, Act 9 of 1858[66] dissolved the Central Road Board and from 1 January 1859 main roads fell under the supervision of the central government and were now under the direct control of the Chief Inspector of Roads – the Civil Engineer of the Colony and three assistant commissioners.[67] The eventual abolition of the Central Road Board closed an important chapter in the colony's history of road building. The Board had served a very useful function resulting in the significant growth of the transportation system.

The colonial government now had to expand on its initial achievements and satisfy the needs of all the inhabitants of the colony. This led to the expansion of the Chief Commissioner of Roads and its employment of more suitably experienced and qualified civil engineers from Britain. As a Crown Colony, the Cape was able to secure funding through the Crown Agents for the Colonies to pay for its infrastructural development. The following chapter will outline how this was achieved and how the provision of funding led to the smooth transferal of infrastructural development from the Central Road Board to the department of the Surveyor General and its successor, the Colonial Civil Engineer.

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65 C.G.Botha, '*The Cape Times'*, 23 January 1931

66 Act No.9 of 1858. 'To Provide for the Management of the Public Roads of the Colony' repealed Ordinance No.8 of 1843, 'An Ordinance for Improving the Public Roads of the Colony', which established the Central Board of Commissioners for Public Roads in the Cape Colony, the Central Road Board, (CRB)

67 Borcherds, *An Auto-Biographical Memoir*, p. 409.

CHAPTER FIVE – THE PUBLIC WORKS DEPARTMENT OF THE CAPE COLONY AND ITS PREDECESSORS

The introduction of the military and in particular the Royal Engineers were crucial to the establishment and improvement of the transportation system through the early building of roads and bridges in the colony. As the colony developed with the influx of new immigrants, public service authorities assumed responsibility for all non-military duties. This chapter outlines the hierarchy, establishment and personnel of the Public Works Department (PWD) of the Cape of Good Hope during the nineteenth century. The achievements of the PWD, in particular the bridge building feats are presented in detail in the penultimate two chapters of this thesis. The PWD developed into a well organised administration employing many highly skilled and experienced engineers from Britain who were tasked with developing the infrastructure of the colony in the absence of suitably experienced private contractors.

THE SURVEYOR GENERAL'S OFFICE

The Public Works Department of the Cape Colony had its origins in the construction and supervision of all company buildings during the period of the Dutch East India Company (VOC). Jan van Riebeeck's earth and timber fort was replaced by the stonework five bastion star-shaped Castle in 1679, after which numerous public buildings were constructed over the ensuing years. Louis Michel Thibault was the first qualified architect to arrive at the Cape in 1783 although he was initially appointed as engineer of fortifications, progressing to chief military engineer in 1795. He designed most of the public buildings at the Cape for Governor van de Graaff. During the first British occupation, he was appointed Surveyor of Buildings and worked on the new governor's house in 1800. During the rule of the Batavian Republic, he held the position of '*Inspector General der Civielle en Militaire te bouwen*', designing various Drostdy buildings amongst others. After the second occupation of the Cape by Britain in 1804, he was appointed as Inspector of Public Buildings and Works and was 'officially responsible for the design and supervision of all civic buildings erected during this period' and headed a fledgling office, the early beginnings of the Public Works Department.[1]

[1] Louis Michel Thibault (1750-1815) qualified as an architect at the *Academie Royale d'Architecture* in 1776 and later as a military engineer at the *Ecole des ponts et chaussees* in 1781 in Paris. On joining a Swiss regiment, he was sent to the Cape in 1783 to defend it against Britain. In 1785 he joined the Dutch East India Company (VOC) employed as a lieutenant of engineers (fortifications) and in 1786 was made responsible for all public buildings, later

After the second occupation of the Cape, many duties of building and maintaining public works also fell under the direction of the Royal Engineers and their subordinates, the Corps of Sappers and Miners.[2] For example, in 1828 when Lord Charles Somerset reported the dilapidated state of the Government House roof which had partially collapsed, after an investigation, Lieut Cowper Rose RE urged that certain repairs be undertaken immediately, providing estimates of cost of repair in a supplementary letter.[3] The repairs would have been undertaken by artisans of the Department of Works and Buildings.

In July 1823 the two members of the commission of enquiry into the administration at the Cape, J.T.Bigge and W.M.G.Colebrooke arrived in the colony to investigate all aspects of its administration and to make recommendations for its reform.[4] After spending several months at the Cape investigating a multitude of events throughout the colony, they made various recommendations regarding the administration and the finances. A significant recommendation regarded the institution of the office of the surveyor-general.[5] They urged that the new appointee '….should be a man thoroughly and practically conversant with his profession…' and was to be given a salary of £800 per annum, while a deputy should be stationed in the eastern province at an annual salary of £400. The surveyor-general's duties were extensive, and included superintending the detailed surveys needed in the colony; preparing a map of the colony; improving passes and roads, and the measurement of the roads throughout the colony, and '…to cause a survey to be made of the boundary of the colony, and to define the limits with an accuracy that has not been hitherto observed…' It was also expected that in order to correct the erroneous surveys that had previously been made and to obtain the services of competent persons as land surveyors, a school of instruction under his superintendence should be established as '…a means of enabling the young colonist to acquire the necessary education to qualify them as surveyors..'

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becoming Chief Military Engineer. During the first British occupation of 1795-1803, Thibault accepted the appointment as architect in charge of repairs to military buildings of the garrison and the position of Surveyor of Buildings. During the brief Batavian republic possession of the Cape he was appointed as Inspector General of State Buildings, Civil and Military. With the second British occupation he was appointed Inspector of Public Buildings and was responsible for the design and supervision of all civic buildings erected during the period. Permitted to work as a Sworn Surveyor in 1807, he was appointed as Government Surveyor in 1811. Ignored by Governor Lord Charles Somerset, he spent his later years as a land surveyor, having previously designed dozens of buildings throughout the Western Cape. *H.R.de Puyfontaine, Louis Michel Thibault 1750-1815: His official life at the Cape of Good Hope, (Cape Town: Tafelberg, 1971)* and Artefacts website, accessed 7/02/2016.

2 See chapter 3 for the detailed duties and completed works of the Royal Engineers

3 Letter from Governor Somerset to Earl Bathurst, 9 October 1824, from 'Records of the Cape Colony' by G.M. Theal, (Vol 18, Cape Town, Saul Solomon, 1897) p.340

4 Letter from the Commissioners of Enquiry to Earl Bathurst, 15 July 1823, from 'Records of the Cape Colony' by G.M. Theal, (Vol 16, Cape Town, Saul Solomon, 1897) p.126

5 Report of the Commissioners of Enquiry to the Earl Bathurst upon Colonial Finances, 6 September 1826, from 'Records of the Cape Colony' by G.M. Theal, (Cape Town: Saul Solomon, Vol.27, 1897) pp.495-496

The recommendations of the commissioners were not however implemented to the letter. For reasons of economy the surveyor general's salary was reduced to £700 and his office was combined with that of civil engineer and superintendent of works. An assistant surveyor-general and an assistant civil engineer were also appointed, both being stationed in Cape Town.[6] A search for a suitable person to fill the dual posts of surveyor-general and civil engineer proved to be a difficult one. By January 1828 the two deputy positions had been filled but it was only in June that the Cape governor Sir Lowry Cole was informed that a 'Major Mitchell' (sic) had been appointed.[7]

The first colonial Civil Engineer and Superintendent of Government Works and Buildings, Henry Willey Reveley, was appointed by Earl Bathurst in November 1826, and arrived at the Cape during 1827. His duties were to examine all government buildings and report on their condition. In addition he was to submit estimates of all public works and ascertain that the work had been executed properly and to certify to an audit.[8] During 1827 he was accused of taking old timber removed from the wharf and using it for his own purposes after which Lieut Governor Richard Bourke recommended that his employment be terminated.[9] His replacement was Major Charles Cornwallis Michell, who arrived in October 1828.[10] His dual functions were as the colonial civil engineer and surveyor general. In his role of surveyor general he took charge of all farm boundary surveys and drew up a proposal for an improved survey of the Colony and instituted the proper training of land surveyors. As the colonial civil engineer his most active area was the planning and construction of roads and passes, which included Sir Lowry's Pass, Houw Hoek Pass, Montagu Pass and Michell's Pass. As an architect he designed churches and light houses. He was the civil engineer on the first board of the Central Road Board in 1843 and through which he had much input into both the Montagu and Michell's Passes.[11] Unfortunately Lieut Colonel Michell's health suffered greatly while undertaking both the functions of surveyor-general and civil engineer, combined in a single department. In December 1847 he suffered a mild stroke and was

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6 L.C. Duly, *British Land Policy at the Cape, 1795-1844*, (Duke University Press, Durham, 1968), p.101.

7 CAD GH 1/15 Letter Murray to Cole, 2 June 1828.

8 Civil Establishment of the Cape of Good Hope in 1827, from Records of the Cape Colony by G.M. Theal, (Vol 34, Saul Solomon, Cape Town, 1897), p.50.

9 Letter from the Major-General Bourke to Viscount Goderich, 3 November 1827, from 'Records of the Cape Colony' by G.M. Theal, (Vol 34, Cape Town, Saul Solomon, 1897), pp. 90-92.

10 Charles Cornwallis Michell, 1793-1851, enrolled as a cadet at the Royal Military Academy at Woolwich in 1807 and was commissioned as a second lieutenant in the Royal Artillery in 1809. He was seconded to the Portuguese Army and served with distinction in various conflicts against the French during the Peninsula war. He was promoted to Captain in the Royal Artillery in 1817. After posts at Sandhurst and RMA Woolwich where he became professor of fortifications, he was promoted major in January 1826, before taking up the position at the Cape, probably through the influence of his cousin, Sir Rufane Donkin. He was promoted brevet Lieutenant Colonel in 1841

11 Richings, *The Life and Work of Charles Michell*, pp. 124-128.

unable to continue with his duties on account of ill health and subsequently returned to England in February 1848. In a letter to the secretary of state, Earl Grey, the Governor Sir Harry Smith said: '….the two departments which have been hitherto conducted by Colonel Michell and in the discharge of which his health has at length given way, have now become so arduous, that it is absolutely necessary to separate them.'[12]

Governor Smith outlined additional reasons for separating the two roles, headed by two different officials. The colonial treasury now had the financial means to maintain two separate departments as proposed. The road, bridge, harbour and irrigation works required '…a civil engineer of great ability, thoroughly conversant with all the latest scientific improvements in this branch of engineering and whose whole time should be exclusively devoted to the legitimate and proper duties of his profession.'[13] A later despatch outlined the division whereby Captain George Pilkington was appointed civil engineer and superintendent of works and Charles Davidson Bell was appointed surveyor-general with Murrell Robinson as the first assistant surveyor-general and George Montagu as the second assistant.[14]

Soon after his appointment, Capt Pilkington[15] was informed that as his immediate duties would be the superintending of several works at great distances apart and as they had to be executed simultaneously, the governor had appointed Josiah Rivers as assistant civil engineer with instructions '…to cooperate with you in every way in carrying out such duties as you may require...'[16] On taking up his appointment, Capt Pilkington was instructed to erect of a lighthouse at Cape Recife, improve the Algoa Bay harbour, dredge the Kowie River mouth and erect of a sea wall in Table Bay.[17]

For ten years after its formation as a separate body, the Department of the Civil Engineer was mainly concerned with repairing old dilapidated buildings and building new ones, under the superintendence of the Inspector of Works and Buildings. It had nothing to do with roads, passes or bridges, as this function was implemented by the Central Board of Commissioners of Public Roads, 'the Central Road Board', as

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12 CAD GH23/18 Despatches to Secretary of State, General, No.28, HG Smith to Earl Grey, 6 March 1848, p.67.
13 CAD GH23/18 Despatches to Secretary of State, No. 29, HG Smith to Earl Grey, 11 March 1848, pp.69-76.
14 CAD GH1/38 Letter from Grey to Smith, 25 August 1848.
15 George Pilkington, 1784-1858, was born in Dublin and educated at Trinity College, Dublin. He joined the Royal Engineers in 1804, attaining the rank of Captain. He left the service in 1814 after he had brought a superior officer to a court martial on a charge of embezzlement which he proved. Pilkington then became chief civil engineer in Sierra Leone and Trinidad. A staunch Christian he became a preacher for seven years until resuming his profession when he replaced Col Michell as Colonial Civil Engineer at the Cape.
16 CAD PWD1/114 Letters Received, Miscellaneous: Montagu to Capt Pilkington, 20 December 1848.
17 CAD CO4934 Letter Book, Civil: Montagu to Civil Engineer, 21 December 1848, pp.179-182.

constituted under the provisions of Ordinance No. 8 of 1843.[18] The colonial civil engineer automatically became a member of the Central Road Board in terms of the above ordinance. As of 31 December 1858, the Central Road Board was finally abolished in terms of Act No. 9 of 1858. The powers and authority of the abolished Board were delegated to the designated chief commissioner of roads, occupied by the colonial civil engineer in a temporary capacity, and was to be assisted by three assistant commissioners.[19]

A select committee appointed by the House of Assembly in 1859 recommended that the office of the chief commissioner of roads be joined with that of the civil engineer when the department assumed control of the public roads. The head of the department was designated colonial engineer and chief commissioner of roads.[20] As a result of the additional duties to be performed by the head of department, a memorandum of his duties was drawn up by the Colonial Secretary being divided into the following four spheres of responsibilities. The duties of the Civil Engineer, Architect, Chief Commissioner of Roads and of miscellaneous duties [21]

Due to the increase in the volume of work, the Cape government was compelled to employ specialist engineers in harbour works and railways, thereby relieving the colonial engineer and chief commissioner of roads from all duties connected with the proposed Table Bay harbour works and from the superintendence and construction of the Cape Town to Wellington railway.[22] As a result, the department was revised during 1859 to combine the road and bridge construction with all the public works aspects. In addition, the new appointments of assistant commissioners of roads as designated in Act No. 9 of 1858[23] were made in August 1859,[24] whereby Robinson was appointed as the deputy colonial engineer and deputy commissioner of roads, based in Graham's Town, with the responsibility of all roads and public works of the eastern province. He assumed his duties in September 1859.[25]

Matthew Woodifield was the second new appointment as first assistant colonial engineer and commissioner of roads, stationed in Cape Town and assumed his duties

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18 Cape of Good Hope Civil Service List, (1898), p.152.
19 Act No. 9 of 1858: An Act to provide for the Management of Public Roads of the Colony.
20 The Blue Book A5-'59, Report of the Select committee appointed to consider and report upon the Colonial Engineer's Department.
21 G.32-'60 Report of the Colonial Engineer for the year 1859, p.20.
22 G.32-'60 Report of the Colonial Engineer for the year 1859, p.20.
23 G.32-'60 Report of the Colonial Engineer for the year 1859, p.3.
24 CAD CO6001 Cape of Good Hope Blue Book, 1859, p.205.
25 G32-'60 Report of the Colonial Engineer for the year 1859, pp.3-4.

in November 1859, to assist the colonial engineer in the western province.[26] Woodifield had been the assistant colonial engineer in Port Elizabeth since November 1855.[27] During this previous appointment, he had been responsible for the eastern province roads, such as the Zuurberg Pass construction, which function had fallen under the authority of the Central Road Board.[28] The third new appointment was Woodford Pilkington, the son of George Pilkington, to the post of second assistant colonial engineer and assistant commissioner of roads, based in Graaff-Reinet and assumed his duties in October 1859. Reporting to Robinson, his area of jurisdiction for roads and public buildings was for the whole eastern province.[29]

On the death of the colonial engineer George Pilkington on 3 July 1858, Sir George Grey, Governor of the Cape, sent a request to the Secretary of State that '...It would be very desirable that the Council of the Institution of Civil Engineers in London should be requested to select from the names of candidates such a person as they may think best qualified to fill the duties required from the Colonial Engineer'. The Institution selected John Scott-Tucker,[30] chosen unanimously from a list of five. Scott-Tucker was appointed colonial engineer and chief commissioner of roads on 7 December 1858 with a salary of £1,000 per annum.[31]

His duties as outlined by the Colonial Secretary, R.W. Rawson were as follows:

> I. As the Civil Engineer of the Cape Colony –
> 1.Devising, estimating for, and carrying out, either by contract or by workmen employed by the department, public works of all kinds throughout the colony, including harbour and river works, railways, with preliminary surveys and laying out of the line, bridges, lighthouses, etc.
> 2.Maintaining and improving the wharves in Cape Town and the landed property belonging to the Government adjoining them.
> 3.Maintaining the lighthouses and lights on the coasts of the colony in efficiency and superintending the light-house keepers.
> II. As Civil Architect –
> 1.Devising, estimating for, and erecting, either by contract or by the department, all public buildings throughout the colony, eg. public offices, gaols, hospitals, etc.

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[26] G32-'60 Report of the Colonial Engineer for the year 1859, pp.3-4.
[27] CAD PWD1/784 Letters Received, Works: Colonial Secretary to M Woodifield, 27 December 1855.
[28] CAD PWD1/784 Letters Received, Works: Civil Engineer to Assistant Engineer, 27 December 1855.
[29] G.32-'60 Report of the Colonial Engineer for the year 1859, pp.3-4.
[30] John Scott-Tucker (1812-1882) completed a pupillage under Isambard Kingdom Brunel on the design and construction of railways and harbour works. He first came to the Cape Colony in 1854 and reported on the Table Bay harbour and proposed several improvements. In 1857 he presented a recommendation to a parliamentary select committee appointed to plan the first railway line construction in the Colony to be built from Cape Town to Wellington. The contract for the work was awarded to the Cape Town Railway and Dock Company, with which Tucker had been associated in England. After a sojourn in Brazil, he returned to the Cape to take up the position of colonial engineer in January 1859. He compiled a map of Table Bay, plans of the Mouille Point and Robben Island lighthouses and with E. Pickering, plans of Somerset Hospital, Cape Town. He was replaced in January 1860 as supervisor of the construction of the Wellington railway after several disagreements. After leaving the Cape Colony, Tucker worked as a consulting engineer in London and ended his career as superintendent of public works in Barbados. Cape of Good Hope, Reports of the colonial engineer, 1859 & 1860. Obituary, '*Proc Inst Civil Engineers'*, Vol 71, 1883, pp.418-419
[31] CAD CO6001 Cape of Good Hope Blue Book, 1859, p.205.

2.Providing for their maintenance and repair.
3.Providing for supply and repair of furniture required for public buildings.
An Assistant Civil Engineer has been appointed to aid the Civil Engineer.
III. As Chief Commissioner of Roads –
1.To construct and maintain all the main roads of the colony, which may at present be estimated at 1,641 miles.
2.To survey and trace new lines of road.
3.To execute all works on old and new lines.
For this service Parliament has provided three Assistant Commissioners.
IV. The following miscellaneous duties required of the Civil Engineer –
1.To advise Government, the High commissioner and public bodies on all matters connected with the three preceding branches.
2.To report on all inventions submitted to the Government.
3.To provide transport for the Governor and public officers, purchasing and taking charge of horses, etc. required for the service.
4.To frame and execute contracts of leases for buildings hired for public purposes.
5.To lease lands and tenements connected with the wharves in Table Bay and to provide for the collection of rents.[32]

He did not occupy the post for long, as after a commission of enquiry into the condition of the colonial engineer's department, the Secretary of State referred to its long-standing mismanagement. In August 1862 he was granted leave of absence for six months.[33] Tucker was not to return to his post as head of the colonial engineer's department as he was officially relieved of his duties in July 1863 when he was dismissed for the mismanagement of his department after a vote of censure had been carried against him in Parliament.[34]

From the end of 1862, Robinson,[35] the deputy colonial engineer and deputy commissioner of roads, was appointed acting chief colonial engineer and chief commissioner of roads, with his appointment being confirmed the next year. During the absence of the colonial engineer and chief commissioner of roads, several revised appointments were made to personnel within the department.[36] At the same time Woodifield was appointed acting deputy colonial engineer and assistant commissioner of roads, with the superintendence and direction of public works in the western districts.

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[32] G.2.-'59 Correspondence between His Excellency the Governor and His Majesty's Secretary of State for the Colonies, relative to the selection and appointment of a Colonial Civil Engineer. 24 July 1858.

[33] Despatches to the Secretary of State, General: No. 139, PE Wodehouse to Duke of Newcastle, GH23/29, CAD, 21 August 1862, p.157.

[34] CAD GH23/29, Despatches to Secretary of State, General: Nos. 50,74,120 & 133, also CO 48/417 NAK, PE Wodehouse to Duke of Newcastle, 2 May 1863, pp.256-260; 20 June 1863, p.281; 14 September 1863 pp.319-320 and 17 October 1863, pp.334-335; GH1/298 Despatches received from Secretary of State: No.670, Duke of Newcastle to P Wodehouse, 31 July 1863, pp.113-115,

[35] Murrell Robinson Robinson (1821-1900) He was first engaged on ordnance survey and then surveying railway lines in England. In 1846 he was appointed deputy surveyor general to the government of the Cape Colony, a post he held for ten years. He then had charge as surveyor general for two years, followed by four years as deputy colonial engineer and commissioner of roads. Finally in 1863 he was appointed chief inspector of public works, a post he held until 1876 when he retired to the UK on pension.

[36] CAD CO5411 Letter Book, Appointments: No. 547, Rawson W Rawson to M.R.Robinson, 30 August 1862, pp.202-203.

W.Pilkington was to direct and superintend all public works in the midland districts of the colony.[37]

The posts of first and second colonial engineers and assistant commissioners of roads lapsed on 31 December 1863 at the expiration of Act No. 9 of 1858.[38] On 1 January 1865, in terms of Act No. 10 of 1864 the maintenance of main roads was transferred from the Department of the Colonial Engineer and Chief Commissioner of Roads to the various local divisional councils. The construction of main roads remained a function of the department.[39] Robinson, the acting head of the department was appointed chief inspector of roads, bridges and buildings in February 1865.[40] This title was changed to that of chief inspector of public works in 1866.[41]

In January 1856 Woodford Pilkington was appointed to the post of civil engineer of the new Crown Colony of British Kaffraria.[42] When the colony of British Kaffraria was annexed to the Cape Colony in April 1866, its civil engineer's office was transferred to the Public Works Department of the Cape Colony.[43] The office at King William's Town was finally closed on 31 May 1867 when the incumbent civil engineer Samuel Trill retired.[44]

PUBLIC WORKS DEPARTMENT 1872-1900

From December 1848 until November 1872, the head of the colonial civil engineer's department had come under the jurisdiction of the colonial secretary. When responsible government was introduced into the Cape Colony in terms of Act No. 1 of 1872, the civil service was divided into several departments and the Public Works Department was created. The first incumbent of the post of Commissioner of Crown Lands and Public Works was Charles Abercrombie-Smith, the member of the Legislative Assembly for King William's Town.[45]

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37 CAD CO5411 Letter Book, Appointments: No. 547, Rawson W Rawson to M.R.Robinson, 30 August 1862, pp.202-203.

38 CAD PWD1/8 Letters Received from the Colonial Secretary: No. 1621, Colonial Secretary to Acting Colonial Engineer, 10 September 1863; Cape of Good Hope Blue Book, CAD, CO6005, 1863, p.253

39 Act No. 9 of 1864: 'To provide for the Construction and Maintenance of the Main Roads of the Colony'.

40 CAD CO4981 Letter Book, Civil: No. 163, R Southey to M.R.Robinson, 4 February 1865, p.392.

41 Cape of Good Hope Civil Service List, (1866), p.43.

42 CAD PWD1/814 Letters Received : Chief Commissioner MacLean to Chief Civil Engineer, 21 January 1856

43 G21-'67 Report of the Chief Inspector of Public Works for 1866, p.6; E.A.Walker, *A History of South Africa* (London: Longmans Green & Co, 1935) p.314.

44 CAD PWD1/817 Letters Despatched, Works: S Trill to MR Robinson, 1 June 1867, p.107.

45 Act No. 1 of 1872: An Act to Amend the Ordinance instituted, 'An Ordinance for Constituting a Parliament for the said Colony'.

As from 16 December 1872 '…all communications on the following subjects, such as have heretofore been addressed to the Honourable the Colonial Secretary, shall in future be addressed to the Honourable the Commissioner of Crown Lands and Public Works:

Crown Lands and Forests
Roads
Bridges
Harbour Works
Jetties
Public Buildings
Lighthouses
Railway Works
Telegraphs
Public Stores….'[46]

Further duties associated with immigration and hydraulics (water supply) was added in January 1876.[47] On 1st July 1876 C.B.Elliott was appointed as the permanent head of the department and was also designated Assistant Commissioner of Crown Lands and Public Works.[48] In September 1892 the newly created Department of Land, Mines and Agriculture assumed the duties of all matters pertaining to lands, mines, forests, irrigation and water supply, and geological exploration.[49]

The following is a list of Commissioners of Crown Lands and Public Works appointed during the period 1872-1910. They were senior members of the cabinet and therefore had a significant part to play in the running of the department which spent the bulk of the colonial development budgets. [50]

1872-1875	Charles Abercrombie Smith
1875-1878	John X Merriman
1878-1881	John Laing
1881-1883	John X Merriman
1884-1886	Frederick Schermbrucker
1886-1890	Frederick Schermbrucker
1890	CJ Rhodes
1890-1892	James Sivewight
1893-1896	John Laing
1896-1898	Sir James Sivewright
1898-1900	JW Sauer
1900- 1902	Dr TW Smartt
1902- 1903	Arthur Douglass
1904-1908	Dr TW Smartt
1908-1910	JW Sauer

[46] Cape of Good Hope Government Gazette, 17 December 1872, Government Notice No.619.
[47] Cape of Good Hope Government Gazette, 3 January 1876, Government Notice No.2.
[48] Cape of Good Hope Government Gazette, 4 July 1876, Government Notice No.344.
[49] Cape of Good Hope Government Gazette, 9 September 1892, Government Notice No.882.
[50] The 'blue books' of annual reports of the Chief Inspectors of Public Works to the Cape Parliament

The Cape Town Railway and Dock Company won the tender to build the first railway at the Cape. This privately owned and financed company started construction from Cape Town in March 1859, reaching Wellington by November 1863. By 1864 the Wynberg Railway Company had connected Cape Town and Wynberg.[51] The geological barrier presented by the mountains of the Cape Folded Belt at first restricted railway development eastwards beyond Wellington. The discovery of diamonds, and the resultant rush to Kimberley that started in 1871, gave impetus to the development of railways in South Africa. The British government finally conceded 'Responsible Government' to the Cape Colony in 1872 under its first Prime Minister, John Molteno. The elected Prime Minister and his cabinet now had total responsibility for the affairs of the colony, leading to a period of strong economic growth and with the eastern-western separatism movement finally abating. The Office of the Commissioner of Crown Lands and Public Works was created by Act No 1 of 1872. The first Commissioner, Charles Abercrombie-Smith, was charged with the implementation of land laws in the Colony, and with the construction and administrative control of all public works. These included government railways, buildings, public roads, bridges, tolls, ferries, lighthouses and harbours, as well as control over the colony's natural and mineral resources, geological exploration, borehole drilling and irrigation.[52] This situation continued until 1 September 1892 when the Offices of Crown Lands and of Public Works were separated into two branches.

Prime Minister Molteno, presented the 'Molteno Plan' for an extensive network of railways to connect the Cape Colony's main ports to its interior and, importantly, to the Diamond Fields. In his first speech to the Cape Parliament he announced the purchase of all existing railway lines and the formation of the Cape Government Railways. Until July 1873 the management of the system initially fell directly under the Public Works Department, after which Molteno established a separate Railway Department under the renowned British railway engineer William Brounger.[53] The final separation of the Railway Department, which ran the Cape Government Railways, from the PWD occurred in October 1893, when the permanent head of the PWD was designated the Secretary of Public Works.[54]

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[51] J.Bisset, *On the Construction of Railways in the Colony of the Cape of Good Hope*, (Cape Town,1869), p.39.

[52] P.A.Molteno: *The life and times of Sir John Charles Molteno, First Premier of Cape Colony, Comprising a History of Representative Institutions and Responsible Government at the Cape*, (Smith, Elder & Co, London, 1900), p. 22.

[53] J.Burman, *Early Railways at the Cape*, (Cape Town: Human & Rousseau, 1984), pp.15-28.

[54] Cape of Good Hope Government Gazette, 30 October 1893, Government Notice No.1069.

The vast extent of the Cape Colony led to the Public Works Department being divided into several districts which were to be administrated by district inspectors. The duties of the district inspectors were to initiate, supervise and inspect the construction of road and bridge works, government buildings such as gaols, post offices, magistrate's courts and civil commissioner's offices and residences. These officials constituted the field establishment of the Public Works Department.[55] The districts were continually being reassigned, for example in 1882 there were seven districts administered by six district inspectors,[56] while in 1893 they were reduced to five districts and five district inspectors.[57] The following is the list of officials who later became known as the Chief Inspectors of the PWD

Executive Heads of the PWD:[58]	Date of Appointment:	
Henry Willey Reveley	Nov	1827 - 1828
Maj Charles Cornwallis Michell	June	1828 - 1848
Capt George Pilkington	August	1848 - 1858
John Scott Tucker	December	1858 - 1863
Murrell Robinson Robinson	February	1865 - 1876
James Fforde	January	1877 - 1881
William Magree Grier	June	1882 - 1893
Joseph Newey	June	1893 - 1905

At the end of 1876, on the recommendation of Sir Charles Hutton Gregory, James Fforde was appointmented the Chief Inspector of Public Works for the Cape Colony, and held this position for 5 years.[59] Robinson retired on 30 August 1876 to be succeeded by James Fforde who assumed duties on 21 January 1877.[60] While Fforde was on extended leave of five months between December 1879 and May 1880, William Magee Grier[61] acted in his place. When Fforde was transferred to the Railway Department on 30 June 1881, Grier was appointed as acting chief inspector of public

[55] CAD PWD2/2/118 Correspondence Files, File No. B115, Redistribution of Districts: Chief Inspector of Public Works to the Secretary of Public Works, 21 December 1896.
[56] G.52-'83 Report of the Chief Inspector of Public Works for 1882, pp.47-76.
[57] Cape of Good Hope Civil Service List, (1893), p.94.
[58] The 'blue books' of annual reports of the Chief Inspectors of Public Works to the Cape Parliament
[59] James Fforde (1836-1879) After serving a three year pupillage in Ireland, he was sent on railway construction to Brazil for five years, returning to the UK in1863. He worked for Waring Bros railway contractors all over the UK and Europe for nine years. At the end of 1876, on the recommendation of Sir Charles Hutton Gregory, a previous employer, Fforde obtained the appointment of Chief Inspector of Public Works for the Cape Colony, and held this position for 5 years. At the end of his Cape contracts he returned to the UK to work as a consulting engineer and retired to Ireland.
[60] G.21-'89, Report of the Chief Inspector of Public Works for 1888
[61] William Magee Grier (1839-1893) He was articled for five years aged sixteen to the iron works of Cochrane Brothers of Dudley. After working for various firms in both the design and construction of bridges, roofs and warehouses, between 1863 and 1865 he was employed by Fleet & Newey of West Bromwich, where he would have worked with Joseph Newey on bridge building. Several years of varied experience in his chosen profession followed. On the nomination of Sir Charles Hutton Gregory, he was in 1877 appointed an engineering assistant in the public works department of the Cape Colony. Four years later the post of chief inspector of public works became vacant and in 1882 on the expiration of one year's probation, Grier was permanently appointed to it. He remained in this position until his death of throat cancer in 1893.

works[62] for a year when he was finally appointed chief inspector on 30 June 1882. When Grier died, while still in office, Joseph Newey was appointed chief inspector of public works on 1 June1893, and retired eleven years later due to ill health on 30 June 1904.[63] As of the 1 July 1904 the title of the chief inspector of public works was changed to that of the engineer-in-chief.[64]

While the public works department 1882-1883 budget stood at a healthy £220,475 due to the recession it was trimmed to £104,698 for the 1883-1884 budget, leading to the retrenchment of three engineers, three draughtsmen and four admin clerks. In 1884 the PWD districts were reduced from 5 to 4, with the retrenchment of two valuable architects, Sydney Stent and Arthur Winder. In Grier's report to Parliament for 1888, he reported: "I have further to regret the severance of Mr Bain's association with this department, an association of long and extreme value". The old 'padmaker' was appointed the Hydraulic Surveyor of the Cape, building irrigation schemes and waterworks. Was his sudden departure as a result of his cantankerous personality with regard to authority, illustrated by his disagreement with his brother-in-law, Adam de Smidt over a subsidiary line to be taken between George and Knysna (passes route), after which they never spoke to one another again, or Chief Inspector Fforde indicating his reluctance to confront him about another pass. The demands of the railway surveys authorised by Parliament took precedence over other works resulting in more professionals being transferred to the Railway Department.

Rinderpest, a cattle plague endemic to Central Africa, spread southwards from1889 onwards and reached Bulawayo, Rhodesia in March 1896, and resulted in the Cape Colonial Government ordering the fencing of the borders of the Colony in May 1896, in the vain hope of preventing the spread of the disease into the Cape Colony. The task of supplying the necessary materials for the construction of substantial fences, and the erection of several sections of the fence, fell upon the Public Works Department, under the direction of Joseph Newey, the Chief Inspector. The 1,700 miles of fence stretched from the northern Bechuanaland border with the Transvaal, down to the Cape Colony boundary with the Orange Free State, and across the Cape Colony boundary with

[62] G.21-'81, Report of the Chief Inspector of Public Works for 1881
[63] D.E.Walters, *Bridging the Eastern Cape, the Life and Work of Joseph Newey,* (East London: Coral Tree Press, 2014), p.108.
[64] Cape of Good Hope Civil Service List, (1907) p.193

Basutoland, right down to the Natal boundary. This monumental undertaking resulted in most other works having to be delayed or postponed during 1896/97.[65]

The first architects at the Cape were mostly trained civil engineers whose education encompassed architecture. Until 1872 the executive powers of the government were vested in the governor. This meant that through the colonial office he initiated and controlled the public works programme of the colony. For example, Governor Sir George Grey had very specific ideas about architecture and saw the public offices building programme as a means of introducing skilled artisans into the districts. After responsible government, the chief inspector of public works was directly responsible to the commissioner of crown lands and public works, thus the familiar chain of responsibilities was set up and the committee type of decision making became inevitable. By the 1880s a clear structure had been instituted to undertake the large public building programme that the expanding colony would require with parliament approving or rejecting them. The employment of professional architects was imperative as they were to be responsible for the design and erection of public buildings. Several were now employed at PWD offices in Cape Town, Graham's Town, King William's Town and Kimberley.[66]

CONCLUSION

The most complete and comprehensive history of the Public Works Department of the Cape of Good Hope may be extracted from the annual reports submitted by the Chief Inspector of Public Works to the Cape Parliament, in the so-called 'blue books'. It is apparent from these reports that as the colony developed, more and more infrastructural work was initiated and completed, resulting in the reports becoming more comprehensive and later including the individual reports of the various district inspectors. This chapter has concentrated on the hierarchy, establishment and individual personnel of the Public Works Department (PWD) of the Cape of Good Hope and its predecessors, the Surveyor General and Colonial Engineers Departments during the nineteenth century. The achievements of the PWD, concentrating on their bridge building feats, are presented in detail in the penultimate two chapters of this thesis.

Approximately forty gaols were built in towns throughout the colony, closely following the establishment of civil commissioners and magistrates in the fledgling towns. Public

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[65] D.E.Walters, *Bridging the Eastern Cape*, p. 109.

[66] D.Radford, 'The Architecture of the Western Cape, 1838-1901', (PhD thesis, University of the Witwatersrand, 1979), pp.33-34.

buildings and residences for these officials, together with post offices, hospitals, police stations, schools, light houses, harbour works, irrigation schemes and canals, borehole water drilling, numerous main roads linking all the towns of the colony and many bridges. Chapters eight and nine will outline how the construction of bridges increased significantly prior to the outbreak of the Anglo Boer War in October 1899.[67]

The role played by the PWD and its initial predecessor the Surveyor General's office, in the designing and construction of public buildings and transportation during the latter half of the 19th century was considerable. The public buildings in every single town and village were designed and built by employees of the PWD or were let on contract and comprised all civil commissioner's/resident magistrate's offices, courts and residences, gaols, railway stations and the Houses of Parliament in Cape Town. It has been shown how the PWD evolved from humble beginnings and expanded to the stage where the technical input of the Royal Engineers eventually gave way to the employment of experienced civil engineers and architects from Britain in the fledgling department of the civil engineer. The advent of responsible government in 1872 heralded the establishment of the official Public Works Department, which expanded to become a most efficient organisation undertaking all types of public buildings, harbours, roads and bridges. While financial grants were initially provided by the colonial office, the colony was forced to search for alternate funding. Events such as the discovery of diamonds and gold made the sourcing of funding much easier for the construction of infrastructure, which was obtained for a time through the Crown Agents. The important role played by the Crown Agents in obtaining loans for infrastructure development will be investigated and outlined in the following chapter.

Fig 15: District Inspector Newey and staff at King William's Town 1883

[67] The Blue Books, Annual Reports of the Chief Inspector of Public Works to the Cape Parliament.

CHAPTER SIX –THE CROWN AGENTS FOR THE COLONIES AND THE FUNDING OF ROADS AND BRIDGES

This chapter will deal with the funding of roads and bridges in the Cape Colony with special emphasis on the Crown Agents, who were a significant source of credit during the second half of the 1800s. During the Dutch occupation of the Cape every attempt was made to restrict expenditure resulting in limited amounts of rudimentary communication improvements.[1] The main emphasis of the British administration during the first occupation was restricted to improving fortifications and transportation routes around Table Bay. Construction projects during the Batavian interregnum rule was limited to a few timber deck bridges and improvements to the road to Simon's Town. While the second and permanent British occupation in 1806 commenced by boosting the economy this was achieved by stabilising the Eastern Frontier, stimulating the agricultural sector economy, undertaking new public works, improving communication and promoting trade. Limited finance was provided by the Imperial Treasury to build roads, mountain passes and bridges, mostly on a *quid pro quo* basis with the local community who desperately needed the transport routes.[2] In 1845 John Montagu introduced the valuation of all land and buildings and imposed rates on immovable property to finance the improvement of the colonial roads through the Central Road Board.[3] As a Crown Colony, the Cape was initially financed directly out of the Imperial budget. This situation slowly changed as it became more economically viable as its exports of produce increased. Loan finance was now obtained through the Crown Agents with the understanding that the Colonists would eventually need to repay the credit provided.

FUNDING OF INFRASTRUCTURE

The Dutch East India Company (VOC) never intended to establish a colony at the Cape, but merely to establish a refreshment station. However natural growth of an enlarging population boosted the economy as the settlement expanded into the hinterland. In their quest to maximise profits, the VOC strictly economised on all expenses, enforcing low prices for produce and neglecting maintenance of public infrastructure.[4] To reduce costs, the VOC left the responsibility for constructing roads and bridges to the colonists

1 E.E.Mossop, *Old Cape Highways*, p.28.
2 A.Muller, 'The State and Development of the Cape 1795-1820', *Grahamstown: Economic History Society Conference*, (1986), p.59.
3 See chapter 4 for details of the reforms introduced by John Montagu
4 See chapter 2 for a detailed description of the initial situation at the Cape

themselves, under supervision of local officials. The VOC expected the new districts of the Colony to be self-financing by collecting various taxes and no provision was made for grant funding. In spite of these measures, throughout the Dutch rule, the VOC ran at an enormous loss, with expenditure consistently exceeding revenues.[5]

Governor Lord Charles Somerset was censured by the Colonial Office for unauthorised spending in 1824 by constructing a mountain pass over the Fransche Hoek Mountains. The project cost £8,390 of which £2,500 was eventually provided by London. Governor Sir Lowry Cole suffered the same fate when he commenced with the construction of Sir Lowry's Pass over the Hottentots Holland mountain range in 1830 without prior authorisation.[6] The frontier wars of 1836, 1846 and 1850, which cost millions of pounds, placed a huge burden on the Imperial Treasury. The resulting increased military expenditure on the frontier, funded by the War Office, while partially offsetting the devastating losses incurred by residents, had a positive economic impact on the region. The strategic need for military posts, interlinking roads and bridges was firmly established, apart from the almost insatiable appetite of the military commissariat. When John Montagu arrived at the Cape to take up the position of Colonial Secretary in 1843, he found an almost bankrupt colonial treasury. He quickly rectified the situation and had the Central Road Board take over the construction of roads and bridges. Their funding in turn was derived from the introduction of property rates, road tolls and grants from the colonial treasury, a situation that was not to last. With the dissolution of the Central Road Board in 1858, funding for rudimentary road construction continued to be obtained from the same sources, while the funding for construction of the expensive bridges was obtained through the Crown Agents.[7]

Crown Agents were exactly what its name implies, agents of His Majesty the King. The origins of the Crown Agents can be traced to the private merchants who, in the eighteenth century, handled the London and Bristol business of several Caribbean Colonies. Most of the colonies discovered that it was advantageous to send agents to London to protect their financial, commercial and political interests. The British government also appointed officials to supervise the expenditure of parliamentary grants-in-aid to the colonies. William Huskisson was appointed agent to the Cape in 1798. The British Colonial Empire was considerably augmented with overseas estates

5 J.Fourie, A.Jansen, K.Siebrits, 'Public finances under Private Company Rule : the Dutch Cape Colony (1652-1795', *New Contree*, (No.68, 2013), pp.51-62

6 See chapter 2 for a description of these specific incidences

7 See chapter 4, for a detailed description of the activities of the Central Road Board

as a result of the end of hostilities with Napoleonic France in 1815. Economic development during the nineteenth century in the wake of the industrial revolution initiated a period of increasing demand from the Crown Colonies. Although some of the development had taken place with private capital and local resources, it soon became clear that the British government had to take a more active role. The Colonial Office officials at the time had little expertise in the economic development of the colonies, which was carried out by the self-serving interests of many individual colonial agents. Due to dissatisfaction in the Colonial Office and the colonies with the standard of service that was being provided by these individuals, of whom almost all were former Colonial Office and government officials, the Colonial Office decided to create a single agency by dismissing all but two of the agents. The private agencies were consolidated by the Treasury of His Majesty's Government on 1 April 1833, when the secretary of state appointed the first Joint Agents General for Crown Colonies - two individuals, George Baillie and Edward Barnard. They were to be directly responsible to the governors of the thirteen Crown colonies served.[8]

Various Prime Ministers and politicians provided the geopolitical rationale and ideology to justify Britain's global empire, while the Crown Agents ran the day-to-day affairs. The Crown Agents supplied the crown colonies with non-locally manufactured goods, organised the provision of external finance, managed their investments in the UK and served as private bankers to the colonial treasuries. In effect, the Crown Agents administered the British Empire, which at one point in the nineteenth century, encompassed over 300 colonies and nominally 'independent countries' allied to the British Crown.[9]

The commercial business included the supply of all stores, which could not be acquired locally, required by various governments for which they acted. Their most important transactions were on behalf of the departments of public works, railways and harbours. For the departments of public works they purchased the materials for the construction of buildings, roads and bridges, structural ironwork, pipes and water fittings, portland cement, steam engines, machinery and engineering appliances of all kinds. For the railways they purchased permanent way materials, locomotives and rolling stock of every description, steamers and dredgers, boats and lighthouse apparatus for harbours. Other items included the issue of postage stamps and bank notes, hospital and medical

[8] L.M.Penson,' The Origin of the Crown Agency Office', *The English Historical Review, Oxford University Press* (40,158, 1925), pp.201-203.

[9] A.W.Abbott, *A Short History of the Crown Agents and their Office*, (London: Private, 1959), p.16.

stores. The Colonial Office through the Crown Agents was able to secure for British firms and shipping, an enormous volume of business which otherwise would be diverted to other nations. All important public works such as railways, bridges, harbour works, water and drainage schemes designated in the Crown colonies and having business connected with the UK, were entrusted to the Crown Agents. This included all correspondence with consulting engineers, commissioning preliminary surveys, preparation of contracts, tender adjudication and advising the Colonial Office of all aspects of the projects. To acquire an item or service, after the necessary funding had been secured, the Governor of a colony would send an indent to the Crown Agents, who passed it to the Colonial Office for authorisation, eventually the indent returned and the goods or equipment were purchased and transported to the colony. The Crown Agents were a private business in the sense that they were not paid out of taxes, rather on modest commissions on orders, and their continued existence depended on satisfying their principals, the Colonies and overseas authorities from whom they took their instructions.[10]

The British Empire evolved into three types of colonies, Crown colonies, Representative institution colonies and Responsible government colonies. In matters affecting the economic affairs of Crown and Representative colonies, the Colonial Office and the Treasury, acted as the guardian of the public purse while the office of the Crown Agents acted as the commercial and financial agent, based in the United Kingdom.[11]

London's lack of control of the Crown Agents was to be of concern to British Governments for the next one hundred years. By 1860 most of the Crown Colonies were financially self-sufficient and no longer in receipt of British government grants-in-aid, but they still needed the new capital that the Crown Agents had acquired from its earliest days raised for them by floating loan bonds on the London securities market. Loans management continued to be a significant part of the Crown Agent's work. The middle decades of the nineteenth century were difficult times for the Crown Agents, and by the time George Baillie retired in 1855, after 22 years as its joint head, it was close to bankruptcy. The reform of 1833 had not adequately dealt with the causes of the

[10] C.Bruce, *The Broad Stone of Empire, Problems of Crown Colony Administration*, (London: Macmillan, 1910), p.217.

[11] Definitions from the Colonial Office list of 1874, from: A.W.Abbott, *A Short History of the Crown Agents,* p.9.

1. Crown Colonies, in which the Crown has complete control of legislation and the administrative functions are discharged by officials under the control of the Home Office.
2. Colonies having Representative Institutions in which the Crown has no more than a veto on legislation, while the Home Office retains control of public officials and the Governor.
3. Colonies having Responsible Government in which the Crown has no more than a veto on legislation, while the Home Office has no control over any public official except the Governor.

dissatisfaction expressed by colonial clients, and by the end of the 1850s it had become clear that further re-organisation was needed. [12]

The appointment of Baillie's successor in 1858 marked a significant break with tradition. The new incumbent, Penrose Julyan,[13] was not a Colonial Office official, although he had undertaken work for it, but a retired soldier with experience of administration and engineering projects overseas. At the time of his appointment he was working in the commissariat branch of the British War Office. Julyan was a forceful man with a reputation for tackling new challenges energetically. True to form, he vigorously set about introducing new work systems, and reforming the ways in which the Crown Agents services were paid for. He turned the organisation around by introducing new systems of work and fixed fee charges based on the value of investments. From the 1860s the agency played a major role in the formulating and implementation of development policy in situations where it had a monopoly over the procurement of non-local goods and services for colonial governments, the raising of money in the capital markets to pay for them and particularly over the appointment of engineering consultants who designed and supervised the construction of railways, bridges and harbours.[14]

Barnard the remaining original joint agent retired in 1861, was succeeded by William Sargeaunt, who had served as Colonial Secretary of Natal, and other Colonial Office positions. Like Julyan, Sargeaunt was a moderniser, and his appointment added impetus to the programme of efficiency improvements that Julyan had begun. The reforms instituted by Julyan and Sargeaunt quickly won the approval of the Crown Agent's clients. The reorganisation brought about codification of systems in 1860, in the form of an instruction manual, 'Treasury Instructions for the Guidance of Agents-General for Crown Colonies'. The business of the Crown Agents for the Colonies increased rapidly after Julyan's appointment. Its average annual disbursements rose from £817,000 in 1858-1860 to £9,481,000 in 1875-1877 while its average annual

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12 Abbott, *A Short History of the Crown Agents,* p.18.

13 Sir Penrose Goodchild Julyan (1816-1907) was born in Cornwall, served with volunteers during the Canadian rebellion of 1837-8, and was Special Commissioner for Roads and Bridges for Lower Canada in 1839, until he took a commission in the Commissariat in the British Army in 1845. He was in Ireland during the great famine in 1848 when he was Secretary to the Board of Works. His next assignment was as Director of the branch of the Royal Mint in Australia in 1862. He was recalled for the Crimean War where he designed and built a floating flour mill and bakery to supply the troops. From 1858 to 1879 Penrose Julyan was Crown Agent for the Colonies. He also served as special commissioner in Mauritius and Malta. From 1879 to 1890 he was a director of the London and Westminster Bank.

14 D.Sutherland, *Managing the British Empire; the Crown Agents, 1833-1914*, (London: Boydell Press, 2004), p.5.

income rose from £12,000 in 1863-1869 to £21,645 in 1876-1882.[15] The size of the Crown Agent's staff almost doubled during the seventies. The Crown Agents' success was largely the result of its growing loan business with colonies with responsible government. The average annual disbursement for these colonies in 1875-1877 was £7,533,000 compared to only £1,948,000 for the Crown colonies.[16] Julyan's intimate knowledge of the 'City' and the efficiency of his department gave him many advantages over the financial representatives of individual colonies.[17]

By 1863 the volume of business was roughly double what it had been when Baillie and Barnard were appointed thirty years earlier, and the scope of work had expanded beyond the traditional activities of raising colonial loans, recruiting and dispatching personnel, and shipping supplies. This was a time when economic progress in the colonies began to demand better physical infrastructure; ports, roads and railways were being built everywhere from the Cape to Hong Kong, and the Crown Agents were now managing dozens of large infrastructural engineering projects. In that same year the name of the Joint Agents General for Crown Colonies was changed to Crown Agents for the Colonies, in recognition of this broader client base, and to officially give Julyan and Sargeaunt the title that had always been theirs and their predecessors – that of Crown Agents.[18]

CROWN AGENTS FOR THE COLONIES

From the mid-nineteenth century onwards, the Crown Agents were increasingly called upon by their principals to manage the construction of ports, railways, roads and bridges that accelerating colonial development and trade made necessary. The Crown Agents raised loan capital, engaged consulting engineers for the design work, procured and shipped the necessary materials and machinery, and project managed the work to its conclusion.[19] During the course of the nineteenth century several colonies were granted a degree of self-government as responsible governments, and thus ceased to be Crown Colonies. Strictly speaking they thereby became ineligible to use the Crown Agent's services, but several expressed a desire to continue doing so. The British government at first raised no objection, and agreed that the qualification for being a client of the

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15 V.Ponko, 'Economic Management in a Free-Trade Empire: The Work of the Crown Agents for the Colonies in the 19th and early 20th Centuries', *Journal of Economic History*, (26, 3 Sep 1966), p.365.

16 Ponko,' Economic Management in a Free-Trade Empire: The Work of the Crown Agents', p.365.

17 The City of London, The financial centre of the Empire, providing financial services such as banking, trading in stocks, bonds & securities, insurance, investment and organising loans for colonies

18 Abbott, *A Short History of the Crown Agents,* pp. 18-19.

19 Abbott, *A Short History of the Crown Agents,* p. 20.

Agents General might be relaxed. As the now broader-based business grew, the British Government became increasingly concerned that suppliers and investors might presume that their dealings with Crown Agents were underwritten by government guarantee – something that was not the case, and never had been.[20]

The treaty of Paris officially ceded the Cape Colony to Britain, making it an official Crown Colony, while in 1835, a Legislative Council was instituted. After much local agitation Representative Government was allowed in 1854 and finally Responsible Government was proclaimed on 1872.[21] The Cape Legislative council created in 1834 was by the early 1840s in general disfavour, as demands for the introduction of representative government were renewed. The five colonial members of the legislative council, nominated by the governor, were consistently outnumbered by the co-opted officials, while the important political decisions were made in the executive council consisting exclusively of four officials. Consequently when the matters reached the legislative council the governor had a veto as well as a casting vote. After years of agitation and protest, the grant of representative government was finally achieved when the Cape of Good Hope Constitution Ordinance of 1853 was promulgated. It allocated 46 seats in the House of Assembly and 15 seats in the legislative council.[22]

The Cape Government undertook two main approaches to secure its resources from the British financial, engineering, manufacturing and shipping concerns. Firstly as a British self-governing colony, the Cape Colony was economically, socially and politically bound to Great Britain and therefore dependent on the imperial tie. The advantages of many British houses of investment in the empire were obvious under the stable, powerful, prosperous and profitable prevailing circumstances. However the second approach was often wrought with several forms of conflict while working within the framework of mutual benefits accruing from the imperial connection. On the financial front there was periodic conflict between the Cape's representatives and allies in London and various British business pursuits, notably bankers, stockbrokers and shipping interests – over the terms on which the Cape infrastructure capital should be raised. Cape government loans were the main source of British capital that accounted for the bulk of all foreign, long-term investment flowing into the colony. While little private enterprise investment was sourced and obtained, it underlies the crucial role the government played in raising overseas investment for capital works in the Cape before the discovery of gold and the

[20] Abbott, *A Short History of the Crown Agents,* p.24.
[21] W.J.de Kock, *History of South Africa*, (Pretoria: Heer, 1971), p. 13.
[22] B.A.le Cordeur, *The Politics of Eastern Cape Separatism 1820-1854*, (Cape Town: Oxford University Press, 1981), p.135.

amalgamation of the diamond mines. The scale of Cape government borrowing for railway building and public works, including bridges & harbours, is outlined as follows: [23]

Summary of Cape Government Expenditure, 1873-1885 [24]

a)	Value of loans raised in London	£	19,591,770
b)	Ditto – specifically for railway purchase & construction	£	12,312,792
c)	Value of loans raised in London for bridges & harbours	£	1,367,202
d)	Value of loans raised in Cape	£	898,968
e)	Ditto - specifically for railway purchase & construction	£	417,258
f)	Value of all loans raised	£	20,490,739
g)	Total outstanding Cape Government Debt on 31 Dec 1885:	£	21,672,161

The Crown Agents represented the Cape Government in all its financial and other business interests in London up until 1882 and they also conducted the business of over 30 colonies at this time. They were appointed and supervised by the Imperial Government at no cost to the British taxpayer as they were paid by the Cape colonial government who used their services. The Crown Agents were an important link in the Imperial connection as their offices were the route through which British manufacturers, shipping, financial and insurance interests conducted their dealings with the Cape government until replaced by their own Agent-General.[25]

Between 1860 and 1881, the Crown Agents secured 27 loans in London for the Cape Colony to the total value of £13,158,000 at interest rates of between 6% and 4%. An additional £1,235,000 was also secured as advances from the London & Westminster Bank between 1880 and 1882.[26] In order to describe the range of Crown Agents' functions in the process of Cape Colony railway and public works construction for which an enormous amount of capital was required, the following range of operations is outlined. They would first be appointed by the Cape government to secure a specific value of loan capital, after which the Crown Agents would then need to decide when best to enter the market and advertise for tenders. They would then decide on the rate of interest and the minimum rate of discount at which the loan would be offered, in order to secure the largest amount of capital at the best possible price. This involved a deep understanding of the prevailing capital market, the current buying and selling of

[23] A.J.Purkis, 'The Politics, Capital and Labour of Railway Building in the Cape Colony, 1870-1885', (PhD Oxford University, 1978), pp.274-279.
[24] Source: Blue Book G.4 – '86, Statement of Loans, pp. 2-12.
[25] Sutherland, *Managing the British Empire; the Crown Agents,* pp. *5-6.*
[26] Sutherland, '*Managing the British Empire; the Crown Agents,* Appendix 3, Table 1 & 3.

securities through various brokers, the bank rates and the activities of rival buyers in the capital market.[27]

Once a loan had been advertised in the business press, they had to incentivise the support of the various financial interests, by the contents of a marketing prospectus and the influence of their financial connections. If support by potential investors for the loan was limited when the tenders were opened, then they would have to deal with the stock brokers and traders for the rest of the loan. Once the loan was floated the Crown Agents were required to collect the monies, remit the funds to the Cape, pay the interest, supervise the annual drawings as the bonds were paid off, and often borrow temporarily to fill gaps in the process. In addition it was in their interest to protect the credit worthiness of the Cape Colony, to counteract rumours and bad press likely to cause damage and to use contacts in the 'City' and financial press media to further promote the image of the Cape. They would signify when it would be opportune to enter the capital market and to provide guidance in order to regulate the financial commitments of the Cape.[28]

The Cape Government stimulated local economic growth by securing as much capital as possible from London, as required and on favourable terms. For Cape public works projects from the 1860s until the opening of the Rand gold mines and the diamond mine amalgamations at Kimberley after 1887-8 the most important source of capital were the loans raised on London. Between 1860 and 1888 Cape Government issues on the London market totalled £30,316,066 while in 1888 outstanding public debt amounted to £22,295,124 after which foreign funds into mining reduced London's significance.[29]

Apart from ordering and concluding engineering contracts for all fabricated construction materials in Great Britain, the Crown Agents also selected the consulting engineers in London. The consulting engineers prepared designs, working drawings, specifications and drew up contracts for all types of construction, from railway line routes, locomotives, water tanks, stations, railway bridges, road bridges, harbours and specialist large-span buildings. They advised on all technical aspects, including tender processes and the selection of technical site staff to supervise construction. As may be seen by the volume of correspondence between the Cape Colonial government and themselves, the communication with the Crown Agents was extensive. As the Crown Agents transacted

[27] Purkis, 'The Politics, Capital and Labour of Railway Building', p. 283.
[28] Purkis, 'The Politics, Capital and Labour of Railway Building', p.283.
[29] A.Porter, 'Britain, the Cape Colony and Natal 1870-1914: Capital, Shipping and the Imperial Connexion', *The Economic History Review*, (34, 4, 1981), p. 557.

business with so many colonies throughout the empire and developed extensive contacts and gained wide ranging experience over many years, it meant that the Cape had access to this valuable asset and was able to tap into the Crown Agents' considerable data base. The Crown Agents invited tenders and placed orders with firms and contractors with whom they had previous dealings and whose reliability and experience had been proven from similar work undertaken for other colonies.[30] For example, the following seven iron wagon bridge manufacturers were used almost exclusively in the Cape colony: Westwood Baillie & Co, Braithwaite & Kirk, Joseph Westwood & Co, Andrew Handyside & Co, Crumlin Viaduct Works, Patent Shaft & Axletree and Fleet & Newey. Fleet & Newey even renamed their firm as the Crown Works in recognition of the many iron structures that they had fabricated on behalf of the Crown Agents. The preferred Consulting Engineers were also short-listed by the Crown Agents. These included Henry Wakefield (a former pupil of I.K.Brunel), Sir George Berkley, Sir Charles Gregory, Sir John Fowler, Sir Benjamin Baker, Sir John Coode, William Brounger, Sir Charles Fox, Sir John Hawkshaw and others.[31]

The Crown Agents while they may be accused of bias, were able to secure favourable terms and prices from suppliers and manufacturers, some offering large discounts in order to keep in their good books. Insurance companies that received much business from the Crown Agents were happy to offer fair premiums and settle claims 'with liberality and promptitude'. The preferential treatment enjoyed by the imperial railway building network undoubtedly favoured British firms as opposed to foreign manufacturing interests. In 1881 for example, the German-owned firm of W.A.Lippert & Co, Cape merchants with Hamburg connections, approached the government that Krupp be given an opportunity of tendering for steel rails for the Cape railways. The offer was rejected on the grounds that Krupp's rails were unproven and that their freight charges would not be economical.[32] The Crown Agents had a further advantage when making up freight cargoes to the Cape they were able to reduce overall tariffs by combining a variety of imports on a single ship. They were not a profit-making organisation and through their commercial influences and by achieving economies of scale, their services were low-priced. The schedule of charges set by the Colonial Office after 1858 outlined the type of colonial business that was undertaken by the Crown Agents.

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30 Purkis, 'The Politics, Capital and Labour of Railway Building', p.284.
31 Walters, *Bridging the Eastern Cape*, p.45.
32 Purkis, 'The Politics, Capital and Labour of Railway Building', pp.287-288.

A commission of 0.5% on all loans contracted and paid off by the Crown Agents was instituted in 1863, while brokerage costs accounted for 0.25% and another 0.25% of loans went to the office fund. At the same time they were made the sole negotiator between the Crown Colonies and the investment brokers in Britain, a function formerly performed by the Bank of England. The bulk of the Crown Agents' revenue came from an annual sum which was paid by those colonies whose transactions were on a large scale. Smaller colonies paid a straight 5% on all purchasing orders executed by the Crown Agents.[33] In 1880 their schedule of charges was laid down by a Colonial Office circular and comprised of only 0.25% commission for negotiating new loans plus 0.25% for brokerage which was paid to whoever issued the loan; 0.25% for the payment of interest and 0.25% for paying off the principal amount at maturity. Furthermore they claimed that they issued loans for 0.25% plus 0.25% for brokerage that would normally cost 2% by a commercial bank.[34]

The Crown Agents had two significant advantages in the business of both temporary and permanent loans. Firstly their track record of reliability and creditworthiness, while the second advantage was the diversity of their business interests, by which banks had a good deal to benefit by co-operating with them. The crucial factor in the loan business was the relationship that the Crown Agents had built up with powerful stockbrokers. There were basically only about six stockbrokers who purchased large portions of Cape loans and of which the three most active were William Westgarth & Co, Mullins Marshall & Co and Scrimgeour & Co, who were also the stockbrokers for the Barings Brothers Bank.[35]

Cape loans taken up from the general public through tenders appearing in the financial press were relatively few, and were limited to bids from speculative buyers who bought up securities with the intention of selling them to permanent investors at a profit. Permanent investors for loans greater than £1 million normally worked through stockbrokers. Tendering was a risky business, if the tender turned out to be too low, the effort was wasted, and if it was successful it would often be more expensive than necessary. It was convenient to let the experts (stockbrokers) take these risks and purchase from them when the going price had been revealed. As happened in 1876 when £½ million Cape government loan was floated the higher bank rate prevented

33 Ponko, '*Economic Management in a Free-Trade Empire: The Work of the Crown Agents'*, p.364.
34 Purkis, 'The Politics, Capital and Labour of Railway Building', p.289.
35 Purkis, 'The Politics, Capital and Labour of Railway Building', p.290.

speculators from borrowing cheaply and the high price of a previous loan prevented profitable speculation.[36]

The importance of the stockbrokers in the market for Cape loans was illustrated in the purchase of the first £4 million issued to meet the expenditure of the Molteno Plan for railway construction. Scrimgeours took almost a quarter, while three others took a half. Reliance on stockbrokers was inevitable and sometimes hazardous. They could quickly use their influence in the market for colonial securities to flood the market and bring down the price. Particularly, if they still held unsold securities from a previous issue. When the loan was advertised, they would 'bear' the market [37] by saturating it with their unsold holdings of securities in the hope of driving down the price of issue, buying it up cheaply and selling it on at a handsome profit. The solid reputation of colonial securities made them vulnerable to this manipulation. The bigger the loan the longer it would take for the investing public to absorb it and the greater the price the syndicates of stockbrokers and investors could charge. The pivotal factor in the business of permanent loans on behalf of the colonies was to gain the essential co-operation of speculating stockbrokers and to promote competition between them without allowing them to 'bear' the next loan. The Crown Agents, who had an intimate knowledge of the markets and the workings of the stockbrokers, offered a substantial advantage to colonial governments as financial agents. The Crown Agents often advised the Cape government to keep out of the market until previous issues had been disposed of by permanent investors and speculators had sold all of their Cape securities. The Cape government would then borrow temporarily on the security of future debentures.[38]

Thus Julyan[39] advised Premier Molteno not to 'dribble' frequent small loans onto the market, thereby upsetting the calculations of the stockbrokers. Timing of the markets was crucial, as the old loans had to be absorbed and the bank rate had to be stable. Setbacks to credit with the significant decline in colonial revenues due to drought, a fall in the diamond price of 1876-77, the Sekhunkhune and Ngqika-Gcaleka wars, did not seriously affect the support of the stakeholders and thereby avoid paying a heavy discount on loans.[40] The relatively light discounts paid by the Cape in loans of the 1870s was due to the relatively small loans on offer, the competition between

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36 Purkis, 'The Politics, Capital and Labour of Railway Building', p.291.

37 A 'bear' market is a condition in which securities prices fall and widespread pessimism causes their downward spiral to be self-sustaining. Investors anticipate losses as pessimism and selling increases

38 Purkis, 'The Politics, Capital and Labour of Railway Building', pp.293-295.

39 Sir Penrose Julyan, the senior Crown Agent

40 Purkis, 'The Politics, Capital and Labour of Railway Building', pp. 296, 297.

stockbrokers and their need to stay in the good books of the Crown Agents and the Cape government. In contrast, during the 1880s recession, heralded more frequent and larger borrowings by the Cape, combined with extraneous factors tending to undermine its creditworthiness as the financial predators of the City began to exploit the situation.

The Treasury and the Colonial Office became increasingly suspicious of Julyan and his associates despite their financial success. The Treasury was alarmed at the Crown Agents' often aberrant[41] relationship with colonies with responsible government, whose internal affairs were not under British control. The Colonial Office was concerned by a series of questionable financial transactions and payments of honorariums to Crown Agent officials. The Treasury wanted its functions severely restricted while the Colonial Office preferred to simply subject them to tighter controls. The Treasury was, however, suspicious of the Crown Agents for another reason. In the past the British government had guaranteed numerous colonial loans for imperial projects. It was argued that the guarantees could encourage the colonies to engage in reckless borrowing.

Treasury officials feared that a loan negotiated by the Crown Agents might be interpreted as having an imperial guarantee. Michael Hicks-Beach, the Colonial Secretary from 1878-1880, initially allowed the Crown Agents to continue to negotiate colonial loans, reckoning that the political advantages outweighed any financial risk.[42] Finally in 1880 the Colonial Secretaries, Hicks-Beach and Kimberley, decided to end the Crown Agents loan raising activities for the self-governing colonies and confine their activities to the Crown Colonies. The arrangement was finalised in 1881. The main reason for the decision lay in the attitude of the Treasury who considered the Crown Agents non-compliant to normal methods of Treasury control. The Crown Agent's income and business relied on colonial government actions over which neither Parliament nor the Treasury had much control. Regulations were ineffective, leading Treasury in the 1870s to state that controls were not working and therefore all connections should cease. Both the Treasury and Colonial Office rejected the popular assumption that the Crown Agent's handling of colonial loans implied their guarantee by the Imperial Government.

The decision to prohibit the Crown Agents from transacting business for colonies with responsible government affected both the governors of the Cape and New Zealand, the

[41] Aberrant – Straying from what is considered the right or moral standard. Officials engaging privately with Colonies in direct competition with their employers the Crown Agents and receiving payment for their professional services. Sutherland's book also charts this 'moral hazard' phenomenon. Moral hazard is a situation in which one party gets involved in a risky event knowing that it is protected against the risk and the other party will incur the cost.

[42] B.L.Blakeley, T*he Colonial Office,1868-1892,* (Duke University Press, North Carolina, 1872), pp. 101-103.

last remaining responsible government colonies still employing the Crown Agents at the time.[43] This decision had the immediate effect of proscribing a quarter of the Crown Agent's business. However, as the century drew to a close, that loss was made up, largely through the addition of new clients. In addition, the Crown Agents Department transferred from the Treasury to the Colonial Office, from the Secretary of the Treasury to the Secretary of State for the Colonies. The principle that the Crown Agents should engage with Her Majesty's Government through the Secretary of State for the Colonies was elucidated by the British Parliament in 1881, 'for the good governance of the colonies'.[44]

The outcome was that the Crown Agents were to cease transacting further government business with responsible governments and would henceforth fall under the Colonial Office. The Cape Government had its own reasons for wanting a break from the Crown Agent's services. Cape politicians felt that the Crown Agents were failing to place loans for them at the best terms available and the costs of such operations were exorbitant. The growth of Cape business by 1879 and its positive economic future prompted Premier Sprigg to conclude that it would undoubtedly be '….more advantageous…..to be represented by an agent where services would be exclusively devoted to the interests of the Cape Government…..'[45]

APPOINTMENT OF THE CAPE COLONY'S AGENT GENERAL

With the Crown Agents no longer in the employ of the Cape government they were free to employ their own Agent-General, the retired soldier, Captain Charles Mills.[46] The break with the Crown Agents highlighted how the political connection with Britain remained crucial to the Cape's effort to obtain capital after 1881 and how by implication the colony's economic interests helped to buttress political loyalty to the British Empire. The Cape government was not reluctant to transfer its business from the Crown Agents to an Agent-General. Recent events suggested a feeling of relief to be rid of the Crown Agents as the large growth in the Cape's business was receiving less attention from the Crown Agents, who now administered over 300 colonies. Secondly savings were to be

[43] Porter, 'Britain, the Cape Colony and Natal', pp.558-559.
[44] Abbott, *A Short History of the Crown Agents*, p.24.
[45] Porter, 'Britain, the Cape Colony and Natal', p.561.
[46] Captain (later Sir) Charles Mills (1825-1895) was the Cape Colony's first Agent-General based in London. He was a close friend of J.X.Merriman and their correspondence reveals his relationship with many English politicians and his frequent access to 'inside information'. Mills came to the Cape in 1857 as staff officer to the German Legion, after military service in the far East. He was then successively government secretary to British Kaffraria, M.L.A for King William's Town (1867-72), imperial secretary in Cape Town and Agent General in London (1882), an office he filled with great distinction and ability. Source: 'Men of the Times – Pioneers of the Transvaal and Glimpses of South Africa', (Transvaal Publishing Co, 1905), p.457.

made through increased efficiencies that a full time Cape agent was able to offer. Savings by dealing directly with shipping companies and not through shipping agents and by eliminating the Crown Agent's various fees and charges. The Cape agent could also promote Cape products, intervene against bad publicity, promote Cape creditworthiness, liaise directly with banks and stockbrokers, newspaper editors, Colonial Office officials and politicians, in effect have a finger on the financial and mercantile pulse of the UK.[47]

In their procuring of colonial finance, the Crown Agents had great scope for personal 'moral hazard'.[48] Monitoring of their activities by the secretary of state was poor. The Colonial Office authorised all Crown Agents' actions and received regular reports of their financial transactions. The Crown Agents could easily obtain authorisation through the provision of biased information. Given the poor standards of accountability it is surprising that there were so few recorded incidences of impropriety.[49]

Rumours began to circulate as a result of various speculations about whether the British government would keep the road to the north through Bechuanaland open to British and Cape interests, or to give way to the Transvaal demands. The protracted war with the Basutos and the first Anglo-Boer war of 1881 aggravated the situation. Together with the commercial recession of the 1880s, these factors created a feeling of despondency about the Cape. Premier Scanlen repeated these fears with the statement that they would have to '…pay the discount for these events in the forthcoming loan…'[50]

During the whole time that the Crown Agents were employed by the Cape Government they used a single stockbroker, Messrs T and A Scrimgeour for their financial transactions who were closely linked to the Baring Brothers Bank. Mills accused this group of warning investors about Cape Colonial loans who were able to manipulate the prices of their debentures in the market to suit their own purposes, by buying low and selling high or by flooding the market to bring down the prices thereby making huge profits at the Cape's expense. Examination of the fortunes of Cape securities listed in the financial press (*the Economist*) in the late 1870s and early 1880s, reveals just such a pattern as described by Mills.[51]

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47 Purkis, 'The Politics, Capital and Labour of Railway Building', p.300.

48 In economics, moral hazard, in the principal-agent situation, occurs when the agent takes risks being fully aware that the principal bears the consequence of those risks.

49 Sutherland, *Managing the British Empire; the Crown Agents,* p.9.

50 Purkis, 'The Politics, Capital and Labour of Railway Building', p.313.

51 Porter, 'Britain, the Cape Colony and Natal', p.563.

By May 1882, the Cape needed the help of a bank as its financial liabilities amounted to more than £2 million, when the Crown Agents performed a 'flagrant' job[52] on the Cape. After their duties were handed over to the new agent-general of the Cape, Capt Mills, they advised the colony to employ Barings Bank as its new issuing house. Given that Barings had never floated a colonial issue and their broker, Scrimgeours held a large proportion of the Cape's previous loans and could easily rig its future issues, this was remarkably poor advice. It was all in the Crown Agent's interests, as they could revenge themselves against the Cape for its earlier criticism of their lax financial obligation and strengthen their relationship with Scrimgeours. Mills took their advice and appointed Barings for a period of ten ears, only to see the Cape's first loan of £3 million rigged in June 1882 and sold at an excessively low price of only 94, (6% discount) which the Cape government regarded as too low.[53]

Determined to free themselves of Barings, Mills instructed the Crown Agents to negotiate a new issuing contract with the Bank of England on behalf of the Cape. Yet again, the Crown Agents appear to have behaved dishonourably by appointing the former and now retired Crown Agent, Sir Penrose Julyan, as their negotiator. Inevitably, the talks broke down after which Julyan advised the Colony to use the London and Westminster Bank, of which he had recently become a director. The Crown Agents, wishing to appease their former boss, agreed, consequently the colony had no alternative but to place its issuing activities with the bank after being declined by the Bank of England. After the Australian colony of Victoria also had their loans under-costed by syndicates in 1891, the London and Westminster Bank itself led a syndicate to 'bear' Cape loans by buying them cheaply and trying to issue loans on the Cape's behalf at a correspondingly low minimum price.[54]

The final strategy that the Cape government adopted after its break with the Crown Agents was to improve its financial position through the conversion and consolidation of existing loans. The Cape wished to not only convert its bonds but to replace them with inscribed stock.[55] Resistance to this operation was considerable as the Crown Agents' fees would be eliminated. After much effort the proposed transaction was successfully accomplished and by 1887 the domicile of the loans was transferred to the London &

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[52] Flagrant job, meaning a shady, cunning or scandalous financial manoeuvre which prejudiced their employers, the Cape Government

[53] Purkis, 'The Politics, Capital and Labour of Railway Building', p.308.

[54] Sutherland, *Managing the British Empire; the Crown Agents*, pp. 203-204.

[55] Inscribed stock: is stock in which ownership information is recorded. The owner's name is placed on a certificate. Only the owner of inscribed stock is entitled to ownership rights.

Westminster Bank. The hold of the Crown Agents and allied bondholders was broken finally removing their combined financial methods and interests from keeping the Cape's financial position in an unhealthy state.[56]

Another running battle was fought by Mills against the 'freight ring' organised by the Union and Castle Steam Ship Companies, led by Sir Donald Currie. The strength of these two companies lay in the fact that return freight from the Cape to Britain was relatively light for much of the year. They were able to demand a subsidy to keep a regular mail service going at all. By bringing in opposition shipping companies, Mills was able to force the 'ring' to offer government rates equal to private ones. In a similar manner, Mills was able to reduce exorbitant charges by insurance companies and local banks by introducing stiff competition.[57]

CONCLUSION

This chapter has highlighted how the political connection between Britain and the economic interests of the Cape had direct recourse to the Crown Agents. It has also shown how the Cape was heavily dependent on the credit, experience and business contacts of the Crown Agents for the procurement of capital, goods and equipment, information and technical expertise in public works infrastructure and railway building works. They all depended, in turn, on the imperial connection, which would prove particularly attractive to potential investors, safe in the knowledge of their investments in a prosperous British colony. This became especially significant after the discovery of diamonds and gold. It was pivotal that the Cape's creditworthiness remained uncompromised. Here the political connection was essential and was promoted by men of financial influence, the Colonial Office, and the Cape bondholders who were obliged to protect their investments by supporting the Cape's credit worthiness. Along the way, the Cape government had to keep a watchful eye on various interest groups seeking to profit at the colony's expense, such as speculating stockbrokers of the City of London and the shipping freight 'ring'. Economic development under responsible government resulted in the Cape Colony deriving advantages from the vast network of connections with British investors, financiers, manufacturers and shippers with whom the deals were made. It was only by 'Buying British' that the economic advantages to colonists living in the British Empire could be realised.[58]

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56 Porter, 'Britain, the Cape Colony and Natal', p.565.
57 Purkis, 'The Politics, Capital and Labour of Railway Building', pp.318-319.
58 Purkis, 'The Politics, Capital and Labour of Railway Building', pp.320-321.

The preceding account has outlined the strategies that the Cape authorities were compelled to adopt to finance the construction of roads and bridges throughout the Cape Colony during the nineteenth century. At first small amounts were raised through various tolls, taxes and rates imposed on the local population. Initially the capital required for public works, roads and bridges was relatively small and raised through grants-in-aid from the British Treasury and through the War Office and Colonial Office budgets. However, with the advent of railway construction following the discovery of diamonds and gold, the situation changed dramatically. Now large sums of capital were needed to construct railway lines from the coastal cities to the mines in the interior. Security provided by the exports of gold and diamonds made the raising of finance on the capital markets relatively easy, however the Cape Government needed an organisation to act on its behalf when dealing with the financial institutions in London.

The Crown Agents proved to be extremely useful as they assisted the Cape Government in raising large amounts of loan capital by offering generous returns on loans to potential investments. Constant vigilance had to be exercised to combat the various interest groups from seeking to profit excessively at the Cape's expense. Disputes with stockbrokers, banks and bankers and the monopoly of the freight 'ring' of ship companies were an ongoing problem that had to be overcome on a regular basis. The Crown Agents walked a tight rope in providing external finance to the many colonies that they serviced as unforeseen events and expenses could damage both their own reputation and their colonial client's prosperity. The failure of a loan, its sale at too low a price, or unexpected construction over-runs could lead to a shortfall of funds. The commissioning of incompetent consulting engineers and the appointment of sub-standard bridge manufacturers, for example, would rebound on to the Crown Agents and were thus compelling reasons for retaining the best that the George Street 'clique' could provide. The eventual employment of the Cape's own Agent General improved matters significantly after the withdrawal of the Crown Agents as he worked exclusively on matters affecting the Cape government and was answerable to them alone.

The following chapter will outline the evolving technology of both design and construction of British bridge building from its roots in the Industrial Revolution and its enforced improvement with the introduction of the railways. Associated with this increase in technological endeavour will outline the beginnings of the civil engineering profession, both design and construction, as theoretical knowledge was forced to keep pace with the demands of times.

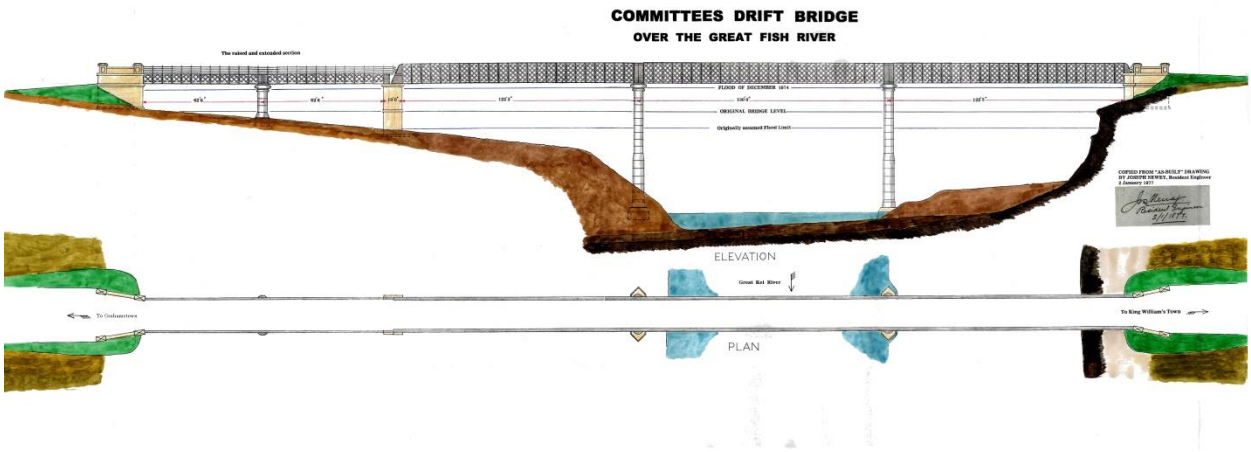

Fig 16: Committees Drift Bridge over the Great Fish River 1877

Fig 17: Committees Drift Bridge over the Great Fish River 1877

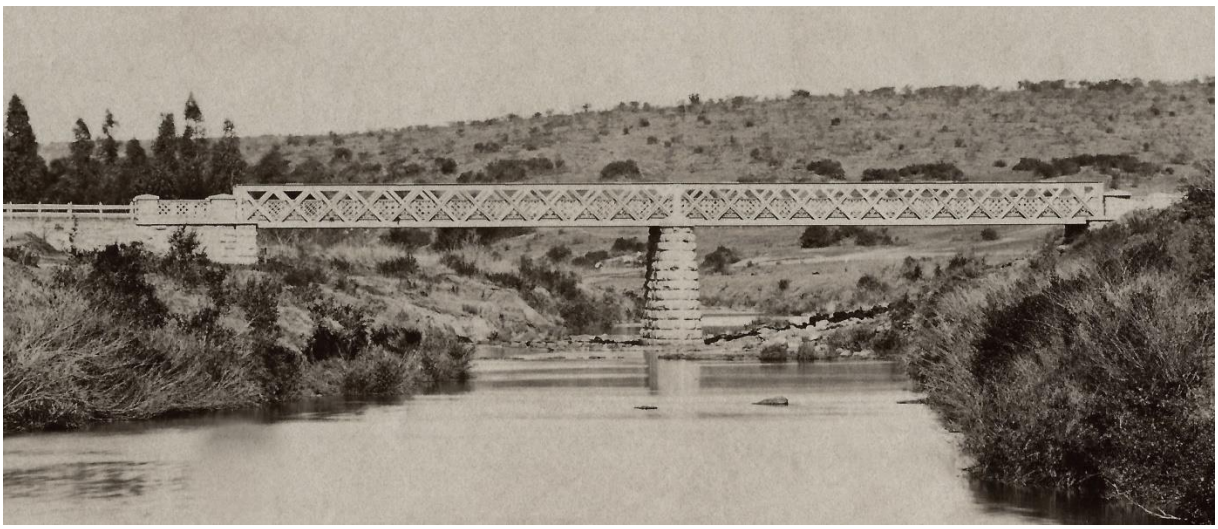

Fig 18: Buffalo River Bridge, King William's Town 1874

CHAPTER SEVEN – BRITISH BRIDGE BUILDING TECHNOLOGY AND THE CIVIL ENGINEERING PROFESSION

This chapter will commence by introducing the theory of structures, starting with the discoveries of the ancient 'natural philosophers', whose theories were expanded upon by succeeding mathematicians. The design of all medieval and later period structures, both buildings and bridges were based on precedence, on earlier structures and on rules of ratio and proportion. The Industrial Revolution introduced the production and use of iron, whose applications were soon to rival and exceed the use of stone and timber in the construction of bridges. An investigation of the design and construction of timber, stone masonry arch and iron and steel girder bridges during the nineteenth century will follow. To appreciate the construction of these structures, it is essential to consider how they were proportioned, designed and finally constructed. Structural engineering, a profession that includes the theory of structures as a fundamental engineering discipline, only rarely finds an audience outside of the discipline. Until the 1990s, the history of the theory of structures attracted marginal interest from historians, with the first specialised international conference only being held in 2005.[1] Finally this chapter will investigate the civil engineering profession from its official establishment in 1818 and its subsequent operation during the research period of this thesis.

EARLY METHODS OF DESIGN

The problem of bridge construction has always been closely linked with the question of available technology. The construction of a modern bridge is preceded by extensive geotechnical and hydrological studies, terrain surveying, complex computer modelling and complicated computer aided design calculations, numerous simulations of anticipated imposed loads and finally the preparation of detailed construction drawings. Basically all bridge design calculations are concerned with the ability of the bridge to safely carry the anticipated imposed loads together with such matters as the geometry and ultimate strength of the required bridge. Structural design is used to determine the way in which a structure actually carries its loads. Imposed loads on bridges are applied by vehicles such as wagons, locomotives, trucks and cars. There are many alternative load paths for a hyperstatic[2] structure; one of these will be chosen by the structure; and

[1] S.Huerta (ed), '*Essays in the History of the Theory of Structures, in honour of Jacques Heyman'*, (Madrid: Instituto Juan de Herrera, CEHOPU, 2005).

[2] Hyperstatic– A statically indeterminate structure. When there are an insufficient number of static equations of equilibrium for determining the internal forces and reactions of a structure.

needs to be discovered by the designer. If the designer misses the resulting load path, the structure may be seriously compromised.

When a structure is loaded with a force it produces stresses, which may cause the structure to deform. Stresses in ancient and medieval structures were low. The stone in a Greek temple, a Gothic cathedral or in the arch ring of a stone masonry bridge normally works at a stress one or two orders of magnitude below its crushing strength. This is the reason why so many of these old structures have survived. The secret to this situation is that the shape of the structure should be 'correct' to satisfactorily accommodate the structural forces; the correct geometry. Hence for such structures stress is of secondary importance; its shape governs its stability.[3]

All surviving ancient and medieval writings on buildings were concerned with geometry. The ten books of the Roman architect and engineer, Vitruvius, is a well-known example of the ancient technologies. The ancient and medieval designers used precise rules of proportion. These rules were never lost, they survived the Dark Ages, written into the secret books of the Masonic lodges and stone mason's guilds they flourished in the age of High Gothic architecture. Normally the design process would have proceeded by trial and error, by past experiences, by the evidence of hundreds of successful masonry buildings and structures and by the use of scaled models. A small-scale model served several functions: it was used by the Master mason to demonstrate the design and overall appearance of the proposed structure to the sponsor of the building and to solve constructional problems. If the model was stable, so also the full-scale building, since the model proved that the geometry was 'correct'.[4]

Building, whether castles, cathedrals, palaces or bridges, is one of the most ancient of the practical arts, and was executed with great skill and ingenuity in some of the notable buildings and bridges of the middle ages. The medieval builders had to solve all their major structural engineering problems in terms of one material, stone, which is reliable only in its resistance to compression. A designer needed to work within the constraints imposed by stone and its ability to be shaped, transported and lifted. The primary structural problem in building construction has always been that of spanning space. In the medieval period it was the arch vault that was almost exclusively used as the

[3] J.Heyman, *Structural Analysis – A Historical Approach*, (Cambridge University Press, 1998), p.1
[4] J.Heyman, *The Stone Skeleton, Structural Engineering of Masonry Architecture*, (Cambridge University Press, 1995), pp. 3,141

system for spanning space in masonry buildings, while in bridges it was the circular arch.[5]

By the beginning of the 14th century some sixty Gothic cathedrals in France and forty in England were complete or under construction. What inspired the building designers to push back the boundaries of what was possible and be much more economical in the use of materials? How did they believe that it would be possible to build cathedrals taller, wider, larger and more daring than before? Part of the answer seems to be bound up with geometry and in particular, with the writings of the Greek mathematician Euclid (300 BC). Euclid was active in Alexandria, Egypt, during the reign of Ptolemy I (323-283 BC), and his manuscript 'Elements' is one of the most influential works in the history of mathematics, especially his writings on geometry, which was used right up until the early 20th century. An Arabic translation of Euclid's lost 'Elements' was discovered, translated and introduced into France and England, at the start of the Gothic period, which improved the level of geometrical knowledge and which facilitated the more accurate description of proposed building designs and was of great practical use in the construction process. However, it was the capacity to provide justification of designs that geometry had a more profound effect. Euclid introduced a crucial new ingredient, the geometrical proof.[6] The mathematical proposition from his Book 1 outlined the methods of describing arches of various configurations which were used to justify the arches of the Westminster Bridge construction over the Thames River by Charles Labelye in 1751.[7]

THE THEORY OF STRUCTURES

What is the theory of structures? The term describes one of the most successful applied science disciplines. The history of the theory of structures is the history of mechanics and mathematics, when in earlier centuries structural design was dominated by empirical methods, undertaken by persons called 'natural philosophers'. Structural analysis, on the other hand, only describes a portion of the process of creating a load-bearing structure. Structural analysis is the analytical process of determining forces in each component of a loaded structure (such as a beam or column) where the arrangement of components is accurately defined. It incorporates the field of applied

5 J.Fitchen, *The construction of Gothic Cathedrals, a study of medieval vault erection*, (University of Chicago Press, 1961), p.1.

6 W.Addis, Inventing a History for Structural Engineering Design, *Proc 1st Int Congress on Construction History, Madrid*, (2003), p.116.

7 C.Labelye, *Description of Westminster Bridge, London, 1751*, in A. Bartholomew, *Specifications for Practical Architecture*, (London: John Williams Library of Fine Arts, 1840), p.176.

mechanics and properties of materials to compute forces, stresses, deformations and the ultimate stability of the loaded structure and is the essential part of the engineering design of structures.[8]

How has structural analysis evolved? Kurrer has divided the history of the subject into a number of periods and phases. During the 'preparatory' period of 1575-1825, empirical knowledge and theory dominated this period in the design of buildings and structures. Theory comprised of geometrical design and dimensioning rules. Galileo Galilei was the first to add elements of strength of materials in the form of the first beam theory in his *Dialogue* of 1638. Robert Hooke continued the work in his discovery of the law of elasticity in 1660, later known as Hooke's Law. Both Hooke and Christopher Wren came to prominence after the Great London Fire of 1666 when they established the first consulting design practice. Differential and integral calculus appeared for the first time in about 1700 and soon forced its way into applications in theoretical mechanics and engineering. Here Leibnitz, the Bernoulli Brothers and Euler brought progress to beam theory and the theory of the elastic line.

It was Charles Augustin Coulomb who first applied differential and integral calculus to beam, arch and earth pressure theories in a coherent form in 1776. Modern-day civil engineers still use his theory of the thrust of soil against retaining walls, called Coulomb's method in soil mechanics. The fragments of knowledge accumulated during this period were eventually combined through the elastic theory that evolved during the first half of the 19th century in France. Here Louis Henri Navier took the lead with his bending theory in his book *Résumé des Leçons* of 1826. Navier's practical bending theory formed the foundation of structural analysis which he used to analyse numerous timber and iron constructions by setting up structural models and integrating the linearised differential equations of the curvature of the deflection curve. Navier's practical bending theory thus became a reference point in the theory of structures. Not one to dwell on his theories, Navier subjected strength test data carried out by others on customary building materials to reinforce and prove his theories. Engineers could now create structural models of structures and solve them by means of an iterative design process based on scientific theory with the help of pen and paper, calculating aides and

[8] K.E.Kurrer, *The History of the Theory of Structures, from Arch Analysis to Computational Mechanics*, (Berlin: Ernst & Sohn, 2008), pp.5-6.

tables of building materials. In addition they could now create and optimise ideal and economic load-bearing structures that would fulfil their load-bearing functions.[9]

While the theories of flexure and bending stress in beams had been established in the 18th century by Bernoulli, Euler and Coulomb respectively, Navier developed the analysis of forces and deflections of beams of various degrees of complexity, with regard to support and restraint, as part of his unique researches in the theory of elasticity of which he laid the foundations. Carpenters have known that the continuity of timber beams over supports and built-in ends contributed substantially to their load carrying capacity. Navier was also aware of this phenomenon as he embarked on the precise analysis of these systems, which was timely in view of the development of wrought iron beams and structures, which was stimulated by the needs of railway construction. Navier was the first person to analyse the load carrying capacity of the continuous and encastré (built-in) beams, as published in his '*Leçons*'. The statically indeterminate (hyperstatic) beam, especially the continuous beam, would dominate the development of the beam in the 19th century.[10]

Masonry, timber and cast iron were initially the only principal materials of construction and their properties dictated the nature of structural forms. The arch utilised the compressive strength of masonry and cast iron. The beam and lattice framework utilised both the compressive and tensile strength of timber. The manufacture and rolling of wrought iron (strong in both tension and compression) was in its infancy in 1800 but was to have a profound effect upon the theory and practice of construction. The building of iron bridges became more widespread after 1850 when cast iron was found to be weak in tension and was soon substituted with wrought iron.[11] The railway boom was the driving force behind the building of iron bridges, resulting in a huge demand for wrought iron with its good tensile strength. During Kurrer's establishment phase of 1850-1875 iron bridge building was the catalyst for the enhancement of the theory of structures as structural analysis became established in the theory of trussed frameworks. While during Kurrer's classical phase of 1875-1900, Karl Culmann

[9] Kurrer, *The History of the Theory of Structures*, pp.31-34.

[10] T.M.Charlton, *A History of Theory of Structures in the Nineteenth Century*, (Cambridge University Press, 1982), pp.14-16.

[11] Iron ore was smelted in a charcoal furnace to which limestone was added as a flux to separate the slag from the molten iron which was poured / cast into sand molds to produce pig iron or cast iron. Cast iron when cold is very brittle due to its high carbon content. The very high carbon content had to be oxidised out of the cast iron which was then heated in a charcoal puddling furnace in which combustion was intensified by blasts of air from a bellows. The molten iron was then pounded by a forge hammer to form wrought iron, which was rolled to form flat iron sheets or iron sections and rails.

expanded trussed framework theory into graphical statics as an attempt to give structural analysis mathematical legitimacy through projective geometry.[12]

After touring Britain and America in 1851, Culmann reported on the state of bridge building in those countries. He made the point that the purpose of determining the forces acting on individual members was to minimise their size and thereby reduce the quantity of material required for fabrication and thereby produce an economical design. In contrast, he reported:

> 'The purpose of all stability investigations, all determinations of the forces acting on the individual constructions, is to execute the intended construction with a minimum of material. It is certainly not difficult to establish all the dimensions for every bridge system such that they are certainly adequate, and it is not difficult to imagine a leap from the limits of the necessary into the superfluous. The English engineer, for example, does this with nearly every iron bridge he designs, characteristic of the English structures in particular is that they appear fattened and even the uninitiated gets the feeling "it will hold". What is befitting for the wealthy Englishman, who goes everywhere fully conscious of the idea "I am in possession of the iron and do not need to worry myself about the statics", is less fitting for the poor devils on the continent, they have to fiddle and experiment, stake out and estimate many solutions for every railway to be planned in order to discover the cheapest, and draw various force diagrams for every bridge to be built in order that no material is wasted and only that which is essential is used…. From the viewpoint of a national economy, it is the American who treads the right path; he uses no more than is absolutely necessary, and preferably a little less, the structure will probably just hold……' [Culmann, 1866, pp. 527-528] [13]

Culmann's method experienced unexpected popularity with engineers designing statically determinate trusses and frameworks. However his method was less suitable to analyse statically indeterminate systems as was commonly encountered. This was followed by Kurrer's third stage which was the development of elements of elastic theory into linear elastic theory of trusses by James Clerk Maxwell, Winkler, Möhr, Castigliano, and Müller-Breslau. Taking the theorems of Castigliano and Maxwell's frame theory as his starting point, Müller-Breslau worked out a consistent theory of statically indeterminate frames which later became the force method of structural analysis, to solve the forces and required member sizes in statically indeterminate trusses.[14] The economies afforded by lattice girders and trusses in relation to arch and plate iron structures were being explored in the middle of the 19th century, by which time mass production of rolled wrought iron sections had begun. The design of the truss,

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12 Kurrer, *The History of Structural Engineering,* pp.318-325.
13 Culmann cited in Kurrer, *The History of Structural Engineering*, p.92.
14 Kurrer, *The History of the Theory of Structures*, pp.348-351.

both timber and iron, thus provided the impetus for the development of analytical and graphical methods of structural analysis.[15]

In Britain, Henry Moseley (1801-1872), who had studied in France, influenced the renowned British pioneers of railway construction, Robert Stephenson, Isambard Kingdom Brunel, John Fowler and Joseph Locke, the result of using advanced scientific principles and experimental techniques as well as ingenuity of construction. Prof Moseley[16] was a pioneer of engineering training along with Professors Pole, Rankine, Maxwell, Willis and Hodgkinson, teaching Navier's methods in his book '*The Mechanical Principles of Engineering & Architecture, 1843*' which was used on the structural design of many noteworthy British bridges and roofs of large buildings such as railway stations.

The need to separate military engineering from that category which dealt with all non-military engineering projects, spawned the discipline of civil engineering. At the time the civil engineering profession tended to prefer the pupillage (or articled) route, possibly because the pupil had to pay for the privilege. However in 1827 the founders of the University College London appointed a professor of civil engineering, John Millington to teach civil engineering. The Royal Polytechnic Institution was founded in 1838, the private College of Civil Engineers in Putney in 1839, and at the University of Glasgow where the first chair of civil engineering was made in 1840, where Prof W.J.M.Rankine held sway, while King's College and Cambridge University were some of the first institutions to confer degrees in civil engineering.[17]

THE BRITISH INDUSTRIAL REVOLUTION

The Industrial Revolution heralded one of the most celebrated events in human history. It was a period between about 1760 and 1830 when a fundamentally technological revolution evolved through economic expansion. A period during which predominantly agrarian, rural societies in Britain and Europe became industrialised and urbanised. While many historians have contributed to the discourse from many different perspectives, Allen has taken a different approach and emphasised the importance of economic incentives as a cause of the Industrial Revolution. The key to Allen's interpretation of the Industrial Revolution was that Britain had a unique wage and price

[15] Charlton, '*A History of Theory of Structures in the Nineteenth Century',* pp.2-3.
[16] Rev Prof Henry Moseley MA, FRS, Professor of Natural Philosophy and Astronomy at Kings College, London
[17] *Engineering History & Heritage*, Proceedings of the Institution of Civil Engineers, ICE Virtual Library

structure which was as a result of their success in international trade that owed much to mercantile activity and imperial colonisation.[18]

Two views of the British Industrial Revolution in the literature are the traditional description of the broad change in the British economy and society[19] which has been challenged by those who interpret the Industrial Revolution as a much narrower phenomenon as a result of technical innovation in only a few limited industries, being cotton and iron, the others being much less developed.[20] Termin applied these two viewpoints to the Ricardian model by analysing both export and import data during the mid-19th century. His conclusion confirmed the traditional belief that the Industrial Revolution saw changes in more than just a few limited industries.[21]

Eighteenth century Britain, where the price of capital and energy was extremely low, had a relatively high wage and price structure in comparison with the rest of industrialised Europe. This price and wage structure affected the demand for technology by giving British businesses a large incentive to invent technology that substituted capital and energy for labour, and was the pivot around which the Industrial Revolution swung. Britain's unusual wages and prices were due to two factors. The first was their success in the global economy, in part due to the state policy of free enterprise, while the second was geological; Britain had large and easily worked, cheap, coal deposits. Cheap coal contributed to the demand for energy-using technology. Energy was an important input in the production of iron and bricks, while cheap energy contributed to the fall in capital prices relative to wages, thus contributing to the incentive to substitute capital for labour. The growth of London with its almost insatiable demand for energy was the catalyst for the replacement of firewood and charcoal for coal for heating. An abundance of cheap coal kept businesses profitable in the high- wage economy.[22]

Innovation and inventions of a particular device or machine was directed at economising the operation which had become expensive, a labour saving invention. Inventors spent money to develop ideas when they believed the inventions would be useful and the return in royalties from a successful patent would make their efforts worthwhile. The second stage of invention was R&D (research and development), the effort needed to

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18 R.C.Allen, *The British Industrial Revolution in Global Perspective*, (Cambridge University Press, 2009), pp.26-56, 80-105 .

19 T.S.Ashton*, The Industrial Revolution*, 1760-1830, (Oxford University Press, 1948), pp.164.

20 N.F.R.Crafts, C.K.Harley, 'Output Growth in the IR: A restatement of the Craft-Harley View', *The Economic History Review,* 45, 4, (1992), pp.703-730.

21 P.Termin*,* 'Two Views of the Industrial Revolution', *Journal of Economic History*, 57, 1, (1997), pp.63-67,80.

22 R.C.Allen, 'Why the industrial revolution was British: commerce, induced invention, and the scientific revolution', *The Economic History Review*, 64, 2, (2001), pp.364-366.

turn a concept into a new product or process. At first British inventions while labour saving, consumed large quantities of energy and capital.[23]

Much of the technology of the Industrial Revolution depended on coal. This included metallurgical applications such as using coke to smelt iron and puddling to refine it from cast iron to wrought iron. Then the steam engine was invented, developed and applied to numerous applications. Newcomen's steam engine used enormous amounts of coal, however, since it was used to pump water out of coal mines, the coal was effectively free. Hence coal-using technology was profitable to invent in Britain but not elsewhere in Europe. The other famous inventions of the Industrial Revolution were the machines to spin cotton. Kay's 'flying shuttle', Hargreaves 'spinning jenny', Crompton's 'spinning mule', Cartwright's 'power loom' and Arkwright's 'water frame' were far-reaching since they inaugurated factory production. The process of technological improvement meant that the various inventions became more efficient, more cost-effective and more attractive to be purchased by firms from Europe and America.[24]

Newcomen's steam engine of 1712 proved that steam could be a practical and an effective source of power and by the 1770s there were hundreds of them pumping water out of mines all over the country. These large, slow and underpowered engines were inefficient and notoriously temperamental and were hardly improved until James Watt completely transformed the steam engine. Watt's vital innovation was to introduce a separate condenser so that steam could be condensed outside the working cylinder and remain above 100ºC, thereby saving huge amounts of heat. Furthermore he made double acting machines, letting steam into both ends of the cylinder in addition he converted the to-and-fro motion into rotational motion, thus revolutionising steam engines.[25]

By the middle of the 18th century, the need for improvements in transport was widely recognised in Britain. Land transport had always existed however, during the 18th century roads were often so bad that wagons could not be used and goods were carried on the backs of horses and mules. Limited river navigations were possible using flat bottomed boats. The exorbitant cost of packhorse transport eventually led to the first engineered canal, the Duke of Bridgewater's canal in 1759. James Brindley built the first canal to take a line across country, independent of a natural watercourse, from the Duke's coal mine at Worsley to Manchester over a distance of ten miles. This project

23 Allen, *Why the industrial revolution was British,* p.368.
24 Allen, *Why the industrial revolution was British,* p.373.
25 A.Hart-Davis(ed), *The Engineers*, (London: Dorling Kindersley Publishers, 2012), p.110-111.

provided the impetus behind British canal construction and the 'Canal Mania' era. A feature of the canal building was its relatively short-lived duration which fell into three periods. The first period ended in 1778 when twenty two major waterways were started. The second period also known as the 'Canal Mania' lasted for less than a decade, during which a further fifty two ventures were authorised. The final period followed the collapse of the 'Mania' from 1797 to the end of canal construction in 1840, during which time the last twenty six canals were completed. The skilled workmen who dug the canal navigations were called 'cutters' of 'bankers', the unskilled being labourers. The word 'navigator' had two meanings 'canal boatman' or 'canal cutter', later shortened to 'navvy'.[26]

The construction of dozens of canals required the constructions of many more single span bridges. The vast majority of these arch bridges across canals were made of dressed sandstone. Later the bridges were built of burnt clay bricks, a much cheaper alternative requiring bricklayers instead of expensive stone quarrying and skilled stone masons. The canal engineers also designed the bridges, with Brindley, John Rennie, Robert Mylne, John Smeaton, William Jessop and Thomas Telford the most renowned. Their designs were based on old proven ratios and proportions of the various arch, pier and abutment components. As the canal engineers became more adventurous and expansive with the extent of their projects, tunnels through hillsides and large multi-arch aqueducts across valleys were completed.[27] Cast iron and wrought iron bridges were eventually introduced in many forms and shapes. In order to avoid crossing a canal with an arch bridge, without the need for large and massive abutment foundations at each end, led to the introduction of tied-arch bridges. This arch bridge variant, made of iron, restrains and overcomes the outward-directed horizontal forces of the arch by introducing a tension tie-rod as the bottom chord. A further improvement was the bowstring arch bridge, similar in appearance to a tied-arch that behaved like a truss, with substantial vertical and diagonal-cross members between the curved top chord and the horizontal bottom chord. These two types of bridge only placed vertical loads on its two end supports, with no horizontal thrusts.[28] From about 1820 dozens of bowstring bridges began to appear across the British landscape, becoming more popular with the introduction of the railways.[29]

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[26] C.Hadfield, *British Canals*, (Stroud: Sutton Publishers, 8ed,1994), pp.83-91.
[27] T.Ruddock, *Arch Bridges and their Builders 1735-1835*, (Cambridge University Press, 1979), pp.80-84.
[28] The bridge on the R72 road across the Kowie River at Port Alfred, is an example of a bowstring arch bridge.
[29] J.G.James, 'The Evolution of Iron Bridge Trusses to 1850', *Trans of Newcomen Society*, 52, (1980) p.67-74.

In 1804 Richard Trevithick mounted a steam engine on a carriage to create the first steam locomotive. George Stephenson and his son Robert initiated the railway age with the Stockton and Darlington railway in 1825 and the Liverpool and Manchester Railway five years later. The Rainhill locomotive trials of 1829 resulted in Robert Stephenson's 'Rocket' being the winner over four other locomotives and setting the steam locomotive firmly on the path of commercial success.[30]

From 1830 British railways and locomotives entered a period of intense growth when there were only 98 miles of railway track. By 1840 there were 1,500 miles and by 1849 Britain had a network of 6,000 miles linking all of its major cities. By 1850 about 36% of the country's GDP (gross domestic product) had been poured into railway development. The railway age was dominated by several promoters who instituted the complicated process of financing, obtaining parliamentary approval, building and operating hundreds of miles of railway lines. Railway shares experienced extreme volatility, marked by the 'Railway Mania' of the mid-1840s. Share prices in railway enterprises peaked in 1845 and the market crashed in 1849. At its peak there were 272 Acts of Parliament for new lines. Several dozen bridges had to be built while the most infamous was the bridge over the river Dee at Chester that collapsed in 1847 causing considerable concern over the design and construction of bridges. The basic cause was the failure of the cast iron members when in tension. The Britannia Bridge completed in 1849 was another Robert Stephenson wrought iron bridge that proved to be most successful.[31]

THE ENGINEERING PROFESSION

The engineering profession as a whole has received limited attention from historians, in spite of engineer's special skills and numerous achievements. The trend has been to only consider the development of engineering as a series of biographies of the great engineers with their subjects chosen almost exclusively from those engineers who flourished between the mid-eighteen to mid-nineteenth centuries. Men such as Smeaton, Watt, Rennie, Telford, the Stephensons and the Brunels, the folk heroes of the Victorian age. Behind the great engineers were hundreds of little known men, who have contributed much more to the profession as a whole than the handful of outstanding, well known personalities.[32]

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30 Hart-Davis(ed), *The Engineers*, pp.110, 122, 128,192.
31 H.G.Lewin, *The Railway Mania and its aftermath,1845-1852,* (Exeter: David & Charles, 1968), pp.26, 75.
32 R.A.Buchanan, *The Engineers, a History of the Engineering Profession in Britain 1750-1914*, (London: Kingsley Publishers, 1989), pp.11-12.

The civil engineering profession in Britain developed very differently from its counterpart in France. In Britain there were only formal systems for educating and training military engineers, such as the Royal Engineers, while similar systems for civil engineers were only established from the mid-19th century. The first French technical school devoted to military and civil engineering and building construction was founded in 1671 and was followed by several military engineering schools. The most famous 'bridge' school was the *école des ponts et chaussées* founded in 1747. While these schools educated and trained military and civilian men, they created an even more valuable asset; the body of knowledge that came to be called civil engineering.[33] The word 'engineer' was originally used in the context of medieval warfare, dating back to the 1300s when an 'engineer' (*Latin, ingeniator*) was referred to as 'a constructor of military engines'. Here an engine referred to a mechanical contraption used in ancient warfare, such as the catapult, counter weight *trebuchet*, *ballista* and *scorpio* crossbows, *mangonel,* battering ram, siege tower, and of course preparing defensive fortifications or undermining those of the enemy (hence, they became known as sappers[34]). The term civil engineering derived from the word 'civilian' and the need to separate between military and non-military engineering fields, with the construction of roads, bridges, tunnels, canals, waterways, land drainage, dams, harbours and roofs of large buildings.

The English civil engineer John Smeaton is generally regarded as the father of civil engineering for establishing the idea of civil engineering as a profession. His Eddystone lighthouse made his reputation while his efforts in consolidating the engineering community with the Society of Civil Engineers in 1771 was the forerunner to the founding of the Institution of Civil Engineers in 1818. The exclusive nature of the Society was the main reason for the establishment of the rival Institution which was more open in its representation especially among younger engineers. British canal engineering, as a 'founder-member' of the discipline of civil engineering, embodied the elementary nature of canal construction, which comprised of the fundamental ability to build a level, watertight ditch, a skill that had been acquired and practiced over many generations of surveying and levelling for land drainage schemes and other water control works. British canal engineering used simple techniques that called for an unprecedented degree of engineering organisation which did more than any other innovation to create the British

[33] W.Addis, *Building: 3000 Years of Design Engineering and Construction*, (London: Phaidon Press, 2007), pp.219-220.

[34] Sapper**,** is derived from the French word *sappe* ("spadework" or "trench") and became connected with military engineering during the 17th century, when attackers tunnelled under walls of besieged fortifications, collapsed the tunnels, thus undermining the walls. These trenches and tunnels were called "saps," and their diggers came to be called "sappers."

engineering profession.[35] The Institution was founded on the premise that there was a deplorable lack of professional education for civil engineers and of contact between other engineers. The would-be engineer was characterised as a 'mediator between the philosopher and the working 'mechanic' and the need of such a professional man to belong to an institution which would enable him to increase his knowledge. At the time young men were 'articled' to older experienced engineers for about four years to act as their assistants (or apprentices) before venturing out on their own. Traditionally the professions of the day were the skills of medicine, law and theology which had been learnt at the medieval universities. The engineering profession thus became a late addition to the group with the establishment of the Institution of Civil Engineers in 1818.[36]

The mid-nineteenth century heralded a period when the construction industry underwent fundamental changes with the design and erection of iron structures. The introduction of new materials and the need for new building systems, influenced the way designers went about their work, which led to increased specialisation and the proliferation of professional organisations to serve their member's interests. A further area of activity was the attempt to apply principles of scientific investigation to the design of structures and to explain and predict their performance. Frequently many of the first technical books were criticised for being too theoretical in content and did not cater for the 'practical man'. Several authors did publish works of a practical nature and were enthusiastically received. A second group of books contained design aids and worked examples in which a readership with limited mathematical abilities could simply copy. Then there were manufacturer's handbooks containing safe load tables and section characteristics. The fourth type of publication was the engineer's pocket books with several going through a large number of editions followed by the technical journals appearing weekly and monthly.[37] Design techniques based on draughtsmanship skills such as graphical statics were enthusiastically employed by many in preference to mathematically based design techniques. As steel overtook wrought iron, stresses in individual members needed to be determined to ensure the economical use of this expensive new material. Foreign engineers were amazed at the lack of English scientific designs, as famous French engineer, Gustav Eiffel mentioned in 1888: '…the English engineers have almost bypassed calculations, and they fix dimensions of their members

[35] Buchanan, *The Engineers, a History of the Engineering Profession in Britain*, pp.50-53.
[36] Buchanan, *The Engineers, a History of the Engineering Profession in Britain*, pp.61-62.
[37] S.Smith, 'The design of structural ironwork 1850-1890: education, theory and practice', *Construction History*, 8, (1992), pp.89-97.

by trial and error, and by experiment….and small scale models…..'[38] At the time the terms science, technology, and theory had limited significance among the construction professions in the United Kingdom where the 'practical man' held sway. The craft approach to design dominated the education of the majority of the design professions where respect for practical experience and tradition were of prime importance.[39] The design of structures based on precedent was slowly overtaken by the need to design them using scientific and mathematical methods when confronted by the following significant evolving situations: the use of new materials whose properties were poorly understood at the time, such as cast iron, wrought iron and steel; the ever-increasing spans of bridges and roofs of wider buildings; the imposition of heavier loads such as locomotives on bridges; the increasing significance of wind loads on ever-slender bridges; and the need for lighter or more economical structures. The parallel developments that were probably the two most important subjects in the history of engineering design were the use by designers of graphical statics and the concept of the factor of safety. The early use of the factor of safety was the multiple by which the maximum load on a bridge could be exceeded without causing collapse, and was typically between 4 and 6. Safety factors had its origin in the practice of proof-testing of iron sections, to allay the fears of the bridge owners. In 1840 Prof Rankine formalised the modern concept of the safety factor, as a means of being able, when designing structures, to make use of mathematical models of loads, materials and different configurations of structures that were known to be imperfect representations of the real world. Using safety factors meant that design engineers could use the idealised theory with confidence in their design of new structures.[40] Fairbairn argued that the ultimate strength of bridges should be six times the heaviest imposed loads after deducting half of the weight of the structure. It was as a result of badly designed and constructed weak bridges that the Board of Trade decided that in wrought iron bridges the stress with the heaviest load should not exceed 5 tons per square inch (77.2 MPa).[41]

In the British Empire engineers were important emissaries as more colonies were developed, requiring all kinds of infrastructural development. These engineers travelled in wider geographical circles and in the process left an enduring mark across the globe as the demand for their services continued. While these engineers were mostly

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38 G.Eiffel, *Les Grandes Constructions Metalique,* (Paris: 1888), pp.10-11.

39 Smith, 'The design of structural ironwork 1850-1890: education, theory and practice', pp.102-104.

40 W.Addis, 'The evolution of structural engineering design procedures: a history of that skill called design', *Transactions of the Newcomen Society*, 61, (1989-90), pp.51-62.

41 W.Fairbairn, 'Experiments to determine the effects of impact, vibratory action, and a long-continued change of load on wrought iron girders', *Phil. Trans. Royal Society, London*, 154, (1864), pp. 311-325.

engaged in construction, their designs, drawings and specifications were mostly carried out by several firms of London-based consulting engineers. Operating from offices in Westminster, this powerful segment of the engineering profession generated their income from planning and designing large infrastructural projects overseas and was most active in the parts of the world where Britain's imperial power was predominant.[42]

An enormous project closer to home, namely the construction of the Thames River embankment of 1862 did much to highlight and promote the engineering profession and provide impetus to its status. The Thames embankment project however, revealed a network of civil engineers and contractors operating on a combination of kinship and patronage dating back to the 18th century. The sheer size of the Thames embankment project engaged significant elements of the Victorian London construction industry, who were largely self-made entrepreneurs, while the engineers were part of a socially ambitious group of trained designers who had recently claimed the status of professionals. By mid-century there was a sizeable community of engineers established near Westminster. The Post Office London Trades Directory for 1866 lists about 500 mechanical engineers and 280 civil engineers, of which not all were consultants or Institution of Civil Engineers (ICE) members. One group of engineers operated near Adelphi Terrace and a much larger group occupied offices in Great George Street, along with several architects, surveyors, construction solicitors and parliamentary agents. The ICE headquarters was also located in Great George Street, a short walk away from the Houses of Parliament, Whitehall and Downing Street. A common retort from unsuccessful and disgruntled tenderers of Thames embankment schemes referred to the "Great George Street Clique", as a monopolistic network.[43]

While most engineers were employed by government or private companies, consulting engineers were 'independent professionals'. They were designers rather than builders who received fees for their services. Consultants were appointed by promoters of engineering projects to carry out terrain surveys, prepare designs and construction drawings, compile bills of quantities, estimate costs, compile specifications and contract documents, invite tenders and adjudicate bids, recommend appointments of contractors, inspect completed fabricated bridges at workshops, carry out load and deflection tests on completed bridges and supervise the construction process, normally

[42] C.Andersen, *British Engineers and Africa 1875-1914*, (Abingdon: Routledge, Taylor Francis, 2015), pp.1,3.
[43] D.H.Porter and G.C.Clifton, 'Patronage, Professional Values, and Victorian Public Works: Engineering and Contracting the Thames Embankment, *Victorian Studies*, 31, 3, (1988), pp.319,326,333.

by resident engineers at the various construction sites. The consultant was independent of the contractor and whose loyalty was irrevocably with his client.[44]

Civil Engineers first congregated in Westminster in the 1830s to be close to Parliament. The reason was the domestic railway system. Proposed railway lines had to be approved by special parliamentary committees and Acts of Parliament before any construction could commence. Civil engineers were required to make the initial surveys of proposed railway lines and prepare plans and cost estimates that could pass through the obstacles posed by the prevailing political system. The engineer's offices needed to be close to Parliament and the Railways Department of the Board of Trade who enforced the Railway Regulation Act of 1840, and whose offices were in Whitehall Gardens close to the Colonial Office, another potential client for overseas commissions. Many engineers became experts in manoeuvring and lobbying through the system of policy making in Westminster, it required skill, experience and presence. Consultants such as Fowler, Hawkshaw, Fox, Shelford, Coode, Brunlees, Rendel, Baker, Wolfe-Barry, Berkley, and many others had addresses in Westminster. The completion of the British railway system in 1860 simply made way for the opening up of Africa and other Crown Colonies for imperial engineering projects. Westminster had unrivalled formal and informal avenues that aided the sharing of information regarding new projects and important news involving politics and finance. Westminster also contained the venues for social and professional engagements, facilitating the informal contacts between engineers and influential persons with imperial interests in the gentleman's clubs. Clubs were immensely popular in late-Victorian London. The most popular club among engineers was the Athenaeum Club in Pall Mall, which was only one of dozens.[45]

With time the ties and connections of Westminster consulting engineers resulted in them being hired by the imperial and colonial institutions such as the various Crown Colonies, Agents General of several self-governing colonies, the War office, Foreign and Colonial Offices and the Crown Agents. Consulting engineer George Berkley's African[46] connections were established through the Office of the Crown Agents for the

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44 Andersen, *British Engineers and Africa 1875-1914*, pp. 57-59.

45 Andersen, *British Engineers and Africa 1875-1914*, pp. 38-42.

46 Sir George Berkley KCMB (1821-1893) served his apprenticeship with the ship-builders Samuda Brothers and in 1840 was employed by Robert Stephenson at 24 Great George Street where he was involved in all aspects of railway and locomotive design. In 1849 he went out on his own, designing many railway lines, stations and bridges for the rest of his career. In 1859 he succeeded Robert Stephenson as consulting engineer to the Great Indian Peninsula Railway Company and several others in India and Britain. In 1874 he became one of the consulting engineers to the Colonies, for railways in Natal and several viaducts in the Cape Colony. He designed most of the bridges in the Eastern Cape. He was President of the ICE during 1891-92 and was knighted in 1893. Source: Obituary, Institution of Civil Engineers,

Colonies, an essential component in the administration of engineering projects in British Crown Colonies. From their headquarters in Millbank in Westminster the Crown Agents organised the supply and transport of manufactured goods to the Crown Colonies, supervised the expenditure of capital, issued loans and performed a multitude of other tasks. The Crown Agents were the crucial link in a trilateral relationship between the Colonial Office, the Crown Colony authorities and the suppliers of goods and services for the colonies.[47] The appointment of consulting engineers by the Crown Agents for various infrastructural projects was the commissions most sought after by the consulting engineers. Sunderland[48] has argued that in order to ensure high-quality services the Crown Agents chose top consulting engineers for whom the cost of poor performance of their duties would be high, leading to the loss of their commercially valuable status. While working for the Crown Agents ensured lucrative fees for their services, the over-riding incentive was of long term commitments. The Crown Agents favoured expensive well-established Westminster firms from the top layers of the profession and were thus important clients to a number of the inner circle of the Great George Street 'Clique'. At least 14 of the 30 engineers who served as presidents of the ICE between 1889 and 1914 carried out work for the Crown Agents in the course of their careers, which indicates the close collaboration between the Great George Street 'Clique' and the Crown Agents.[49]

LATTICE GIRDER BRIDGES

As the vast majority of the investigated wagon bridges in this thesis are lattice girder type trusses of single, double or multiple, both deck and through spans, this study has concentrated on the method of design of lattice girder trusses. The interest in parallel-chord iron truss design in the 1840s manifested itself with the various arrangements of members connecting the top and bottom chords, the sections of the chords themselves, methods of jointing such as pinning or riveting, and the growing acknowledgement of the need for uncomplicated theoretical principles and acceptable calculation methods.[50]

The familiar parallel chord truss bridges of today seemed less obvious to the early 19th century engineers, who had to battle with timber trusses that sagged with age, unless given supplementary arches for support. The lattice girder was an early refinement when only small sections of wrought iron bars became available from manufactured

47 See Chapter 6, the Crown Agents.
48 Suntherland, *Managing the British Empire,* pp. 57-62, 110-116.
49 Andersen, *British Engineers and Africa 1875-1914*, pp.77-79.
50 J.G.James, 'The Evolution of Iron Bridge Trusses to 1850', *Trans of Newcomen Society*, 52, (1980) p.78.

stock. These bars could be easily transported, cut and riveted on site to form large webs between the top and bottom chords of the girder. As a greater variety of larger iron sections became available, and methods of structural analysis became more widespread, the lattice girder bridges became larger, so that by 1850 iron lattice girder bridges with spans of up to 100ft were so common as to be ignored in the technical literature.[51]

The first commercially successful lattice-bridge builder was Ithiel Town (1784-1844) whose 1820 patented all-timber lattice truss was commonly used for covered bridges in America. The timber lattice was composed of two oppositely sloped, dense layers of diagonal planks contained between two top and bottom parallel chords. In his original description, Town proposed spans of 120 to 160 ft made of wooden planks 10 to 11 in wide by 3 to 3½ in thick set at 45º to form relatively open lattices with a span to depth ratio of 10:1. The diagonals of Town's timber lattices were wide and spaced close enough together so that the resulting structure could rationally be calculated as if it were a solid girder. Town's carpenter licensees gradually improved the system and by 1831, he could list twenty bridges made under his patent. As the system was adopted by railway companies, the diagonal lattices were placed much closer together, commonly coupled in pairs and provided with adequate longitudinal deck-stringers, all incorporated in his second patent of 1835.[52]

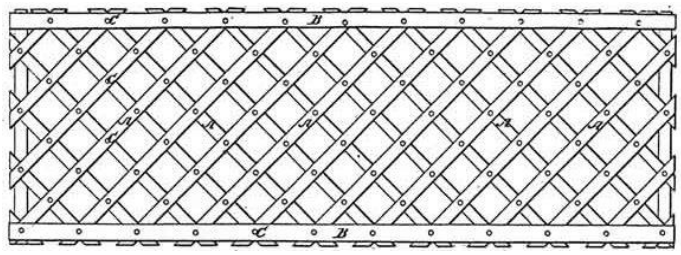

Fig 19: Ithiel Town, Timber Lattice Girder, Patent No. 3169, 1820

Town never considered building in iron because timber was cheap, while the first true iron lattice bridge finally appeared in Ireland in the 1840s when John MacNeill converted to the iron 'lattice beam' instead of timber for the Irish railways. Initially the iron lattice trusses were simply iron adaptations of the timber lattice configuration. Early 19th century engineers did not have the ability to analyse a lattice configuration.[53]

51 James, 'The Evolution of Iron Bridge Trusses to 1850', pp.78-82.
52 James, 'The Evolution of Iron Bridge Trusses to 1850', p.78.
53 D.Guise, 'Lattice Configurations', *Structure Magazine, ASCE,* (Aug 2011) p.24

The terms lattice and multi-Warren have been used interchangeably. Double and triple intersecting configurations are more commonly referred to as double and triple intersecting Warren trusses, while quadruple and greater intersecting configurations are interchangeably referred to either as lattice trusses or multi-Warrens. The quadruple-Warren was the 'lattice' through-truss configuration used at Carlisle, Committees and Berg River Bridges. Engineers viewed lattice trusses as a composite group of separate overlapping Warren trusses, and analysed each overlapping arrangement as a separate triangular bracing system. Thus a quadruple-Warren would be treated as four separate trusses.

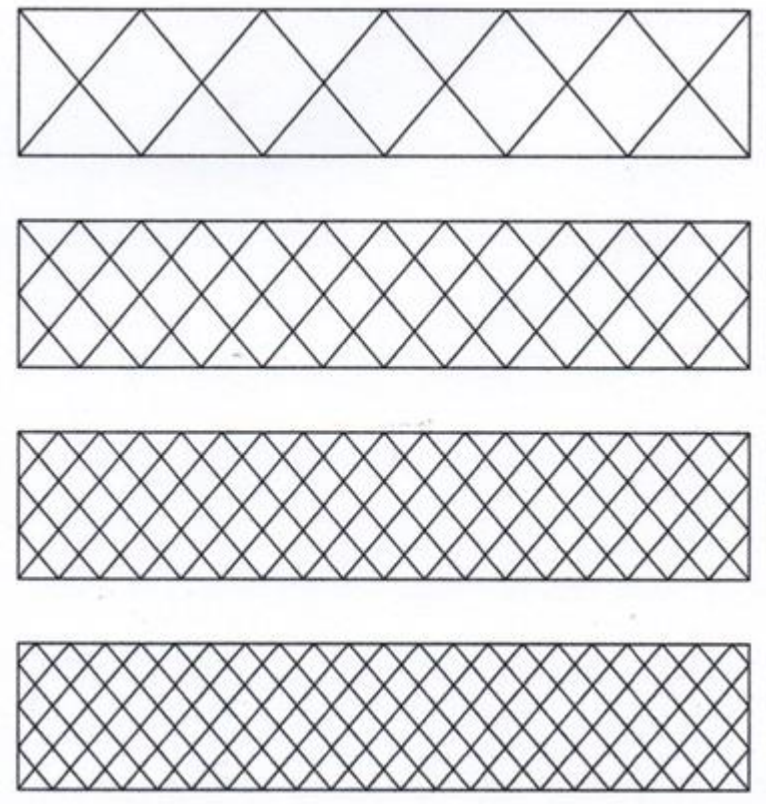

Fig 20: Lattice Girder Configurations

A moving load causes each of the individual triangular web systems to work in successive order, with the contiguous members of each individual Warren system alternatively resisting tensile and compressive stresses. Since the diagonals in the web were actually connected to each other at their intersections, an accurate calculation of the stresses in any individual web member was beyond the capacity of the engineers that built them at the time. However, the overall simplified solution erred slightly on the conservative side.[54]

[54] D.Guise, 'The American Metal Lattice-Truss Bridge', *Structure Magazine, ASCE*, (Oct 2011) pp.30-31

Fig 21: Committees Drift Bridge, the lattice has 8 triangulations

Some engineers derided the redundancy of the lattice configurations while others found it comforting that if a derailed train dislodged a web member of the truss, the redundancy could prevent the bridge from failing. Additionally the tensile diagonals were also capable of absorbing some compressive stress by default, because the fixing of the diagonals at their crossing points with the compression diagonals subdividing their lengths into shorter segments. Each resulting shortened section was then less subject to buckling.[55]

Lattice girder trusses are statically indeterminate structures because imposed loads are carried through multiple paths in the structure and the member forces cannot be calculated from equations of equilibrium alone. Accurate analysis of indeterminate structures requires a study of deformations and the solution of a system of simultaneous equations which were not able to be solved for 19th century bridge designers.[56] By the early 20th century engineering textbooks included analysis methods for indeterminate structures, including trusses, continuous beams and suspension bridges. Today the structural analysis of indeterminate structures is easily performed using the finite element method (FEM). Text books at the time normally presented a design method for a simple double-intersection Warren truss as the lattice girder, such as for most of the lattice girder bridges studied in this thesis.[57]

The double diagonal intersection lattice truss is structurally indeterminate while each of the component trusses are structurally determinate. 19th century bridge engineering text books recommend designing multiple intersection Warren trusses by analysing each statically determinate component truss independently considering only the loads which

[55] Guise, 'The American Metal Lattice-Truss Bridge', p.31
[56] T.Cargill, 'On the Construction of Wrought Iron Lattice Girders', *Jnl. Franklin Inst,* 46, (1863), pp. 3-11, 82-90.
[57] W.H.Warren, *Engineering Construction in Steel and Timber,* (London: Longmans, 1894), pp. 178-182.

are applied to it.[58] The forces in the diagonals are obtained directly from each of the statically determinate analyses and the forces in the chords and end posts shared by all component trusses, are the sum of the forces from the individual analyses. Analysing this method of the lattice girder truss reveals that this approximate method is reasonably accurate when compared to a modern FEM analysis. The approximate method underestimates the forces in some of the members by 10% a difference well within acceptable limits for 19th century design, while some of the other methods overestimate the forces by 15%, resulting in some inefficiency, but providing a conservative design, a factor of safety.[59]

During the last quarter of the 19th century the Cape Colony experienced fluctuating bridge building activity due to prevailing economic conditions, both for wagons and for railways. In the course of consolidating the basic network of roads across the colony driven by increased commercial and transportation activity, the same type of bridge was chosen in most cases, namely the lattice girder bridge. Figure 22 shows an original construction drawing by Henry Wakefield of the Buffalo River Bridge, a typical triangular lattice girder, trellis girder or double Warren girder configuration.[60]

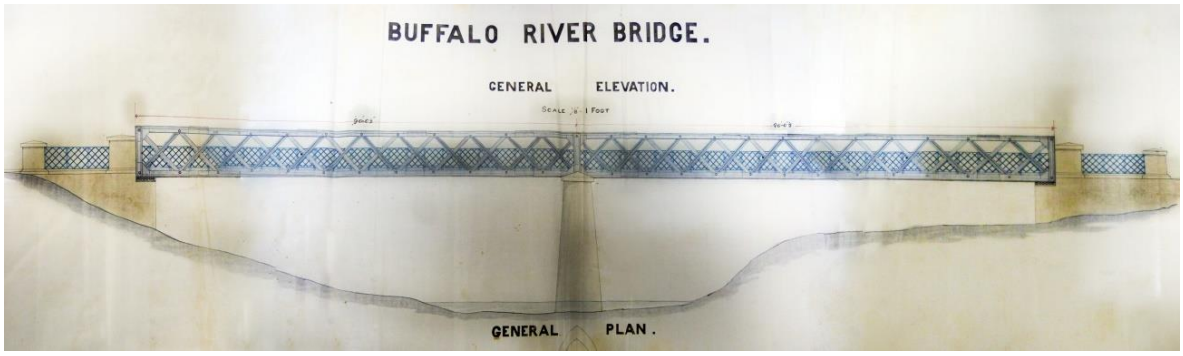

Fig 22: Buffalo River Bridge, King William's Town 1873

During the second half of the 19th century the iron lattice girder became the dominant bridge type for both railways and roads in Britain and its colonies. In America the Howe, Warren, Whipple, Fink, Bollman, Baltimore and Pratt trusses dominated the vast landscape. The popular use of iron lattice girders led to a plethora of technical information, both practical for the 'practical man' and theoretical for the bridge designers. When properly designed and constructed they proved to be superior to other configurations over a wide range of spans of 60ft to 300ft. The main advantages of the

58 W.J.M.Rankine*, A Manual of Applied Mechanics*, (London: Griffiths & Co, 1856), pp. 160-161.
59 S.G.Buonopane, J.M.Spivey, D.A.Gasparini, 'Engineering Analysis as a historical documentation tool: recent work of the Historic American Engineering Record', *1st Internat Congress of Construction History*, (Madrid, 2003)
60 See chapters 8 and 9 for a detailed description

lattice girder were the saving in weight and its increased stiffness.[61] The open 'web' system enabled the sizes of the lattice sections to be altered to suit changes in the applied shear forces, which provided significant savings in web material compared with a large plate girder. At the time material costs were much less than fabrication costs. The smaller sized flanges or chords of the lattice girder further reduced material quantities. Section stiffness and stability was achieved when channel sections were used for web bars under compression, riveted at their intersections with flat bar tension sections. Apart from the basic classification of bridges as beam, arch or suspension, they were also classified according to where the bridge deck was situated.[62] All the Eastern Cape bridges were 'through' bridges with their decks on the same level as the lowest chord which allowed overhead cross-bracing of the top flanges / chords. All four of the Orange River bridges were 'deck' bridges as their decks were level with the top flange / chord of the bridges.[63]

Due to its popularity the lattice girder bridge evolved into several configurations of which the most common form was the double-lattice web with multiple triangulations. A double-lattice web has two sets of parallel web bars joined by Warren diagonal bars connected to the top and bottom flanges / chords. All Eastern Cape bridges had this configuration with the exception of Committees Drift and Carlisle Bridges.

Multiple-triangulations, as alluded to above, refers to the number of separate Warren trusses within the pattern of intersecting lattice bars. Fig 20 shows the most common patterns and number of triangulations, with two being the most common variety in our study. Without tracing the separate Warren trusses, the number of triangulations can be determined in two ways: (a) count the number of 'diamonds' and parts thereof in any vertical section and multiply by two, or (b) take any lattice bar diagonal, count the number of intersections and then add one.[64]

Technical publications of the time provided a number of methods for the analysis of lattice girders. There were basically two methods, the use of beam theory and the use of truss theory. In the former the lattice girder was visualised as a beam with an open rather than a solid web. Elementary statics of beams is then applied to calculate bending moments, M, and shear forces, S, at sections midway between the load joints.

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61 Stiffness is the rigidity of an iron section — the extent to which it resists deformation in response to an applied load or force. The complementary concept is flexibility; the more flexible a section is the less stiff it is.

62 R.E.Best, and D.J.Fraser, *Lattice Girder Bridges in New South Wales*, (Brisbane: Conference of Protection of the Engineering Heritage, 1982), pp. 85-92.

63 See Chapters 8 and 9 for comprehensive details of theses bridges

64 Best and Fraser, *Lattice Girder Bridges in New South Wales*, p. 86.

From the condition of internal equilibrium, compression C_f = tension T_f = M/D and C_w = T_w = S/(4sinθ) as shown in fig 23. Shear force and bending moment diagrams may also be used to achieve the same solution.

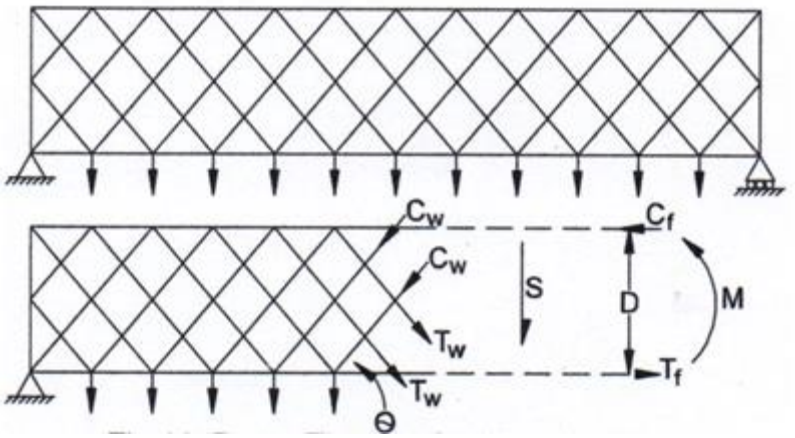

Fig 23: Beam Theory solution of Lattice Girders

In truss theory, the lattice girder is visualised as a series of overlapping Warren trusses, equal to the number of triangulations, as shown in fig 24. These trusses are analysed separately and the results added together. Various authors presented the truss theory in tables of various lattice configurations to simplify the calculation.[65]

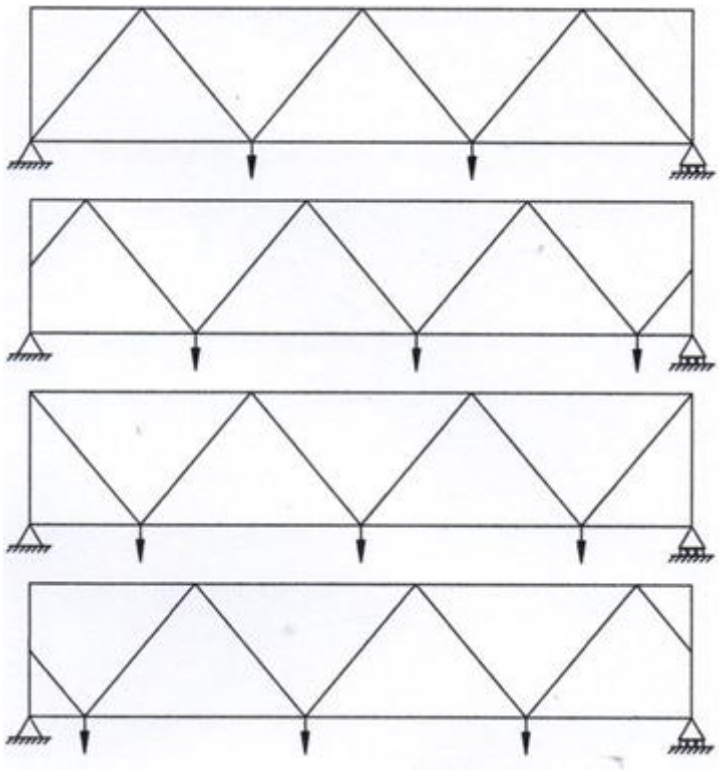

Fig 24: Beam Theory solution of Lattice Girders

[65] Best and Fraser, *Lattice Girder Bridges in New South Wales*, pp. 85-92.

CONCLUSION

This chapter outlined the development of the theory of structures as applied to the problems of structural analysis and the design of bridges. It has been shown how the structures of old, both building and bridges, were designed using complicated rules of ratio and proportion and were based on precedence, on similar existing structures. The works of Navier, the founder of the modern theory of structures and elasticity, were expanded upon by succeeding engineers from several countries. The Industrial Revolution which has been acknowledged to have been started in Britain, introduced the production of iron and its many applications to the rest of the world. Technical innovation became essential for the Industrial Revolution to continue to develop in Britain. It has been argued that the high wage – low energy cost placed Britain at the forefront of technological innovation.[66] In Britain the improved theory of structures was used to design the many railway bridges required by the advent of the 'railway mania' period. Iron lattice girder and truss bridges soon followed, being able to support the large loads of passing locomotives and carriages over ever larger spans of bridges.

Civil engineers and their profession have not received the recognition that they deserve by scholars who have mainly concentrated on other aspects of nineteenth century imperialism. Ever since they received recognition as a profession, engineers have spent millions of pounds of investment finance on hundreds of infrastructural projects throughout the world, leaving behind many impressive works for the convenience of the citizens of many countries. It has been shown how various circumstances led to many of the top consultants and their ancillary supporting professions relocating to Westminster, the political heart of London. It was imperative for them to be close to the corridors of political and imperial power, global news, finance and engineering innovation. The Westminster consulting engineers followed the growth of Britain's imperial expansion into wider geographical regions of the world. Africa soon had a great need for infrastructural development for which British engineers were soon to dominate by using their privileged position earned on previous successful ventures. The following chapter takes up this theme and outlines in detail the actual bridge projects that were successfully used to bridge the various Eastern Cape Rivers.

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[66] R.C.Allen, 'Why the industrial revolution was British: commerce, induced invention, and the scientific revolution', *The Economic History Review*, 64, 2, (2001), pp.364-366.

CHAPTER EIGHT – EASTERN CAPE BRIDGE CONSTRUCTION DURING THE PERIOD 1860-1899

The previous chapter detailed the development of Victorian British bridge building technology in order to show how this technology was later introduced to the Cape. These methods of design and fabrication of bridges evolved from the development of materials such as iron and steel. Britain, the 'workshop of the world', carved out the largest empire after the Industrial Revolution and the Napoleonic wars. This was partially achieved due to the advantage that Britain had accomplished due to its inventive superiority over its rivals gained during the Industrial Revolution. This chapter will outline the strides made by the local British colonial civil engineers as the Cape Colony expanded eastwards. Bridge building activity was briefly curtailed by a depression during the mid-1880s only to surge ahead as economic conditions improved along with the discoveries of diamonds and gold.

The following narrative will trace the construction history of the various stone masonry arch, iron lattice girder and timber bridges that were built across rivers of the Eastern Cape Colony. The primary sources of information used in this study have been the numerous monthly PWD progress reports and letters by the resident bridge engineers, clerks of works and district inspectors to the Chief Inspector of the Public Works Department and the annual reports by the Chief Inspector of the PWD to the Parliament of the Cape Colony, as found in the relevant annual 'Blue Books'.

As we have seen the Central Road Board which existed from 1843 to 1858 was dissolved with the passing of Act No. 9 of 1858. In its place three commissioners were appointed to carry out the duties of the board until 31 December 1859, after which responsibility for main roads fell under the colonial government and under the direct control of the Chief Inspector of Roads – the Colonial Civil Engineer and three assistant commissioners.[1] They immediately began to implement previous plans once the sanction of parliament had been obtained. During the Central Road Board's last years of operation the following major bridges in the eastern districts were under construction, the Rawson Bridge over the Zwartkops River, the Koonap River Bridge near Fort

[1] Act No.9-1858, '*To provide for the Management of the Public Roads of the Colony,* Statutes of the Cape of Good Hope, 1652-1886', (Cape Town: Vol. II, Richards & Son, 1887), pp.2535-2548.

Beaufort, the Carlisle Bridge at Espag's Drift over the Fish River, the Bushman's River Bridge, and the Sunday's River Bridge at Addo drift.[2]

The three road inspectors at the time were Andrew Geddes Bain (appointed 9th April 1846), Thomas Bain (appointed 1st January 1854) and C.L.Stretch (appointed August 1858). The chief inspector of roads who doubled as the colonial civil engineer, was the newly appointed John Scott-Tucker as the previous colonial civil engineer, George Pilkington had died on 3 July 1858. Scott-Tucker's three assistants were the deputy colonial engineer and deputy commissioner of roads Murrel Robinson, the first assistant colonial engineer and assistant commissioner of roads Matthew Woodifield and the second assistant colonial engineer and assistant commissioner of roads Woodford Pilkington.[3]

Road Inspector Andrew Geddes Bain in 1859 reported his views on the need to bridge various rivers.

> The object of bridging the various rivers crossing the main line of road has occupied the late board's attention, and the reports of the officers who were called upon to supply information will give the particulars. More immediate attention was directed to those rivers in the eastern districts, which from their particular nature, and by which communication is so impeded, if not entirely prevented, require more particular consideration.[4]

After making observations concerned with the construction of the bridges over the Koonap River and at Espag's Drift, he outlined the locations of proposed bridge sites as follows: the Tarka River, Baviaans River, Bushman's River, Sundays River, Zwartkops River, and Committay's Drift[5] on the Fish River. Robinson, in turn, reported that for the first time since assuming control from the Central Road Board, funds had been voted for bridge construction in the eastern districts of the Colony and as a result two important rivers had been bridged (over the Koonap and Zwartkops) and others commenced at Espag's Drift on the Fish River and over the Tarka River on the main road between Graham's Town and Cradock. He also maintained the urgent need for similar works over the Sunday's River at Tunbridges and Noorse Doorns including bridges over the Keiskamma River at Breakfast Vlei and over the Fish River at Cookhuis Drift, for which sums had been budgeted in the 1860 annual estimates. Matthew Woodifield had also

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2 G.18-'58 Report of the Colonial Civil Engineer for 1857
3 G.32-'60 Report of the Colonial Civil Engineer for 1859
4 Report on the Operations of the late Central Board of Commissioners for Public Roads for 1858, De Smidt to Rawson, 15 June 1859 in G.32-'60
5 Committays was the first English spelling, later refined to Committees, after the original Dutch, '*commetje's*', (saucer) to indicate the numerous shallow, circular 'saucer-like' depressions dotted over the landscape

selected the site of a future bridge over the Little Fish River at Somerset, in addition to selecting the site and surveying a section of the Great Fish River at Cookhuis Drift during April 1859.[6]

The release of funds meant that estimates were presented for bridges over the Sunday's River at Tunbridges, at Noorse Doorns and at Capper's Drift, over the Little Fish, and at Cookhuis and Committees Drift on the Fish River. The stone masonry of the bridges at Espag's Drift across the Great Fish and Tarka Rivers were proceeding satisfactorily under clerk of works Alexander Clarke and Colin Lawrence respectively, while a few other timber bridges were repaired. Progress was slow due to the delays in recruiting suitable immigrant artisans from Britain. The Colonial Engineer also submitted the drawings of no less than 30 new gaols throughout the colony in his report for 1860, involving more work for the bridge stone masons, who were often lured away from the bridge works to work on buildings and churches in towns.[7]

The controversial commissioner Scott-Tucker[8] was deputised by Murrel Robinson whose report for 1862 recorded the significant deterioration of five timber bridges in the western region which had only lasted for about ten years and needed to be replaced. Timber bridges have lower strengths and are susceptible to moisture movements and shrinkage on drying out when compared with iron. In addition, the jointing between members introduced points of weakness which would cause timber bridges to become 'rickety' with age. Due to severe budgetary constraints, work on the Espag's and Tarka bridges had to be curtailed once more. From December to March 1863, Robinson made an extensive tour of inspection from Cape Town to Fort Beaufort and back, where he witnessed the completion of the Espag's Drift Bridge which was finally opened to traffic during June 1863.[9] In a letter from the Colonial Secretary of 23 April 1864, he stated '…you will take care to incur no expense beyond that which is absolutely necessary for keeping the main roads open and in passable order…' [10] Hence not much was achieved during 1864 with the exception of the completion of the Tarka River Bridge which was opened on 1st January 1865.

In October 1864, the accomplished Andrew Geddes Bain died. He had identified and motivated for the construction of several bridges across the region. With the recall of

6 G.32-'60 Report of the Colonial Civil Engineer for 1859
7 G.21-'61 Report of the Chief Commissioner of Roads for 1860
8 See Public Works Department chapter 5
9 G.34-'63 Report of the Commissioner of Roads for 1862
10 G.39-'64 Report of the Commissioner of Roads for 1863

Scott-Tucker, Robinson, was appointed the new Chief Inspector of Roads, Bridges and Buildings. He reported the extensive repairs to the timber Rawson Bridge piers over the Zwartkops River due to the damage wrought by the *teredo navalis* shipworm which tunnels into underwater piers and pilings causing major damage and destruction to marine timber structures and the hulls of wooden boats. The large amount of traffic continually passing over the Rawson Bridge on the main route to Graham's Town had destroyed the false timber decking between the kerbs.[11] The Rawson Bridge was damaged once more due to floods during 1869 and was once again displaying serious settlement of over three feet in differential settlement due to river scour from the fast flowing Zwartkops River and from timber deterioration.[12] A toll gate was installed at the entrance to the Rawson Bridge. The authorities then auctioned the toll annually to individuals who were then required to pay a monthly fee while collecting the tolls. In June 1869 the toll was awarded to William Ferriman for the annual amount of £732 or £61 per month. When the Rawson Bridge collapsed in 1876 the Toll Keeper was Nelson Pearson who was paying £30 per month. The toll for the replacement Wylde Bridge in 1887 was only £10 per month while all local tolls were abolished on 1 July 1903.[13]

Authority was granted to proceed with a bridge at Cookhuis Drift over the Great Fish River for which tenders were invited in 1865.[14] During the following year, Robinson with the revised new title of Chief Inspector of Public Works, reported the completion during 1866 of all the stone masonry components at the Cookhuis Bridge at a cost of £3,105.[15] The Cookhuis Bridge on the main road between Somerset and Fort Beaufort was finally completed in December 1868 and opened for traffic. New bridge work was still being delayed for want of funds, as during 1869 only the two timber bridges over the Klaas Smits and Zwart Kei rivers were completed due to the fact that easily sourced local timber was used for the bridge decks on locally designed bridges using rudimentary stone abutments.[16] A continuing complaint from the road inspectors was the use by wagon drivers of iron 'brake shoes' on steep declines. While effective in preventing the iron rims of the wagons from over-heating and damaging the wooden wheel rims when braking, they caused considerable damage by ripping up the roads. Several road

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11 G.14-'66 Report of the Chief Inspector of Roads, Bridges and Buildings for 1865
12 G.15 -'70 Report of the Colonial Civil Engineer for 1869
13 J.J.Redgrave, *A Century of Progress: The Story of the Divisional Council of Port Elizabeth 1856-1856,* (Port Elizabeth: Nasionale Koerante, 1956), pp.34,35.
14 G.14-'66 Report of the Chief Inspector of Roads, Bridges and Buildings for 1865
15 G.21-'67 Report of the Chief Inspector of Public Works for 1866
16 G.15-'70 Report of the Chief Inspector of Public Works for 1869

inspectors recommended that wagoners using them on mountain passes be fined as they caused extensive rutting damage to the road surfaces.[17]

As the military garrison at King William's Town evolved into a commercial centre for the region after the conclusion of the 8th frontier war of 1850-53, the need arose for a more permanent crossing of the Buffalo River as the drifts were often flooded for days by the raging river. The roads from Graham's Town and Fort Beaufort to King William's Town became more important, with larger volumes of wagon traffic to supply this burgeoning commercial centre. Finally the Colonial Government agreed to the erection of the Buffalo River Bridge.

The austerity measures implemented by the government meant that very little new work was initiated during 1871, with the exception of a proposed bridge over the Buffalo River at King William's Town. Here two tenders for the erection of a timber bridge were rejected as being too costly. Permission was granted for an iron bridge to be used instead and for which the process of the bridge design and invitation to tenderers was commenced by the Crown Agents in London and their appointed consulting engineer, Henry Wakefield.[18] The stone masonry abutments and a central pier for the Buffalo Bridge at King William's Town were completed and the ironwork assembled and riveted together.[19] 1872 heralded a more optimistic period for new bridge construction as funds amounting to £80,000 became available, with implementation being restricted by the lack of experienced and competent field staff.[20]

Fig 25: Buffalo River Bridge, King William's Town 1873

17 G.15 -'70 Report of the Chief Inspector of Public Works for 1869
18 Walters, *Bridging the Eastern Cape*, p.40.
19 G.28-'73 Report of the Chief Inspector of Public Works for 1872
20 G.28-'73 Report of the Chief Inspector of Public Works for 1872

On the 15 October 1872, twenty six year old Joseph Newey was appointed to the post of bridge erector by Walter Williams, the owner of the Wednesbury Oak Ironworks of Tipton, Staffordshire.[21] The contract with the Cape of Good Hope Government was for two years during which time he had to erect two bridges across the Buffalo River and the Fish River at a salary of £30 per month. Newey and family sailed from Southampton and arrived at East London on 10 January 1873. He immediately set about the erection of the Buffalo Bridge at King William's Town which he completed six months later using the novel method of launching the girders over the Buffalo River without the need for timber support staging.[22] He had used this same method when erecting a bridge across the 260ft wide x 360ft deep Comba Scura River in Italy during 1871.[23]

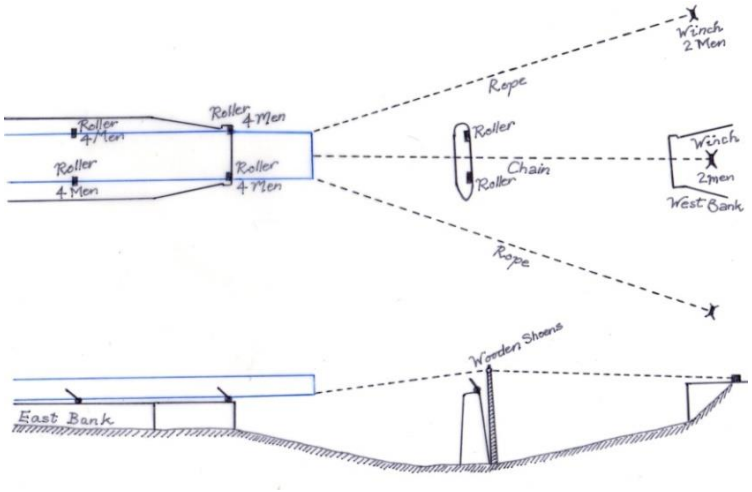

Fig 26: Buffalo River Bridge, system of launching the side girders used by Jos Newey[24]

This ingenious method of erecting a bridge was performed by winching the two partially completed side girders, on rollers, from the abutments to the central pier. It eliminated the need to erect staging and scaffolding, especially if the river below was flowing strongly. Most modern bridges are erected in this manner, by the method called incremental launching. Newey introduced a novel, rapid and economical way of erecting bridges at the Cape.

Meanwhile, much of Parliament's time in 1871 was taken up by the submission of reports into the desirability of extending the railway line from Wellington to the interior, with a branch being envisaged from Port Elizabeth to the burgeoning Diamond Fields of Kimberley, threatening direct competition for wagon transportation.[25]

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21 CAD PWD2/9 Employment Contract between Newey and the Crown Agents, 2 November 1872.
22 Walters, *Bridging the Eastern Cape*, p.40.
23 Walters, *Bridging the Eastern Cape*, p.38.
24 CAD PWD1/152 Letter A de Smidt to Chief Inspector of Public Works,10 May, 1873.
25 G.28-'72 Report of the Chief Inspector of Public Works for 1871

THE GREAT FLOOD OF DECEMBER 1874

On Wednesday 8 December 1874, Chief Inspector Robinson received alarming telegrams from the Civil Commissioner of Graham's Town reporting massive floods throughout the eastern districts and that the iron bridge under construction over the Fish River at Committees had been washed away. The flood was a major disaster that was to have far reaching consequences for the transportation and bridge-building programme of the eastern districts.

Subsequent telegrams from the Civil Commissioners at Bedford, Cradock and Queen's Town confirmed that the following nine bridges had been destroyed: [26]

1. Committees bridge over the Fish River
2. Fort Brown bridge ditto
3. Carlisle bridge ditto
4. Cookhuis bridge ditto
5. Cradock bridge ditto
6. Tarka bridge over the Tarka River
7. Koonap bridge over the Koonap River
8. Cathcart bridge over the Klaas Smits River
9. Victoria bridge over the Kat River

These exceptional floods occurred after several days of incessant rainfall throughout the region, saturating the catchment areas from the Fish River in the west to the Kei River in the east, leading to record flood heights. The flood in the Fish River between Cradock and Committees Drift saw the rise in level from 16ft to 22ft above the previous highest known flood levels although the flood of 1819 could have matched or even exceeded this level.[27]

After a week of rainy weather, heavy rain commenced on Thursday night 3rd December 1874, which continued with brief intermissions for the following days. In Graham's Town the weekly post cart was delayed. Normally dry gutters became raging torrents, eventually walls and roofs collapsed and houses near watercourses were flooded. Dr Atherstone (of diamond identification) measured a total rainfall of 10.55in (268mm) in three days.[28] In the next edition of the *Graham's Town Journal* following the slow flow of information, it was reported that the Fish River Bridge at Committee's had sustained considerable damage, '…On Sunday the Fish river reached flood limit and continued rising until it reached 21 feet above highest flood level. All the stores were 5 or 6 feet

[26] G.42-'75 Report of the Chief Inspector of Public Works for 1874
[27] G.42-'75 Report of the Chief Inspector of Public Works for 1874
[28] Graham's Town Journal, 7 December 1874

under water. At 9am this (Monday) morning no sign of bridge or barracks…' A stop press announcement at 4 pm stated that the Fort Brown and Koonap Bridges had also been washed away.[29] For miles along the beach from Kowie towards Kleinemonde a dense mass of driftwood was thrown up, in some places 10 feet high presenting an impenetrable barrier to the surf. Intermingled with the flotsam was a large quantity belonging to the staging of Committee's bridge. It was also reported from Port Alfred that, '…large quantities of staging belonging to the Committee's Bridge works has been washed ashore east of Kowie. A gang of men was sent out to collect and pack it up ready for re-transport by wagon…'[30]

A visit to the Committee's Bridge site revealed the full extent of the flood as this was where the first flood damage occurred the day before the Carlisle Bridge was wrecked. The storm water runoff response from the lower Fish River tributaries, the Kat and Koonap river catchment areas was shorter than that of the upper Fish River, as they join the Fish River downstream of the Fort Brown and Carlisle Bridge positions and reached the Committee's Bridge on Sunday night. The second flood passed Committee's on Tuesday, and was caused by the contributions of the Little Fish River and upper reaches of the Great Fish River.

The river level at Committees first rose on Saturday the 5th December, when it later swept away the temporary wooden bridge at the works. On Sunday it kept rising and at 7:30pm Newey and five workers abandoned the bridge works when shortly afterwards the staging collapsed and the partially completed bridge toppled into the river. By 10pm the water was waist deep in the old military barracks and 900 feet wide.[31] Newey reported to Chief Inspector Robinson that the Great Fish River rose to a height of 22½ ft above the assumed flood level, or 1½ ft above the highest part of the partially completed bridge superstructure. The partially assembled 172 ft long bottom iron chords forming half of the main lattice girders were found lying one upon the other along the bank and river bed about 15 yards from the site, much bent, buckled and twisted and broken in three or four places. The partially assembled cylinder piers were displaced by various distances along the river bank, buried in the river bed.[32]

Previously, Newey's November monthly progress report outlined that both stone masonry abutments and wing walls were completed. Regarding the ironwork, all the

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29 Graham's Town Journal, 9 December 1874
30 Graham's Town Journal, 9 & 11 December 1874
31 Graham's Town Journal, 9 December 1874
32 CAD, PWD1/356 Monthly Report Newey to Chief Inspector of Public Works, December/January 1875.

cylinder piers had been riveted together, while the east side pier had been erected up to a height of 20 ft and braced by bridge erector Bill Deason.[33] Thirty five feet of the main girders had been assembled on the west side and partially riveted. On the eastern abutment, 192½ ft of the bottom half of the main girder had been laid in position for launching and partially riveted. That was basically the position before the flood dumped everything into the river.[34]

A month later Newey was to report that 80% of the smaller objects had been recovered and cleaned while the lost girder sections had been retrieved and were being repaired. Five cylinder pier sections were still missing of which one had been seen in the river near Trompetter's Drift, twelve miles downstream.[35] After the flood Newey raised the final level of the bridge by a further eleven feet. This necessitated the bridge having to span the west bank flood plain by 125 ft requiring two additional girder sections which were also fabricated by Fleet & Newey.[36]

An inspection of the wrecked Carlisle Bridge at Espag's Drift revealed that only the central stone masonry pier and abutments were still standing firmly on their foundations. The ironwork was lying across the bed of the river, some twenty to thirty feet from the pier, the parapet lattice handrails were smashed to pieces. During the previous week the Great Fish River was extremely high, being above the ordinary high water mark and on the Sunday was just below the bridge deck. On Monday morning, between eight and nine o'clock, the toll-keeper Adams and the hotelier Keen had just left the river satisfied that the immediate danger had passed as the water level was within a few feet below the bridge deck. After they had only walked about 100 yards from the bridge they were startled by a loud rushing noise as a 20 ft high and four hundred yard wide wall of water descended on the bridge, and ten minutes later the bridge had been swept away. As the flood waters rolled on, trees, large pieces of timber from roofs, and animals, oxen and sheep, in one instance a flock of 200 to 300 sheep, floated past. The river commenced to fall on Monday afternoon so that only on Wednesday morning did the tips of one of the abutments become visible to confirm that the bridge was gone. Due to the importance of this bridge on the road from Graham's Town to Cradock, the Civil

[33] CAD PWD1/275 Letter Newey to Chief Inspector of Public Works, 9 April 1877.
[34] CAD PWD1/356 Monthly progress report for November, Newey to Robinson, dated 19 December 1874.
[35] CAD PWD1/356 Report into Committees Bridge Damage, Newey to Robinson, 7 January 1875.
[36] CAD PWD1/339 Letter Berkely to Chief Inspector of Public Works, 9 November 1876.

Commissioner of Albany sent a work party to the site to construct a new wagon drift across the river as bridge wreckage was lying across the old drift.[37]

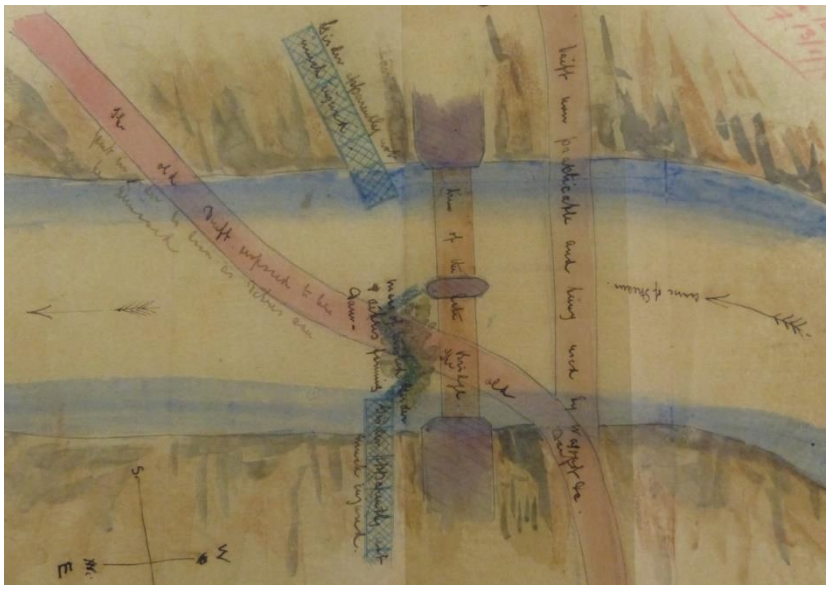

Fig 27: Carlisle Bridge, over the Great Fish River, Newey's watercolour of the destruction

After the flood had subsided a week later the former Fort Brown bridge site revealed four stone masonry piers and two abutments, the only remnants of the original five span timber bridge. The great flood had taken place on Monday night when the bridge was heard to collapse shortly after midnight when it burst from the stonework piers with a loud crash, splintered into hundreds of pieces and was swept away in the raging torrent. The water had risen 20 ft above the decking of the bridge, which means a total depth of water of over 70 ft and a sheet of water 1,200 ft wide and within 30 ft of the stone fort. The Fort Brown Bridge had withstood several previous floods, with waters reaching up to the roadway which had been set at 37 ft above the ordinary run of river. Here as at the Carlisle Bridge site, passengers and mails had to be conveyed across the river by rope and pulley.[38] Wagons had crossed the bridge for 30 years and while it could safely carry vertical loads, the horizontal force of the flood destroyed the bridge in minutes. The removal of the top transom beam, in order to allow wagons loaded with wool bales stacked high meant that the side girders had lost an important bracing element, making it unable to withstand any horizontal force.

Further up the Great Fish River at Cradock, the *Cradock Register* reported that the river had been flowing full all week until 7am on Sunday when the surface was within a few feet of the roadway of the two ironwork span Gilfillan Bridge. By 11:30pm the river was

[37] Graham's Town Journal, 11 December 1874
[38] Graham's Town Journal, 14 December 1874

flowing right over the bridge and the toll house was gone. Later during the night a tremendous crash was heard from the river as the bridge was forced off its solitary stone masonry pier. Early on Monday morning when the waters had subsided it was plain to see that the bridge deck was gone.[39] In this case the connection between the iron bridge and the stone masonry pier was at fault as it should have been able to withstand the horizontal force of the flood.

Similarly, the *Somerset Courant* reported that further downstream the three span Cookhouse Bridge was entirely swept away off its two stone masonry piers during Sunday night and lodged in the bed of the river. The toll house was in ruins as the waters had reached as far as Ferguson's hotel. It was speculated that the bridge may have survived but for the large number of huge trees coming down and lodging against the girders, restricting the flow path and forcing the river to rise over the topmost rails of the bridge birders. Here again the connections between the iron superstructure and the stone piers were inadequate. Messrs Jardine and Ferguson had been unable to retrieve any ironwork from the river bed for several weeks. Two of the three spans could be re-used, while the third span would have to be made of timber. The roadway which was 37 ft above ordinary run of river was over-topped by 16 ft, the river being 1,200 ft wide at that point.[40]

Fig 28: Victoria Bridge, over the Kat River at Fort Beaufort, December 1874
Immediately after the flood, photo shows view from upstream

The *Fort Beaufort Advocate* reported that on Sunday at first only the tops of the Victoria Bridge's parapets were protruding above the water level, a little later they disappeared. By Monday morning when the waters of the Kat River had subsided, the remains of the

[39] Graham's Town Journal, 16 December 1874
[40] Graham's Town Journal, 16 December 1874

bridge were visible, little more than a heap of stones. The three arches were still standing, but over the central arch the masonry had been swept away within a foot of the arch keystone. Over the arch on the far right side, a breach several feet deep had been washed out, creating a gap 15ft to 20ft wide, between the bridge and the approach roadway. On the near town side the retaining wall on the downstream side had been undermined and washed away. In this case the openings of the bridge were too small, causing the river to overtop the side spandrel walls which were severely scoured by the raging torrent. A work party of Frontier Armed & Mounted Police and all available convicts were sent to affect a temporary roadway over the remaining portion of the bridge. By Tuesday afternoon the river had subsided considerably revealing heaps of stones for nearly a hundred yards downstream. During the deluge the Katberg Pass road had also suffered to a great extent with several wash-a-ways.[41]

In Queen's Town, Dr Dyer recorded a total three day rainfall figure of 7.81inches (198mm), great damage being done to several dwellings, wool-washes and commercial buildings. A visit to the Cathcart Bridge over the Klaas Smits River only revealed two stone masonry abutments, as the timber trestle piers and timber deck spanning the river were destroyed during Saturday night.[42]

In trying to explain how the bridges were washed away, it is suggested that large accumulations of driftwood packing against the bridge openings restricted the flow paths between the spans leading to the damming-up of waters on the upstream sides placing enormous pressure on the bridge girders which were not particularly well connected to the tops of the piers with the result that the girders were simply pushed off the piers, crashing into the riverbed, all twisted and mangled and releasing the driftwood. Had the girders been set at higher levels the driftwood would have passed through the openings as had previously happened at the bridge at Fort Brown. It was normal practice at the time to set the proposed bridge roadway levels a few feet above previously known flood levels.[43]

Later, Chief Inspector Robinson argued that in order to provide for the safe bridging of rivers under the conditions of the recent flood would require large financial outlays which may not be warranted for ordinary road traffic, especially considering the long intervals of time that occur between such extreme floods. It was speculated that the previous flood of 1819 was of a similar magnitude to that of 1874. The chief

41 Graham's Town Journal, 16 December 1874
42 Graham's Town Journal, 11 December 1874
43 G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874

consideration was what amount of risk the government would be prepared to take that future floods would exceed the recent flood. It was the government's policy to only span the normal channel of the rivers, using iron girders of 100ft spans, allowing extreme floods (with high return periods[44]) to simply overtop these channels and inundate the flood plains.[45] In other words the government took the risk of erecting bridges that were only adequate for flood flows contained within the river channels. Newey was able to motivate and received approval to raise the Committees Bridge by 9ft, which entailed extending the bridge by 125ft over the flood plain and increasing the waterway by a large degree. His foresight was significant as proved one hundred years later by the flood of 1974, when the Committees Bridge was the only link over the Great Fish River for several days.

Nine months after landing at the Cape, Robinson sent Newey to undertake a site inspection of a proposed bridge site over the Little Brak River near Mossel Bay. Newey displayed his grasp of hydrology when he strongly advised the construction of a wide trestled timber bridge, to reduce the potential scour around the bridge piers by providing a larger waterway.[46] His advice was not taken, and instead a single 100ft span iron bridge fabricated by the Patent Shaft & Axletree Co was erected which lasted for 24 years when it was washed away, caused by scour and the subsequent collapse of the one abutment during a heavy flood in 1905. Another example of the government taking the risk of the bridge failing by erecting a shorter bridge with a restricted waterway between the abutments.

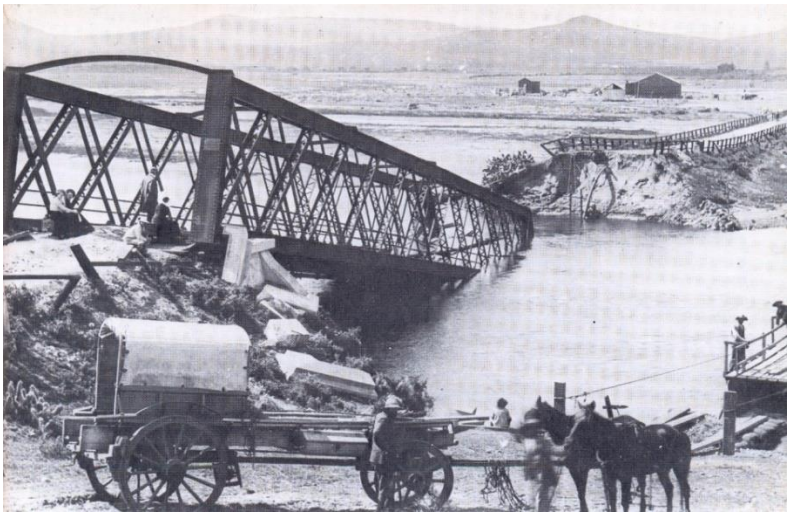

Fig 29: Little Brak River bridge destroyed by a flood in 1905

44 Return Period in years expresses the hydrological statistical probability that a flood will occur
45 G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874
46 CAD PWD1/153 Report of Newey to the Chief Inspector of Public Works, 8 October 1873.

The government resolved not to change any of the existing designs except at the Committees and Fort Brown bridges, where the waterways were increased substantially. During re-construction most of the other six bridges were raised by adding a few feet to their masonry piers and abutments which was not an expensive undertaking. The Government instructions were to immediately commence with restoration work and to assist the various Divisional Councils with the opening of drifts. However, the constant flooded nature of the Fish River during the rest of December seriously interrupted traffic causing great loss to transport contractors. The immediate reconstruction of the bridges at Fort Brown and Carlisle was considered to be the most important as they were on major transport routes.[47]

Newey was instructed to take up a central role and to proceed with the removal and repair of the displaced iron girders and to reconstruct the masonry piers and abutments of several bridges. A difficult undertaking was the removal of hundreds of iron rivets from the displaced girders as they were too heavy to lift.[48]

Fig 30: The re-constructed Cookhuis Bridge, showing one iron span and two timber spans

A new timber truss bridge for Fort Brown was framed in Cape Town and transported to site via Kowie harbour. Patrick Fletcher the Road Inspector on the Great Northern line was sent to restore the Cathcart Bridge over the Klaas Smits River, the small bridges on the Katberg pass and make temporary repairs to the Victoria Bridge at Fort Beaufort to allow passage. James Jardine was sent from the Jansenville bridge site to repair the masonry at Cookhuis, Tarka and Cradock bridges. David Ferguson went to repair the ironwork, unriveting and straightening of girders at Cookhuis, Cradock and Tarka

[47] G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874
[48] G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874

bridges.[49] The construction of a new bridge over the Sundays River at Tunbridges was slightly affected by the flood.[50] Most bridge work during 1875 was employed in repairing the various flood destroyed and damaged bridges, aside from completing the new bridge over the Sundays River at Jansenville six months after the flood.

Cost of Restoration of Bridges destroyed by Floods in December, 1874 [51]

Cathcart and Wodehouse Bridges	£2,153	6s.	10d.
Buffalo Bridge	521	17	6
Carlisle Bridge	3,416	0	0
Cookhuis Bridge	6,414	0	0
Tarka Bridge	4,056	9	0
Koonap Bridge (Contract)	4,000	0	0
Fort Brown Bridge	5,278	0	0
Victoria Bridge, Fort Beaufort (Contract)	4,550	0	0
Cradock Bridge (Grant in aid to Divisional Council)	2,500	0	0
Committees Bridge (Loss of material, labour and time)	5,000	0	0
Total	£37,339	13	4

In a recent regional flood frequency study of the Eastern Cape using systematic, historical and palaeo flood data, the December 1874 flood was identified as the largest flood recorded in the region with the various bridge sites data as follows:[52]

Carlisle Bridge	Q = 9,231m/s	H = 19.2m	Return Period = 1/120 years
Fort Brown Bridge	Q = 7,000m/s	H = 18.3m	Return Period = 1/100 years
Committees Bridge	Q = 7,200m/s	H = 21.8m	Return Period = 1/100 years
Hunts Drift Bridge	Q = 9,000m/s	H = 15.0m	Return Period = 1/120 years
Kei Bridge	Q = 10,800m/s	H = 12.8m	Return Period = 1/110 years

A flood almost exactly 100 years later in February 1974 flooded the same extended area with similar devastating results. While all the new concrete bridges were basically undamaged, all their earthwork approaches were washed away.[53] It is interesting to note that only the bridge over the Fish River that was immediately passable to traffic was the Committees Drift Bridge, Newey had obviously done a good job of his 1876 reconstruction and estimation of the correct flood level.[54] While the Cape Colony engineers obviously did not have access to this type of data, they did choose to ignore the warnings that flooded rivers would destroy bridges if they were not built with sufficient clearance for the flooded river to pass, because of budgetary constraints.

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49 CAD PWD2/9 Letter Robinson to Commissioner of Crown Lands & Public Works, 29 December 1874.

50 G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874

51 G.42-'75 Report of the Chief Inspector of Public Works to the Cape Parliament for 1874

52 D van Bladeren, P K Zawada and D Mahlangu, '*Statistical Based Regional Flood Frequency Estimation Study for South Africa Using Systematic, Historical and Palaeo Flood Data',* Report to the Water Research Commission, WRC Report No 1260/1/07, (March 2007)

53 Daily Dispatch, 7 March 1974

54 In another recent study of bridge failures in the USA from 1800-2009 it was found that 54% of bridge failures were due to hydraulic failures from floods and scour, of which floods accounted for 51% and scour 15% of failures. Ref.: S.Sharma, and S.Mohan, '*Status of Bridge Failures in the USA, 1800-2009',* TRB 90th Annual Meeting: Transportation, Livability & Economic Development in a Changing World, Washington, D.C, (2011).

DESIGN DEFICIENCIES

The destruction of the nine bridges highlighted the design deficiencies of the London consulting engineers. Their knowledge of the science of hydrology appears to have been limited, as their estimates of the waterways through the bridges, the selected heights of the bridge decks and the sizes of the bridge openings between the piers and the abutments were inadequate. These values had simply been based on precedent and the largest recorded floods of the past. The engineers should have been in possession of Nathaniel Beardmore's 'Manual of Hydrology'[55] of 1862 which contained many pages of relevant tables. In particular, section 2 'on rivers and flows from large districts' which provided tabular data on all manner of conditions. It was still seventeen years before Manning's Equation of the velocity component V, was formulated to complete the continuity equation of Q=VA,[56] and allow engineers to estimate flood discharges of rivers and channels more accurately. In each bridge design the London engineers would have been provided with the cross sectional drawings of the bridge channel by the PWD and the level of the highest recorded flood. As the floating debris, trees and flotsam which the rivers carried along their path of destruction packed up against the girders of the various bridges, they formed an impenetrable wall that combined with the force of the floodwaters to simply tip (shear) the iron and timber girders off their masonry piers. A third deficiency in the consulting engineer's designs was that the connections between the girders and the tops of the stone masonry piers were woefully inadequate. While the sub-tropical climatic conditions at the Cape are totally different from Britain, the consulting engineers should have been aware of the power of the treacherous Monsoon conditions of India where many of their previous bridges were designed to withstand torrential rain and massive floods. The lessons of the 1874 floods obviously made an impression on George Berkley when designing the four Orange River Bridges later because he changed the stone masonry piers to elongated cylindrical iron piers filled with concrete to support the bridge decks.

NEW BRIDGE BUILDING PROJECTS

After many deputations and memorials by commercial traders and missionaries, a suitable site for a bridge over the Great Kei River at the entrance to the Transkei was selected, sections surveyed and designs sought from London-based consulting

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55 N. Beardmore, *Manual of Hydrology*, (London: Spon, 3rd Ed, 1862), pp.121-192.

56 Robert Manning MICE, presented his formula in a paper: 'On the flow of water in open channels' *Trans. Institution of Civil Engineers, Ireland',* 20: (1891), 161-207, 24, Q=flow; V=velocity; A= cross sectional area of channel

engineers.[57] Funds secured under Act No. 6 of 1877 allowed construction of the Great Kei River Bridge at Victoria Drift to commence with the pier foundation excavations.[58] Joseph Newey who had recently successfully completed the erection of the Committees Drift Bridge had his contract extended, was tasked to erect the Great Kei Bridge. Progress on the bridge over the Great Kei River had reached a stage where all the piers had been erected when construction was suspended due to the outbreak of the ninth frontier war in September 1877.[59] Newey displayed his thorough theoretical and practical knowledge when he designed and erected a temporary timber bridge over the Great Kei River which was used to convey military troops and commissariat on their journey to the hostilities on the Transkei side of the river. The work on the bridge re-commenced during April 1878 after the ending of conflict. Soon afterwards progress was well advanced as all the piers were in place and filled with concrete up to full height and seven of the twelve girder spans had been erected. A flash flood washed away Newey's temporary timber bridge and soon afterwards the Great Kei Bridge was completed in September 1879 and proved invaluable to the troops engaged during the war in Transkei as they were allowed to pass toll-free. A toll on this bridge allowed under Act No.6 of 1877, collected an amount of £980 between February and 31st December 1880.[60]

A new six-span stone arch bridge across the White Kei River near St Marks Mission was designed by Chief Inspector Fforde in which construction progressed to the level of the springing of the arches when work was suspended and abandoned due to the outbreak of the war. Work re-started during July 1878 and the bridge was able to pass light vehicles during the floods of 1880, after which it was completed at a final cost of £10,403.[61]

The site for a stone arch bridge across the Kraai River, 5 miles outside Aliwal North on the road to Barkly East was selected and cross sections surveyed by the local road inspector Patrick Fletcher.[62] A cost estimate of the proposed stone arch bridge amounted to £17,580. Construction of the bridge progressed to the point where

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57 G.42-'76 Report of the Chief Inspector of Public Works for 1875.
58 Act No. 6 of 1877 –'To provide the means for paying for the construction of a bridge across the Great Kei River, and for the levying of tolls on such bridge,' 8 August 1877.
59 CAD PWD1/358 Letter Newey to the Chief Inspector of the PWD, 11 September 1877.
60 G.28-'81 Report of the Chief Inspector of Public Works for 1880
61 G.28-'81 Report of the Chief Inspector of Public Works for 1880
62 G.42-'77 Report of the Chief Inspector of Public Works for 1876

Parliament passed an Act[63] to enable the Divisional Council of Aliwal North to borrow £5,000 as its contribution to the construction of the bridge, the remainder coming from the PWD budget. The bridge was completed under contract and handed over to the local Divisional Council during September 1881 and named the Sauer Bridge. This was the second of eight stone arch bridges to be designed and constructed by the PWD and highlighted their rapid progress as competent bridge builders. Their productivity was hampered by the scarcity of suitable stone masons, which was partially offset by the training of local tradesmen.

In 1870 a proposal was presented to Parliament for the construction of two iron bridges over the Orange River at Bethulie and Aliwal North, the incentive being to make provision for the busy wagon route to the rapidly developing Diamond Fields and the expanding town of Bloemfontein to the north. Crossing the Orange River during floods or high river flows meant delays of several days and even weeks at the many drifts along the river. A bridge at Bethulie below the junction of the Caledon River would avoid the cost of having to cross it as well.[64] The proposal to Parliament was suitably motivated by its business promoters as the member's positive response resulted in the promulgation of Act No.15 of 1871, 'To Promote the Construction of a Bridge or Bridges over the Orange River'.[65] District inspector Sydney Stent was instructed to obtain the necessary topographical and other information for the preparation of preliminary designs of bridges over the Orange River.[66] With the help of Government Surveyor P.Dowling, Stent completed the surveys and site investigations of the bridge sites at Colesberg, Aliwal North, Bethulie and Hope Town during 1873.[67] Stent was one of a rare breed in that he was both a qualified civil engineer and architect who later designed the town halls of both Graham's Town and Queen's Town after being retrenched. The preliminary designs and cost estimates prepared by Stent for the four bridges at Aliwal North, Bethulie, Colesberg, and Hope Town, varied in cost between £40,000 and £65,000.[68] Construction first commenced at Bethulie and later Aliwal North, while tenders were invited for the two remaining bridges at Hope Town and Colesberg.

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63 Act No.11 of 1878 – 'To authorise the Divisional Council of Aliwal North to borrow money upon security of Road Rates and Tolls for the erection of a bridge over the Kraai River', 2 August 1878.
64 G.31-'71 Report of the Chief Inspector of Public Works for 1870
65 H.Tennant, E.M.Jackson (Ed), '*Statutes of the Cape of Good Hope 1652-1895'*, (Cape Town: Vol 1, Juta&Co).
66 G.28-'73 Report of the Chief Inspector of Public Works for 1872
67 CAD PWD1/153 Letters from Stent to the Chief Inspector of Public Works, May to October 1873.
68 G.42-'74 Report of the Chief Inspector of Public Works for 1873

Chief Inspector Robinson retired on 31st August 1876, to be replaced by James Fforde.[69] Fforde made his first trip of inspection to most of the Eastern Cape bridge sites during 1877 and was able to provide first hand reports into their progress. The Orange River bridges took up much of his time as the contractors for the Bethulie and Aliwal North Bridges, the Crumlin Viaduct Works Co Ltd were experiencing financial problems. The bridge at Bethulie was far advanced, while the Aliwal North Bridge had not commenced. Eventually their two contracts were terminated due to lack of progress with continued construction having to be done departmentally by the PWD. The contracts for the erection of the bridges at Colesberg and Hope Town were awarded to Westwood Baillie & Co, of London.[70]

At the Cookhuis Bridge, Fforde found that the two replacement timber spans of the 1874 flood damaged bridge had deflected considerably due to their defective design under daily wagon loads, and instructed that the girders be strengthened. As outlined above, timber bridges were prone to deterioration from drying out and jointing failure, leading to deflection and becoming rickety. The other flood damaged bridges that had been repaired were all found to be in a satisfactory condition.[71]

A severe drought throughout the colony during 1878 affected ox wagon transport especially through the harsh, dry semi-desert Karroo with very little grazing and water for the oxen. In addition, the recent ninth frontier war hostilities led to the loss of skilled amaXhosa labourers, which all contributed to delays in all aspects of bridge and road construction. The transport of ironwork to the bridges was almost impossible and had affected the construction of all four Orange River bridges as the ox wagons had to transport feed as well as the ironwork. The Hope Town Bridge construction had finally commenced with the excavation for the piers as they also awaited the delivery of the ironwork.

69 CAD PWD2/237 Employment Contract between Fforde and Crown Agents, 1 December 1876.
70 G.42-'78 Report of the Chief Inspector of Public Works for 1877
71 G.42-'78 Report of the Chief Inspector of Public Works for 1877

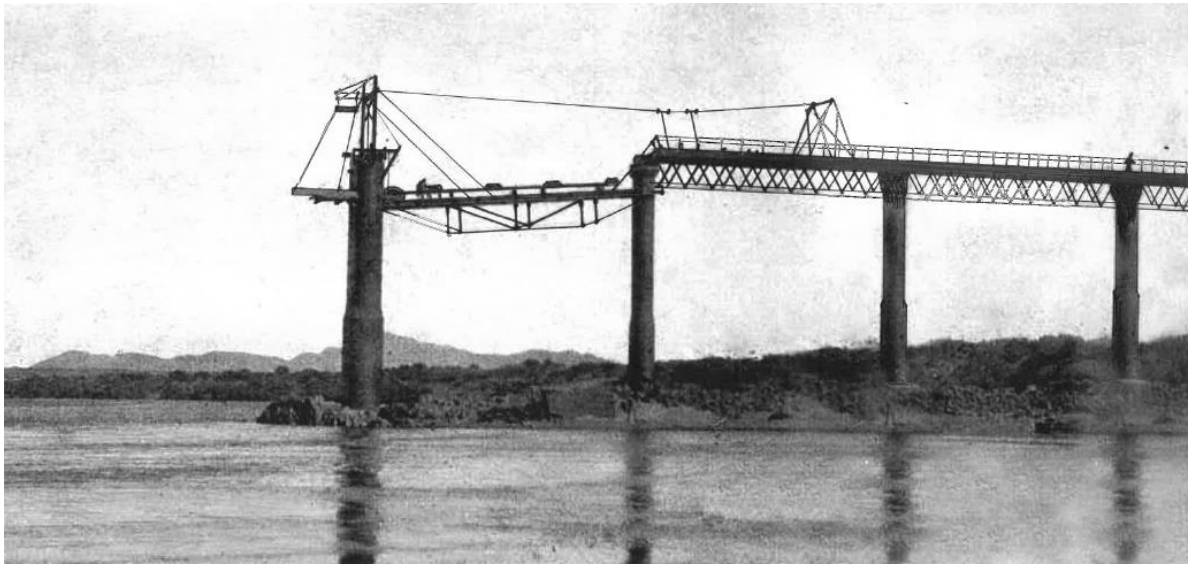

Fig 31: Colesberg Bridge over the Orange River under construction 1879

At the Colesberg Bridge seven of the fifteen spans were erected after which work had to stand idle as they awaited the arrival of the rest of the ironwork. These delays meant that the contract periods would be exceeded for the two bridges and were to be legitimate grounds for later claims for extensions of time and related costs by the contractor, Westwood Baillie & Co. The other two bridges, which were taken over by the PWD, had also been delayed. At Bethulie great difficulty was experienced due to the ingress of water into the foundation excavations, requiring several additional steam pumps to keep the foundations dry while the concrete bases of the iron piers were being cast. In spite of the difficulties the bridge was completed and opened to traffic during March 1879. The original contractors, the Crumlin Viaduct Works Co finally went into liquidation, thereby justifying Fforde's decision to terminate their contract. The Aliwal North Bridge construction was under way by the PWD, with the masonry abutments well advanced and three piers erected to full height. Floods had caused a temporary suspension of the works, a constant occupational hazard along the Orange River.[72] All the spans of the Orange River Bridges were erected in the same manner. Once the iron cylinder piers had been installed, the iron girders were placed using a 'Blondin' overhead cableway, suspended from towers on either end.[73]

William Grier presented the 1879 Public Works Department annual report to Parliament in the absence of James Fforde who was on six months leave. Heavy rains and resulting floods in the Orange River at Aliwal North delayed the erection of the final pier

[72] G.36-'79 Report of the Chief Inspector of Public Works for 1878

[73] 'Blondin' overhead cableway first patented in 1873 as 'JM Henderson Aberdeen Patent Blondin' comprised a 3-wheeled load carriage with separate drums wound with the travelling and the hoisting cables, suspended from towers on either end, first used in 1866 in quarries in Scotland to lift and move stone blocks

in the main channel of the river for several weeks. During February the Orange River was flowing full once more and had risen 34 ft at Aliwal North and 42 ft at Colesberg above the normal river flow level when the coffer dams and pumps were submerged once more. The Orange River Bridge at Aliwal North was finally completed and opened to the public on 21st July 1880 and proved invaluable for the passage of troops during the military intervention in Basutoland. The tolls collected on this bridge amounted to £3,080 over the period 21st July to 31st December 1880.[74]

The Colesberg Bridge was opened to traffic on 7th July 1880 where toll receipts only totalled £803 over the period August to December 1880. This was attributed to the fact that certain provisions of Act 15 of 1871 had not been enforced as a private pontoon was operating within the five mile exclusion zone on either side of the bridge. The toll receipts on the Bethulie Bridge amounted to £5,275 over the period January – December 1880. At the Hope Town bridgeworks, most of the piers were completed and four spans were hoisted and fixed in place during1881.[75] The Hope Town Bridge over the Orange River was finally opened to traffic on 5th April 1882. The total cost of erecting the four Orange River Bridges amounted to £374,554. The claims instituted by the two contractors on the four Orange River Bridges went to arbitration in London. The outcome was that Crumlin Viaduct Works only received £4,577 of its claim[76] and Westwood Baillie received £9,126 of its claim of £18,682 with costs against the government being an additional £6,294.[77]

While under construction, Chief Inspector Robinson remarked that the four river ponts at Aliwal North and the two at Bethulie had combined gross traffic receipts of over £4,000 per annum.[78] Furthermore the tolls paid to these pont operators were far in excess of those to be levied at the completed bridges. Road inspector J.H.Brown speculated that the public would reap the benefit of greatly reduced tolls with up to half price as provided in the bridge toll charges as outlined in the tariff of tolls according to Act 15 of 1871, and the transport operators would gain the security against ruinous delays of often a month or more on the banks of the Orange River with no hope of crossing it.

74 G.28-'81 Report of the Chief Inspector of Public Works for 1880
75 G.41-'80 Supplementary Report of the Chief Inspector of Public Works for 1879
76 G.25-'88 Report of the Chief Inspector of Public Works for 1887
77 G.21-'86 Report of the Chief Inspector of Public Works for 1885
78 G.42-'76 Report of the Chief Inspector of Public Works for 1875

The tariff of tolls as outlined in Act 15 of 1871 was as follow:

	£	s.	d.
Upon each loaded buck-wagon, drawn by any sort of animals, not exceeding sixteen in number ……..	0	17	6
Upon each buck-wagon carrying not more than 500 lbs, drawn as above …….....	0	7	6
Upon each animal, over and above sixteen, drawing such vehicle……	0	1	0
Upon each loaded tent or other wagon, not being a buck-wagon, drawn by any sort of animals, not exceeding twelve in number……...	0	12	6
Upon each wagon carrying not more than 500 lbs, not being a buck-wagon, drawn as above……...	0	5	0
Upon each animal over and above twelve drawing such wagon…… …	0	1	0
Upon each travelling cart, spider, wagon, or other conveyance, drawn by not more than two animals …….. …….	0	5	0
Upon each animal over and above two drawing such vehicle…….	0	1	0
Upon each saddle horse ……...	0	1	0

The need for the Orange River Bridges to improve transportation was fully justified when the initial toll receipts for 1881 were presented. However, they soon showed a downward trend as the railway extensions continued to advance into the interior of the country, as railway transport was beginning to provide slow moving wagon transport with a compelling alternative.[79] A significant landmark was the abolition of collecting tolls on the four bridges by order of the government on 12 August 1889 in order to save the ox wagon transport industry from ruin. During the lifetime of collecting Orange River Bridge Tolls the following annual tolls were collected: [80]

	1881	1882	1883	1884	1885	1886	1887	1888	TOTALS
Aliwal North	£8,322	8,903	5,916	4,066	3,268	2,580	3,367	3,845	£40,267
Bethulie	£7,802	6,671	3,475	1,766	962	542	1,680	1,840	£24,738
Colesberg	£5,837	5,641	3,597	7,159	3,212	1,911	2,556	2,694	£32,607
Hope Town	------	£2,646**	3,031	4,293	4,699	533	870	991	£17,063
Totals:	£21,962	23,863	16,021	16,021	12,141	5,617	8,473	9,371	114,732
Great Kei	£986	£1,342	1,682	2,206	1,956	1,201	1,551	1,974	£12,898

The above amount of money collected by the tolls begs the question of how many wagons actually crossed the various bridges every year. If one assumes that 95% of traffic comprised of loaded and empty buck wagons at a cost of 17s.-6d + 7s.-6d. = £1-3s.-0d. per trip of back and forth, then the number of wagons that crossed the Aliwal

[79] G.16-'85 Report of the Chief Inspector of Public Works for 1884
[80] G.21-'89 Report of the Chief Inspector of Public Works for 1888

North Bridge during 1882, the year with the highest toll receipts, would have been approximately 7,355 trips, or 1200 wagons per month, or 40 wagons per day. The above table also shows how ox-wagon transport declined significantly after 1885 when the railways reached Kimberley.

In 1880, Fforde reported to Parliament that preliminary work on an ironwork bridge over the Koonap River at the village of Adelaide had commenced with surveys, sections and foundation trial holes being completed. The bridge design, drawings, specifications and tender procedure was completed and the ironwork ordered from England. Newey again presented the method of launching the iron girders from the abutments to rest on the central masonry pier without the need for timber support staging. The bridge erection was let on contract to John Mackay of Port Elizabeth and was completed within budget.

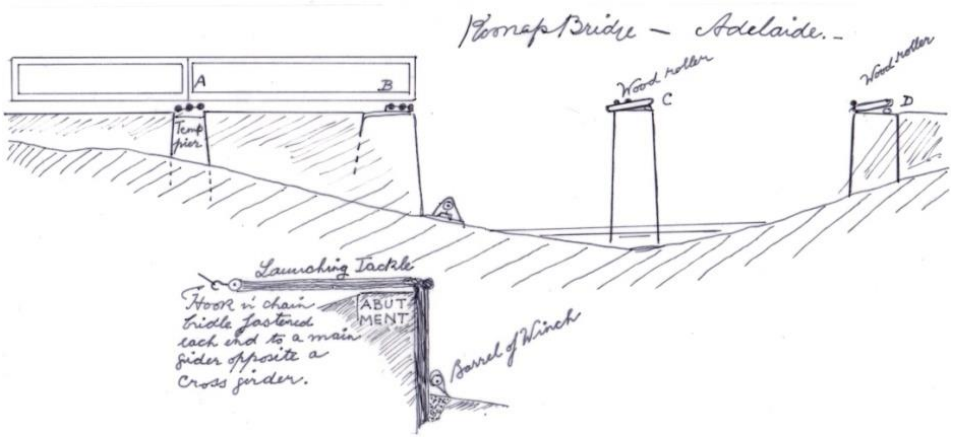

Fig 32: Koonap River Bridge, Adelaide, system of launching to be adopted, by Jos Newey 1882

Chief Inspector James Fforde was transferred to take control of the Railway Department on 30th June 1881 as it was felt that his extensive UK railway experience would be better utilised there. William Grier was appointed as acting Chief Inspector of the PWD in his place. A year after being the acting head, William Grier was appointed as Chief Inspector of the PWD on 30th June 1882. The six district inspectors of the PWD during 1882 were: Thomas Bain (No.1), Sydney Stent (No. 2), Richard Wright (No.3), Patrick Fletcher (No. 4), P.S.Hyslop (No. 5) and Joseph Newey (No. 6).[81] After completing the final supervision of the Aliwal North Bridge over the Orange River, which was named the Frere Bridge after the Governor, Sir Bartle Frere, Newey was appointed district inspector of the eastern border area in addition to the newly annexed region of the Transkei, Tembuland and Griqualand East territories.[82]

[81] G.52-'83 Report of the Chief Inspector of Public Works for 1882
[82] G.52-'83 Report of the Chief Inspector of Public Works for 1882

The Civil Commissioner of Fingoland, Captain Matthew Blyth was influential in petitioning for the Kei Bridge soon after taking up the post in 1869. Under Blyth's guidance the Fingoland District fund was established in 1882 when every Mfengu man contributed a voluntary tax of 2s. 6d. for local purposes. The proceeds of this half-crown tax amounted to about £800 annually, to which the Government contributed £ for £. The fund was used for the construction and repair of local roads and bridges, with a contribution made towards the new Kei Bridge-Toleni road.[83]

THE RECESSION OF THE 1880s

While an amount of £220,475 was voted for the 1882/1883 financial year under the Works and Buildings, and Roads and Bridges budgets, exclusive of the new Houses of Parliament and harbour works, a much reduced amount of £104,698 was voted for the same purpose for the 1883/1884 financial year, a reduction of 52%. This was due to reduced revenue owing to the on-going recession. Unfortunately, the Commissioner of Crown Lands and Public Works sanctioned the retrenchments of three engineers, three draughtsmen, two clerks and an overseer. The huge programme of railway building at the time absorbed the lion's share of the budget in comparison with the PWD budget. Owing to the comparatively small amount of work by the PWD authorised by Government to be executed during 1884, a careful study was made of the number of professional and other personnel necessary to discharge the duties of the PWD. The result was that the districts allocated to the district inspectors was reduced from five to four, resulting in Sydney Stent and senior architect Arthur Winder being retrenched along with others who were pensioned off. The construction of bridges was put on hold owing to budgetary constraints being introduced from a lack of revenue.[84]

The chief inspector's reports to Parliament for 1885, 1886, 1887 and 1888 noted that neither new bridges nor work on existing bridges were undertaken. Even work on public buildings had drastically declined with only repairs being done. The low overall government budget estimate of £166,745 for 1888-1889 eventually gave way to a sizeable increase on account of a return to prosperity the following year. 1888 proved to be an exceptional year as the budget estimate for the following financial year of 1889-1890 grew to £318,743 an increase of 48%.

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[83] A.Rodger, 'The early history of Blythswood Missionary Institute', (BDiv degree, Rhodes University, 1977), pp. 9,20-22.

[84] G.16-'85 Report of the Chief Inspector of Public Works for 1884

The expenditure on the Works and Buildings, Harbour Works, and Roads and Bridges for the following financial years was presented:[85]

1884-1885…….. £132,589
1885-1886…….. £119,171
1886-1887…….. £ 81,641
1887-1888…….. £104,290
1888-1889…….. £123,881
1889-1890…….. £233,158
For half year ended 31st December 1890…….. £135,448

The economic upturns and downturns of the 1860s and 1870s in the Cape Colony resulted in a concentration of the economy being attracted to the prosperous Diamond Fields, both in the forms of mercantile trade and capital investment. This fragile dependence was exposed by the recession which followed the collapse of the diamond share market in 1881. The problems of the Cape economy could not be blamed on the diamond fields alone as conditions in international markets, as well as the drought, the slump in agricultural product prices combined to contribute to a long and deep recession. The saviour of the situation was the discovery of gold in 1886, which led to great prosperity and confidence throughout the region leading to another bout of financial speculation.[86]

The discovery of the first diamonds in 1866 and 1869 led to a notable migration to the Diamond Fields from 1870. By 1873 Kimberley was the second largest town in South Africa with a population of 40,000 and was transformed in the 1870s and 1880s largely as a product of mining company formation. During the period 1877-1881 the emergence of the mining capitalists who began to turn the diamond diggings into a mining industry where steam powered machines outperformed horse drawn technology. As a result diamond output from the four Kimberley mines soared as investment in fixed capital increased resulting in larger machines being required. The escalating inflation in the market value of mining claims inevitably resulted in a dramatic slump in prices. The crisis was the result of the over-production of diamonds precipitating the extended depression during the period 1882-1885 which led to the centralisation of production as the mines went deeper and consolidated mining company formation. The arrival of the railways to Kimberley in 1885 reduced the high transport costs and brought the heavier steam powered haulage and de-watering pumping machinery to the mines. The 16

[85] G.21-'91 Report of the Chief Inspector of Public Works for 1890
[86] A.Mabin, '*The Making of Colonial Capitalism: Intensification and Expansion in the Economic Geography on the Cape Colony, South Africa 1854-1899',* (PhD Simon Fraser University, 1984), p. 180.

steam engines in 1877 increased to 306 in 1881, all having been transported to Kimberley by ox-wagon transport. This technology growth materialised in parallel with the investment boom of 1879 to 1881, mostly through the formation of joint-stock companies.[87]

Several small mining companies began operating from the start and were initially restricted in size. Once restrictions on claim ownership limits were lifted, these companies grew and attracted investment capital by listing their shares on the stock exchange. Investors comprised of claim owners, merchants and professionals from Kimberley and the established commercial community from the rest of the Cape Colony. From some 20 companies at the end of 1880 the 'share mania' boomed during the first half of 1881 to 70 companies mostly listed on the recently established Kimberley Royal Stock Exchange. As speculation grew, shares were increasingly purchased on credit advanced through banks.[88] Eventually becoming concerned by the inflationary conditions of the share formulations, the banks refused to accept share scrip as collateral in April 1881. From June the inflated share prices began to fall and this dragged down numerous investors. Many firms and individuals were reduced to insolvency for over- exposure to diamond shares. The overproduction and subsequent fall in the diamond price, combined with the reduction in diamond exports, the curtailment of the large military expenditure as a result of the cessation of the various local wars, combined with the severe drought and finally the collapse of the wool and ostrich prices in 1884 and 1885 was the stage when the recession in the Cape plumbed its greatest depths.[89]

Following the demise of the short-lived goldfields of Barberton and Pilgrim's Rest in mid-1887, attention shifted to the Witwatersrand and the future Johannesburg. Small scale speculation, the buying of farms and the floating of small companies with money provided by merchants and individuals from the Cape Colony and Kimberley led the way to the retardation of development in the Cape.[90]

Following the discovery of lumps of quartz encrusted with many specs of gold, the search for gold along the Witwatersrand intensified by December 1885. Finally in July 1886 while prospecting on the farm Langlaagte, George Harrison discovered the

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87 R Turrell, 'Capital, Class and Monopoly: Kimberley Diamond Fields 1871-1889', (PhD University of London, 1982), pp.35,177.

88 R Turrell, 'Capital, Class and Monopoly: Kimberley Diamond Fields 1871-1889', p.181.

89 A.Mabin, 'The Making of Colonial Capitalism: Intensification and Expansion in the Economic Geography on the Cape Colony, South Africa 1854-1899', (PhD Simon Fraser University, 1984), pp.170,186.

90 Mabin, 'The Making of Colonial Capitalism', pp.228-238.

auriferous conglomerates of the Main Reef Series, the impetus for the world's largest ever gold rush which would later transform the area with the richest gold mines the world had ever seen.[91]

Combined with this new found prosperity as a result of the mineral discoveries, the lifting of the drought and improved agricultural production and business activity, led to raised government revenues, with concomitant increases in development and operating budgets to the various departments. The steady advance of the railway lines from the port towns Cape Town, Port Elizabeth and East London, financed by huge loans raised in London was a further stimulant to the Cape economy.[92]

THE RESUMPTION OF BRIDGE BUILDING

After four years of bridge building inactivity, 1889 signalled the start of a period of prosperity and major bridge building activity throughout the Cape Colony. To carry out the large number of works authorised by the Legislature for the financial year 1889-1890 an increase in professional and clerical staff was required, however this was easier said than done as so many experienced personnel had been retrenched. An added difficulty was the on-going railway expansion and its need for and employment of engineers and related staff. The Cape Government Railways fell under the PWD until June 1873 when it became a separate entity, raising its own loans through the Crown Agents. Road bridge building activity was able to resume as a result of the burgeoning development budget of the PWD.

While in search of a bridge site over the Tsomo River outside Cala, Newey selected a site during 1883 comprising a solid rock shelf foundation, to which Fletcher was sent to survey cross sections of the site. Newey then prepared two designs and specifications for the bridge, one of steel superstructure on stone masonry piers and for one entirely of stone comprising five arches which although more expensive, was eventually approved.[93] After a break of almost six years, the Tsomo River Bridge construction was able to commence during 1889 due to the increased budget and the employment of several immigrant stone masons from England. The bridge was completed and opened on the 29 December 1890 and named the Xalanga Bridge, comprising of five stone arches each of 40ft span and elliptical in shape. This was one of the first bridges

91 J.R.Shorten, *The Johannesburg Saga*, (Johannesburg: Shorten Publishers, 1970) pp.55-62.
92 See chapter 2
93 G.27-'84 Report of the Chief Inspector of Public Works for 1883

personally designed by Joseph Newey after assuming the position of the district inspector for PWD Districts 6 and 7.

Permission was granted to commence the surveys, sections and designs of bridges over the Little Fish River at Somerset East, the Umzimkulu River Bridge, the second Kraai River Bridge on the road to New England, the Gouritz River Bridge, plus several new bridges in the Western Cape.[94]

Two bridges were built over the Little Fish River outside the village of Somerset on the road to Cookhouse. The first one was a 'through' triangular lattice iron bridge of a single 100ft span on stone masonry abutments, while the second one was an 'over' triangular lattice iron bridge also with a single 100ft span. The first bridge was completed and handed over to the Somerset East Divisional Council during April 1891 while the second was completed in 1893. Both of these bridges were washed away forty years later, their waterways proving to be too small. This proved to be another case of the design engineers only allowing for the bridges to span the relatively low river channels, resulting in opening waterways being too small for major floods.

Patrick Fletcher, the local road inspector, located a suitable site for a second bridge over the Kraai River on the Barkly East to New England road during 1883 near Vorster's Mill. A design was completed by Newey based entirely on the design of the Xalanga Bridge at Cala, a logical consequence as the length of the bridge was the same and the timber centering to support the arches was identical and therefore reusable. Construction of this bridge was proceeded with departmentally as no tenders were received in response to newspaper advertisements.[95] The construction of this stone arch bridge progressed very slowly due to adverse weather and frequent flooding. A large quantity of stone was quarried less than a mile from the site and dressed ready for use. A shortage of labourers adversely affected construction as better wages could be earned working on the railways.[96] The Kraai River Bridge was almost completed as the last arch was keyed-in on the 5th December 1892, which left the rest of the side spandrel walls, the abutments, the roadway and the parapet walls to be completed. The approach roads to the Kraai River Bridge were completed during September with the

94 G.15-'90 Report of the Chief Inspector of Public Works for 1889, see chapter 9 for detailed descriptions.
95 G.21-'91 Report of the Chief Inspector of Public Works for 1890
96 G.24-'92 Report of the Chief Inspector of Public Works for 1891

opening ceremony taking place on 6th December 1893 and named the Loch Bridge after the Governor of the Cape Colony.[97]

The designs, plans, reports and cost estimates for the replacement of the timber bridge over the Zwart Kei River which had been destroyed several times was completed by Newey. The timber bridge over the Zwart Kei River was completed with a single ironwork span of 150ft triangular-lattice girder. The ironwork fabricated by Andrew Handyside & Co of Derby, was delivered to site but owing to yet another flood it was decided to raise the stone abutments by a further 2ft.

After investigating several locations along the deeply incised Gouritz River valley with cross sections surveyed and presented, a final position was selected by Chief Inspector Grier. This bridge was designed by Sir Benjamin Baker who had recently completed the Forth Rail Bridge in Scotland with Sir John Fowler in 1882-1890. The bridge was also designed on the cantilever bridge principle, where cantilever truss beams projected horizontally into space from each abutment. Construction on the massive Gouritz River Bridge commenced under the clerk of works James Chadwick, later to be joined by the site engineer, Wilhelm Westhoven who had recently completed the Forth Bridge. A large slice of the 1891 budget was taken up by the construction of the huge Gouritz River Bridge. The bridge was completed and opened on 30 March 1892.[98] Following on the heels of the first cantilever bridge at Blaaukrantz on the Graham's Town to Port Alfred railway line in 1885, the Gouritz Bridge showcased the progress that the technical personnel of the PWD had made in constructing a very complicated steel bridge manufactured by Andrew Handyside of Derby, England. It highlighted the contribution of engineers such as Westhoven and Chadwick and the manner in which they trained and supervised local personnel to help build a magnificent structure. The 'Blondin' overhead cableway system as used on the Orange River Bridges was used once more. These bridges resulted in significantly reducing the travel times of the local transport operators.

Due to the availability of additional funding with the completion of most railway lines, 1892 turned out to be the busiest year that the PWD had ever known in terms of new projects, both bridges and buildings. Chief Inspector Grier had consultants prepare the designs and specifications of ten new bridges throughout the colony of which the Public Works Act No. 11 of 1892 provided the financial authorisation so that they could be commenced without delay.

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97 Barkly East Reporter newspaper, 8 December 1893.

98 G.12-'93 Report of the Chief Inspector of Public Works for 1892

The Public Works Act of 1892 was titled 'to apply a sum not exceeding £170,915 for the construction of certain public works, and for other purposes'. The schedule of finance for these bridges included:

Breede River Bridge at a point near Worcester ….	£10,000
Gamtoos River Bridge ……	£20,000***
Keiskamma River Line Drift Bridge ……..	£18,240***
Olifant's River East Bridge ……	£20,000
Kaffir Kuil's River Bridge ……	£8,500
Stormberg Spruit Bridge ……	£8,500***
Breede River, Swellendam ……	£16,500
Umtata River Bridge ……...	£8,000***
Kraai River Bridge (to complete) ……..	£9,000***
Bashee River Bridge (..do..) ……..	£15,700***
[***Eastern Cape Bridges]	£134,440

Two wagon bridges were proposed for the village of Burghersdorp, which had recently acquired a railway junction. The Stormberg Spruit Bridge was designed to comprise of three spans of 100 ft each of iron triangular-lattice girders supported in stone piers when preliminary work commenced during October 1892 and was completed and opened to traffic on 19th October 1893. The second bridge over the Buitendag Spruit River from the Burghersdorp village to the new railway station, of one single 100 ft iron girder span, was completed and handed over to the Albert Divisional Council on 31st August 1895.[99]

A decade after the Great Kei Bridge at the entrance to the Transkei was completed in 1879 a bridge over the fast flowing Bashee River became an urgent priority. Once selected, investigated, surveyed and designed, the proposed new Bashee River Bridge plans had to remain in the PWD plan drawers until the depression of the 1880s had subsided. Construction of this 6 x 100ft span triangular-lattice girder iron bridge supported on iron cylinders only commenced in 1890 as no tenders were received. Adverse weather conditions and frequent flooding of the fast flowing river delayed on-going construction.[100] The Bashee River Bridge was finally opened to traffic on 9th September 1893 and named the Griffiths Bridge after the Chief Magistrate of Transkei.

The bridge over the Umtata River in the village of Umtata was not able to commence due to a dispute over the final bridge position which was brought about by a Mr Cassel who wanted the approach road to pass in front of his hotel.[101] After the bridge position delays were resolved, the construction of the Umtata River Bridge finally commenced at the end of York Road. The stone abutments and the mid-stream base foundations were

[99] G.24-'96 Report of the Chief Inspector of Public Works for 1895
[100] G.21-'91 Report of the Chief Inspector of Public Works for 1890
[101] G.12-'93 Report of the Chief Inspector of Public Works for 1892

soon completed and had to stand for several months as the ironwork which had been fabricated by Braithwaite & Kirk of West Bromwich was also delayed. Other Transkei bridges along the road from Umtata to Kokstad were the Tsitsa River Bridge comprising five 100ft spans of triangular lattice girders on cylinder piers and the Tina River Bridge comprised of three spans of steel triangular-lattice girder work on iron cylinder piers and stone masonry abutments. Another bridge further along the same road was the six 100ft span Umzimvubu River Bridge which also had to wait for its iron superstructure. All the masonry sections were completed but due to drought, the manufacturing delays in England and later the ravages of the Rinderpest epidemic, resulted in ox-wagon transport being almost unavailable and hence the projects had to stand idle for want of a few loads of cement and finally the arrival of the ironwork from the East London harbour.[102]

The incumbent Chief Inspector of Public Works, William Grier, had to take leave of absence for six months due to ill health from 28th December 1892 to seek medical care in Europe. Wilhelm Westhoven who had recently completed the construction of the Gouritz River Bridge joined the PWD during August and was tasked with discharging his engineering duties during his absence.[103] Chief Inspector Grier died of throat cancer on the 27th May 1893, a post he had held since July 1882. As the most senior district inspector, Joseph Newey was appointed as the new Chief Inspector of Public Works on 1 June 1893. Thomas Bain, the road inspector who had made a huge contribution to road and bridge building and the motivation of numerous bridges in the Cape, died on 29th September 1893. Due to the lengthy 'apprenticeships' that these English engineers had to undertake in Britain and their previous and varied work experiences before being employed at the Cape made them extremely useful and capable of carrying out all the tasks given them. The skill of the stone masons is quite apparent when inspecting the stonework of the existing bridges.

In Newey's second annual report as the Chief Inspector of Public Works to the Commissioner of Public Works for the year 1894, he lamented the lengthy bureaucratic delay associated with having bridges and other public works approved before construction could commence. In addition, he suggested that bridges be constructed out of such materials that may be procured in the Colony, and complained about the fact that it was cheaper to build bridges through forest regions of the Colony out of steel

[102] G.24-'96 Report of the Chief Inspector of Public Works for 1895
[103] CAD PWD1/690 Letter Elliott to Commissioner of Crown Lands and Public Works, 30 December 1892.

lattice girder superstructures than out of timber. He proceeded to show that it was cheaper to import and deliver to site Pitch Pine, Jarrah, Karri and Kauri timber from lands 7,000 miles away in Western Australia, than to use Yellow wood from local forests. He then quoted an example of how the Divisional Council of George bought creosoted Yellow wood timber from the Knysna forests at 4/9 (four shillings and nine pence) per cubic foot, while the imported timber, sawn straight and true to specification, could be delivered to any of the ports of the Colony at 3/- (three shillings) per cubic foot. Timber was still used extensively for bridge building throughout the Colony as it was quicker and easier to build using a standard PWD trestle design in spite of having a lifespan of only ten to twelve years. Newey expounded on the advantages of using sandstone for building stone arch bridges which, while being somewhat more expensive than those of wood or steel, they had the advantage of being practically everlasting, requiring no painting nor repairs, and were much cheaper in the end. In addition, while stone bridges may cost 20 to 30 % more than the iron or steel ones, almost the entire cost, or 90%, was spent in the Colony on wages and materials, depending on the location, while for steel bridges, only 30 to 40 % was spent in the Colony.[104]

After a thorough inspection of the existing bridge at Fort Brown, it was decided to replace the timber bridge which had been built to replace the original teak timber bridge that had been destroyed by the 1874 flood with a longer and higher bridge. The new bridge was to comprise of 10 spans of 58 ft 5 in each and the girders were to be erected 27½ ft above the present level of the bridge. The PWD had learnt their lesson regarding previous floods and increased the bridge considerably. As the new replacement bridge would have double the number of spans from five to ten, Newey had trial holes excavated beyond the ends of the bridge to determine the depth to bedrock in order to design the stone masonry piers, while the existing piers were to be utilised and lengthened. Due to the difficulty in sourcing suitable stone for the piers and abutments, which was also experienced by the Royal Engineers while building the original bridge in 1842, Newey had the perimeter stockade stone wall and several of the buildings of the abandoned Fort Brown demolished to use their stone in the new piers. He had done the same while building the Committees Drift Bridge over the Great Fish River in 1874. The ironwork for the new bridge was designed and ordered from the bridge fabricators, Joseph Westwood & Co of Milwall, London. During reconstruction all traffic had to use the old drift. It was Newey's opinion that under normal circumstances '...the present wooden superstructure would have given way years ago, it now apparently hangs

[104] G.18-'94 Report of the Chief Inspector of Public Works for 1893

together by force of habit….' [105] The reconstruction of the Fort Brown Bridge commenced in earnest once all the delayed ironwork had arrived on site for erection. The new bridge was raised above the stone masonry piers while the old timber superstructure was used as staging for the new iron girders.

A site investigation was carried out in 1879 at the designated bridge location over the Gamtoos River with cross sections and numerous trial borings of the river bed were undertaken to establish the secure depth of the future pier foundations.[106] Soon after the construction of the proposed bridge over the Gamtoos River near Humansdorp had commenced, it was placed on hold as instructed by the Commissioner of Crown Lands and Public Works due to the depression. The twice weekly mail cart had to cross the Gamtoos River by pont four times a week on the main road from Cape Town to Port Elizabeth, while 500 wagons crossed every month for which the pont receipts amounted to £461 per annum. These statistics were presented to the Select Committee appointed by order of the Legislative Assembly into whether a causeway or a bridge should be built over the Gamtoos River. The argument for the causeway was that it would hold back fresh water on this tidal river and only cost £5,000 however when in flood a pont would still be required. The argument in favour of a bridge prevailed as it would present a permanent way and be passable during floods and would cost an estimated £20,000 to build.[107]

A start was finally made to the Gamtoos River Bridge which was also to comprise of six spans of 100ft supported on iron cylinders sunk into the river bed, where preliminary operations had been commenced during November 1892. The Gamtoos River Bridge was eventually opened in November 1895 after great difficulties were overcome securing the bridge pier foundations, and which had involved the personal interventions of both Grier and Newey on several occasions.

Several bridges were erected in the districts around East London. They were the single 75 ft iron girder span Blaine Bridge over the Gonubie River on the road between Kei Road and Komgha which was handed over to the Divisional Council on completion. The stone masonry abutments and central pier of a second bridge over the Gonubie River, the Brabant Bridge just outside East London was let under contract to Maby and Haine, however on their 'failure' in September 1895, the work had to be completed departmentally. The import of the ironwork for the two 100ft spans was also delayed

[105] G.30-'95 Report of the Chief Inspector of Public Works for 1894
[106] G.41-'80 Report of the Chief Inspector of Public Works for 1879
[107] C.2-'89 Report of the Select Committee on Bridge over the Gamtoos River, July 1889.

from England. The delay in receiving ironwork from England was experienced at most of the bridge sites under construction at the time. The selection of the site of the bridge over the Kwelegha River was delayed after several interventions by local farmers and inn keepers. However, this Braithwaite & Kirk fabricated bridge comprising two 100ft iron triangular-lattice girder spans was soon erected, opened to the traffic and named the Petersen Bridge.

The Line Drift Bridge over the Keiskamma River was situated on the road between King William's Town and Graham's Town and comprised of four spans of triangular-lattice girders of 100 ft supported on stone masonry piers for which preliminary work commenced during September 1892. At the same time Newey, his son George and assistant engineer Harry Fuhr, set out the winding and torturous Keiskamma River pass down to the Line Drift Bridge. The Line Drift Bridge stone piers and abutments including the approach roads were completed under contract, while the erection of the iron work which had been fabricated by Joseph Westwood & Co of London, was erected departmentally.[108]

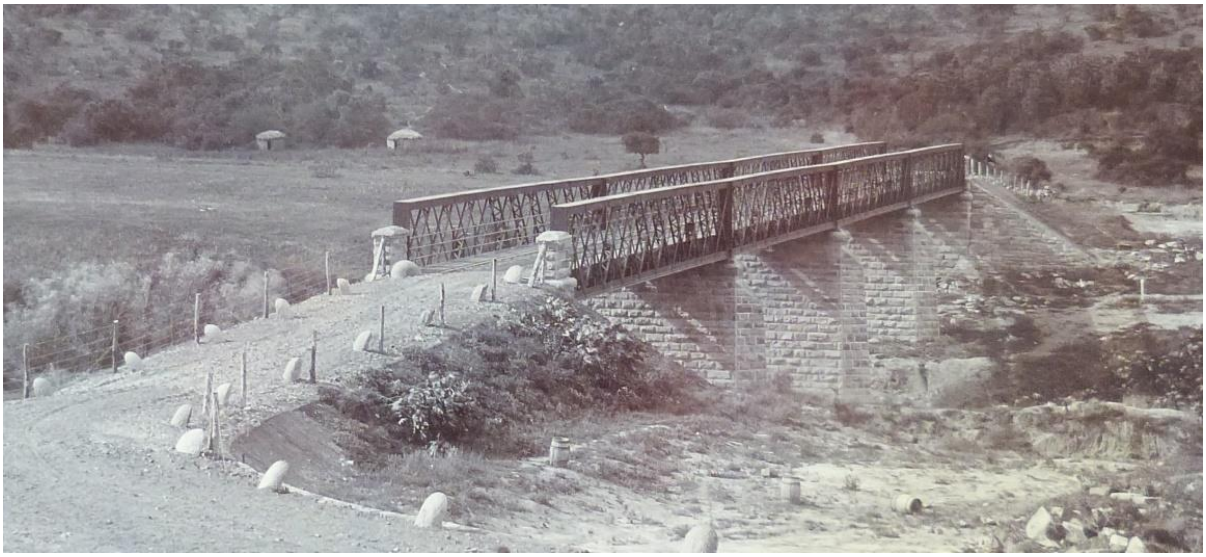

Fig 33: Line Drift Bridge, Keiskamma River 1894

A few miles from King William's Town on the road to Kei Road village, the 100ft single span bridge over the Yellowwoods River named the Lonsdale Bridge, was erected in 1896 and cost £3,427. A second two span bridge over the Yellow woods River at Breidbach outside King William's Town commenced with the masonry contractor, James MacKenzie completing the abutments and central pier before the erection of the two 75ft ironwork triangular-lattice girder spans.

[108] G.30-'95 Report of the Chief Inspector of Public Works for 1894

Fig 34: Lonsdale Bridge over the Yellow Woods River, King William's Town 1896

Designs were made for a pedestrian suspension bridge over the Tyumie River at the village of Alice which was to be undertaken by the Divisional Council of Alice.[109] Another suspension bridge was also designed by Newey to carry pedestrians, horses, oxen, mules and carts drawn by hand, across the Keiskamma River at Convict Station Drift, had also been delayed for want of the ironwork and steel cables from Manchester. The bridge was to comprise of a central span of 200ft and two side spans of 100ft each. This suspension bridge was much larger than the ones at Alice, Tsomo and Keiskammahoek that Newey had previously designed and had erected.

The two 100ft span triangular-lattice girder bridge at Driver's Drift over the White Kei River with stone masonry abutments and a central pier was erected outside the village of Lady Frere on the road to Queen's Town. The Elands River Bridge outside Tarka comprising two 100ft span iron triangular lattice girders was completed and handed over to the Divisional Council of Cradock during May 1895. The ironwork for the Sundays River Bridge at Cappers Drift arrived at Port Elizabeth while the construction of the concrete piers and abutments was in progress. This was the first time that the normal triangular lattice girder type bridge had been substituted with another pattern, a Pratt truss girder bridge, and was completed during March 1895 and named the Mackay Bridge after the one-time Port Elizabeth member of the Legislative Assembly.

The following bridges were completed during 1896:

Breede River Bridge at Worcester
Doorn River Bridge at van Rhynsdorp
Gonubie River Bridge – Brabant Bridge
Yellow-Woods River Bridge, King William's Town – Lonsdale Bridge
Grobbelaars River Bridge, Oudtshoorn – Juta-Olivier Bridge
Driver's Drift Bridge over the White Kei River
Umzimvubu Bridge, in Transkei
Toleni River Bridge, Kei Cuttings

[109] G.18-'94 Report of the Chief Inspector of Public Works for 1893

Timber trestle bridge construction continued unabated with the use of 10,000 cubic feet of Jarrah, 8,000 cubic feet of Teak and a large quantity of colonial sneeze wood during the year. The construction of these timber bridges was proof that while being a temporary solution to last 12 to 15 years they could be built quickly, using local carpenters and were based on the standard PWD timber trestle bridge design. The labour troubles and a lengthy engineering strike in England delayed most iron and steel deliveries by more than six months.[110] Due to the fact that the majority of the triangular-lattice girders were in lengths of 100 ft and for which their design loading was very much the same, the heaviest load being for ox wagons, it was proposed to order sets of these girders and place them in storage until required. The main bridges completed during 1897 were:[111]

Newey Suspension Bridge, convict Station Drift over Keiskamma River
Kraai River Bridge Aberdeen
Sir George Grey Bridge, French Hoek
Droevig Bridge near Kokstad
Oorlog's River Bridge, Calvinia
Nel's River Bridge, Calitzdorp

The delays experienced in the delivery of bridge ironwork to the various sites due to British fabrication and local ox-wagon transport delays contributed to the decision to build the final four stone arch bridges in addition to several timber trestle bridges at the time. The stone arch bridges and abutments of the North-East Cape were all constructed of stone blocks quarried from the yellow fine-grained sandstones of the Clarens or Cave Sandstone sedimentary geological formation of the Stormberg Group of the Karoo Supergroup[112] and were easily shaped by the stone masons.

The design for a three 40ft span segmental stone arch bridge over the Long Kloof River, an upper tributary to the Kraai River, on the road to the village of Rhodes and the Basutoland border beyond was prepared by Newey, unfortunately the Commissioner of Crown Lands and Public Works decided to hold the construction over to the 1894-95 financial year when additional funds were to be voted to make up the current shortfall. Problems were experienced during the construction of this bridge when one of the piers

[110] With trade unionism on the rise in England, an Employer's Federation was established in the engineering industry in 1896 to protect workers interests including the practice of employing 'blackleg' or non-union labour and countering strikes with 'lock-outs'. In July 1897 the Amalgamated Society of Engineers (ASE) labour union went on a strike for an 8-hour working day. The strike ended in January 1898 without achieving their objective, due to the ordering of a nation-wide lockout, an unprecedented act which brought about a complete capitulation of the Amalgamated Engineering Union (AEU) of which the ASE was aligned. From L.C.B Seaman, *Victorian England, Aspects of English & Imperial History, 1837-1901* (London: Routledge, 2002) pp. 327,328

[111] Detailed descriptions of these bridges appear in the following chapter nine.

[112] A.B.A.Brink, *Engineering Geology of Southern Africa*, (Pretoria: Building Publications, 1983), pp.69-70.

in the river while under construction began to settle as the foundations kept flooding the coffer dam. The bridge was finally completed and opened during October 1898.

Two more identical three 40ft span segmental stone arch bridges over the Wildebeeste and Mooi rivers commenced with the quarrying of sandstone at the villages of Ugie and Maclear.[113] The three span stone arch bridge at Ugie over the Wildebeeste River progressed to the point where the abutments and two piers were up to springing level. Work was then suspended pending the completion of the nearby Mooi River Bridge at Maclear as they were to use the same timber centering for the arches. The latter bridge was at the same stage of construction, except that they were busy erecting the timber centering.

After considering a comparison of building either an iron or stone bridge, it was decided to build a stone arch bridge of two 40ft segmental spans over the Karnmelk Spruit River on the road between Lady Grey and Barkly East. The Karnmelk Spruit Bridge was delayed owing to drawn out negotiations with the local Divisional Council and also by difficulties in pumping water out of the west side abutment excavation. The bridge was completed in 1899 and was the last stone arch bridge to be built in the Cape Colony, and was used for over 70 years until replaced by the nearby two lane concrete bridge.

During 1898 the following bridges were completed:[114]

Mooi River Bridge at Maclear
Wildebeeste River Bridge at Ugie
Karnmelk Spruit Bridge at Lady Grey
Long Kloof River Bridge at Barkly East
Tsitsa River Bridge
Fort Brown Bridge
Kwelegha River Bridge
Touw River Bridge – on the passes road between George and Knysna
Diep River Bridge - ditto
Karatara River Bridge - ditto
Homtini River Bridge - ditto
Yellow Woods River Bridge 2 – under construction
Tina River Bridge – ditto

The above bridges were erected along busy roads in mostly outlying and rural areas away from railways lines, most of which ran parallel to the coastline on the Cape Town to Transkei route. These roads had large ox-wagon, cart and carriage users that were only replaced 70 years later due to their dangerous single lane configurations.

[113] G.63-'97 Report of the Chief Inspector of Public Works for 1896
[114] G.53 '99 Report of the Chief Inspector of Public Works for 1898 for detailed descriptions see chapter nine

THE DEMISE OF WAGON TRANSPORT

The downfall of wagon transport was ascribed to the advent of the railways, which reached Kimberley on 28 November 1885, Bloemfontein on 17 December 1890 and Johannesburg on 15 September 1892.[115] Railway transportation was fast, regular, reliable, safe and could transport very heavy freight such as mining equipment and was relatively cheap. Ox wagon transport was unable to compete for all the opposite reasons as it was slow, irregular, unreliable, unsafe and seasonal along the same railway routes. Its target market changed to supplying short-haul destinations of outlying districts not serviced by the railways. Ox wagon transport rates decreased considerably in order to compete with the railways however their disadvantages of long delivery times and limited load carrying ability when compared with rail transport contributed to their decline and finally the scourge of the dreaded cattle killing Rinderpest epidemic during 1896/97 was its final demise.[116]

Rinderpest, a cattle plague that was a major killer of livestock and a major setback to the ox-wagon trade in the Colony, spread southwards from central Africa during1889 reaching Bulawayo, Rhodesia in March 1896, and resulted in the Cape Government ordering the fencing of the borders of the Cape Colony in May 1896, in the vain hope of preventing the spread of the disease into the Cape Colony.[117] The task of supplying the necessary materials for the construction of substantial fences, and the erection of several sections of the fence, fell upon the PWD, under the direction of Chief Inspector Newey.[118] The fence comprised of five strands of wire with poles consisting of sneezewood, olive, karree and camelthorn, installed ten yards apart. A total length of 1700 miles of fencing was erected, of which at least one third was situated in the most inaccessible hills and mountains of the Colony. Wagons and mules had to transport the materials vast distances, leading to one of the greatest difficulties, that of supplying drinking water for both men and animals, as drawing water from rivers was prohibited. The fence stretched from the northern Bechuanaland border with the Transvaal, to the Cape Colony boundary with the Orange Free State and along the Cape Colony boundary with Basutoland, right down to the Natal boundary. By the time the epidemic subsided, it was estimated that four million head of cattle had died and the ox wagon

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115 J.Burman, *Early Railways at the Cape*, (Cape Town: Human & Rousseau, 1984), pp. 95,139,140.

116 J.Burman, *Towards the Far Horizon, the story of the ox-wagon in South Africa,* (Cape Town: Human & Rousseau, 1988), p.134-146.

117 Colonial Veterinary Surgeon, Cape of Good Hope, *Special Report on Rinderpest in Southern Africa, March 1896 to February 1897*, in C,Van Onselen, Reactions to Rinderpest in Southern Africa 1896-7, *Journal African History,* 13, 3,(1973)

118 CAD PWD1/702 & PWD1/703 Reports about Rinderpest fence, 1896-1897.

transport enterprise almost wiped out. This monumental undertaking resulted in most other works on the PWD programme having to be delayed or postponed during 1896/97.[119] While the construction of the Rinderpest fences had taken up much of the PWD's work during 1897, the eventual appearance of the cattle plague in the colony brought about the prohibition of the movement of cattle in most divisions. Transport therefore became almost unobtainable for many months and was extremely expensive, delaying several works due to the lack of the supply of timber or ironwork.

During the late 19th century the railways relentlessly threatened the activities of long distance ox wagon transport. The demand for heavy cargo transport by wagon during the initial stages of diamond and gold mining and during the Anglo Boer War only lasted for a short time.[120] In spite of many setbacks, transport riding continued in areas not served by the railways, especially in the Eastern Cape and Transkei. Annually almost 8,500 wagons carried more than 25,000 tons across the Kei River Bridge in the early 1900s, or 24 wagons per day to the 600 odd trading stores in Transkei. Once the railway line was constructed into Transkei, the authorities went to great lengths to stifle the African dominated ox-wagon transport industry which was much cheaper than rail. In spite of all kinds of official interventions, it took an outbreak of East Coast Fever to ravage the herds and the subsequent closure of the Kei River Bridge for a decade to finally end the ox-wagon transport industry of the Transkei.[121]

Additional proposed stone arch bridge sites were surveyed, designed and construction drawings prepared for crossing of the Bell River on the road from Moshesh's Ford to Rhodes and Naudeshoek, with others over the Kraai River near Moshesh's Ford, the Kraai River at Belmore, Barkly East, and over the Sterkspruit River at the village of Sterkspruit, all bridges that were never built. The outbreak of the Anglo Boer War in October 1899 once again curtailed all colonial bridge construction. The war which lasted from 11th October 1899 to 31st May 1902 resulted in many stone masons being used to build stone masonry blockhouses and repair sabotaged bridges and culverts during the hostilities.[122] The services of the PWD was used extensively throughout the war drilling for water to supply the troops in the field at the various camps and also at some of the 7,888 blockhouses situated all over the Cape Colony, Orange Free State

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119 G.63-'97 Report of the Chief Inspector of Public Works for 1896

120 W.R.Nasson, 'Moving Kitchener: Black Military Transport and Supply during the South African War, 1899-1902', with Particular Reference to the Cape Colony, *Journal of South African Studies*, 11, (1984), pp.25-51.

121 G.H.Pirie, 'Slaughter by Steam: Railway Subjugation of Ox-Wagon Transport in the Eastern Cape and Transkei, 1886-1910', *International Journal of African Historical Studies*, 26, 2 (1993), pp.319-343.

122 E.H.Bethel RE, 'The Blockhouse System in the South African War', *Chatham: Professional Papers of the Royal Engineers,* 30, (1904), p.280.

and the Transvaal. A large number of officers of the PWD went on active service, some joined the various Town Guards, while others had their services placed at the disposal of the Military Authorities in connection with intelligence work and professional and technical undertakings.[123] The disruptions of the Anglo Boer War and the subsequent demise of skilled stone masons led to the more common use of reinforced concrete. Steel bridges continued to be built, however the expensive triangular-lattice girders were eventually substituted with mostly more cost effective Pratt truss bridge configurations such as first seen at the Mackay's Bridge over the Sundays River near Colchester.

All of the above mentioned stone arch and iron lattice girder bridges were built with narrow, single lane carriageways, leading to most of them being replaced with wider, reinforced concrete bridges much later as the increasing volume of motor transport made it inevitable. The only stone arch bridges to be built after the Anglo Boer War was in Bloemfontein over the Bloemspruit in 1904, six flat arch bridges with wider two-lane carriageways. The first reinforced concrete bridge in the Cape Colony, the Putt Bridge over the Kowie River at Port Alfred, opened in 1908, signalled the commencement of the modern era of bridge design and construction and for motor vehicle transportation.[124]

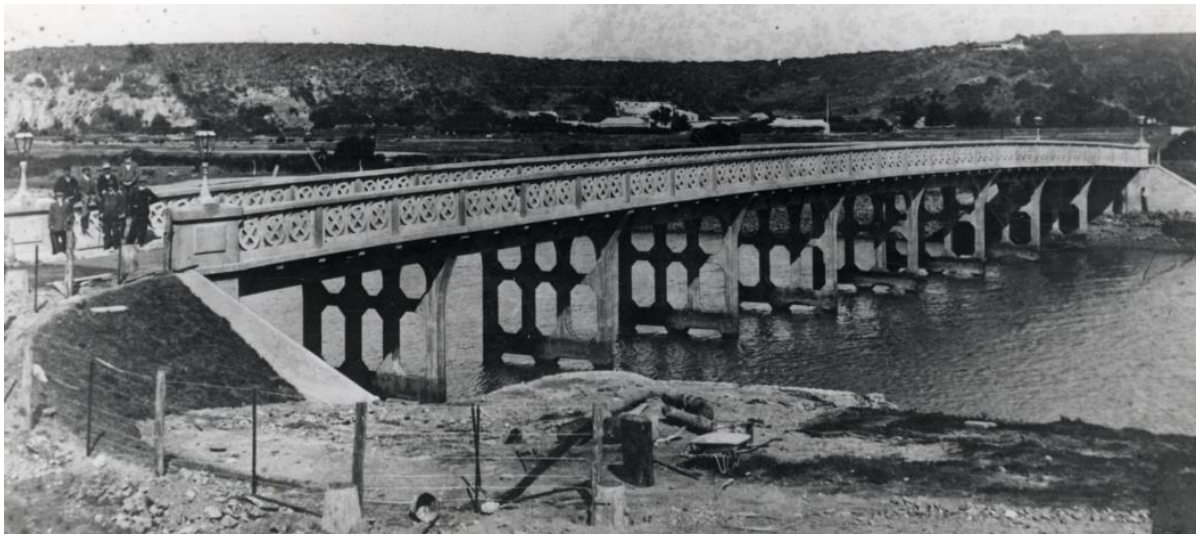

Fig 35: Putt Bridge over the Kowie River, Port Alfred, 1908

[123] G.48-1901 Report of the Chief Inspector of Public Works for 1900
[124] The Henry Putt Bridge, Port Alfred, Hallmark 36, *The Civil Engineer in SA* (Jan 1981), pp.22-23.

CONCLUSION

The above chapter has outlined the bridges that were erected in the Eastern Cape from the time the Central Road Board was disbanded in 1860 up until the outbreak of the Anglo Boer War in 1899. It has featured timber bridges, iron lattice girder bridges and stone masonry arch bridges from throughout the region. The design of iron lattice girder bridges was well known, although they were statically indeterminate, they were able to be analysed by superimposing a number of statically determinate 'warren' trusses one on top of another, and arriving at an acceptable solution. Fabricated in England, they were able to be assembled quite easily on site and riveted together. Newey showed how the girders were launched into position without the need for supporting falsework having to be erected in the flowing rivers. The great flood of 1874 highlighted various design deficiencies and the degree of risk that the authorities were prepared to accept that bridges could be damaged or destroyed in the event of extreme floods. A recent study has shown that the bridges were destroyed by a flood with a statistical probability of occurring of one in a hundred years.[125] The successful construction of bridges was very much dependent on the transport of the hundreds of pieces iron to the bridge sites by the slow-moving ox wagons which were badly affected by drought conditions and disease. Eventually manufacturing delays in Britain together with transport delays forced the authorities to erect large numbers of timber bridges in the remote regions and to construct stone masonry arch bridges instead of iron bridges.

In the following chapter the detailed construction histories of the various individual stone arch and iron lattice girder bridges that were constructed in the Eastern Cape Colony will be presented. The construction of these bridges will cover the period from 1860 to 1900 and will include the last decade of the nineteenth century when a bridge building boom took place, only to be halted by the onset of the Anglo Boer War. The construction record of individual timber trestle bridges have been omitted from this thesis due to the absence or paucity of both archival and reported information regarding their construction, and the fact that no physical evidence remains regarding their actual locations. Timber bridges were a temporary solution and finally became obsolete when heavier petrol engine motor vehicles became the preferred mode of transport and necessitated the erection of suitable two-lane bridges.

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[125] Van Bladeren, Zawada and Mahlangu, '*Statistical Based Regional Flood Frequency Estimation Study for South Africa Using Systematic, Historical and Palaeo Flood Data'.*

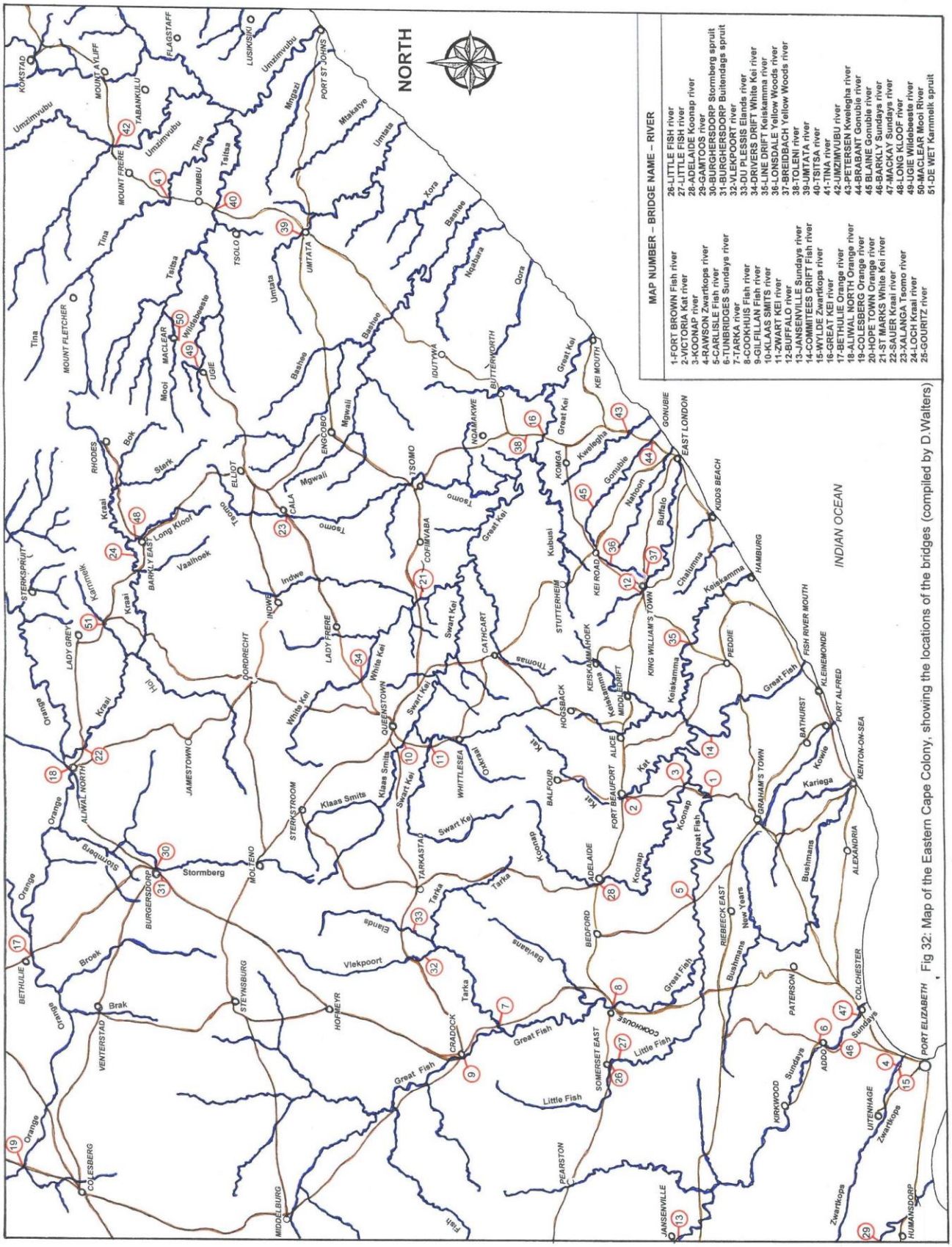

Fig 36: Map of the Eastern Cape, showing the locations of the bridges

CHAPTER NINE – DESCRIPTIONS OF BRIDGES BUILT IN THE EASTERN CAPE c.1858 – 1899

The following synopses of the individual bridges that were constructed in the Eastern Cape will describe the design innovations and construction methods, identify the manufacturing and fabricating ironwork companies, the design engineers and the accomplishments of the bridge erectors, as well as identifying any problems and challenges encountered during the construction of the individual bridges as well as the costs of construction. Of all the individual bridges investigated and described in this study, very little technical information regarding their detailed engineering design such as design calculations has been found. While only limited original construction specifications and drawings have been located. The only other resources are the bridges themselves, (those that have not been demolished) and knowledge of general bridge design methods of the day, as outlined in chapter seven. The following are the detailed histories of construction of the more significant individual bridges to which the narrative in chapter eight refers.

1 - THE RAWSON BRIDGE OVER THE ZWARTKOPS RIVER, PORT ELIZABETH

From 1856 the calls by Port Elizabeth merchants, transport contractors and regular users of the Port Elizabeth to Graham's Town road for a bridge became more frequent as the pontoon was unable to operate during heavy north-westerly gales. The large amount of traffic to cross the Zwartkops River by pontoon led to unacceptable delays which justified the building of a bridge. It was said that the tolls, which amounted to £600 per annum, would soon recover the expense of construction. The Colonial Engineer, Capt Pilkington framed an estimate of £5,000 to construct the bridge.[1]

The site selected for the bridge was two miles from the mouth of the Zwartkops River and comprised of a timber trestle bridge, was named after the Cape colonial secretary at the time, Rawson W. Rawson. The Rawson Bridge was designed by the assistant colonial civil engineer, Matthew Woodifield while Murrel Robinson, the acting civil engineer supervised the contractor Mr Kerr, who was awarded the contract in 1858 for the fixed price of £5,000.[2] It was reputed that wagons carrying half the materials used to build the frontier towns passed over it. The very heavy traffic over the timber bridge deck required the installation of iron plates to receive the wagon wheels and protect the

[1] G.18-'56 Annual Report of the Central Board of Commissioners of Public Roads for the year 1856
[2] G.57-'59 Report of the late Central Board of Commissioners for Public Roads for 1858

timber deck, in addition to the installation of 48 guard rail posts by the clerk of works Richard Howland.[3] The bridge which finally cost a total of £6,030.17.5 to build was opened on 24 September 1858.[4]

In 1862 the ironwood piles showed signs of serious sea-worm inflicted decay at the level of the low-water mark in spite of withstanding the floods of November 1867 and again in October 1869, when the bridge began to cant alarmingly.[5] Robinson inspected the bridge soon afterwards and found that it had settled by 5ft 7in on the downstream side and 2ft 10in on the upstream side. In addition the whole bridge had displaced horizontally downstream. James Jardine repaired the bridge with black stinkwood piles at a cost of £775.[6] Finally during the floods of 1876 the old worm-eaten timber piles snapped, and '….with an expiring groan like a cannonade….' as the *Uitenhage Times* described it, the old Rawson Bridge collapsed and was swept away into the ocean and the public had to use a ferry once again.[7] This timber bridge would have been selected due to the simplicity of pier construction in a tidal river with deep mud and sand deposits beneath the river bed. It was easier to pile drive timber piers into the sand than to try and excavate down to solid formation, requiring coffer dams and steam pumps. The Rawson Bridge was replaced by the iron Wylde Bridge, described below.

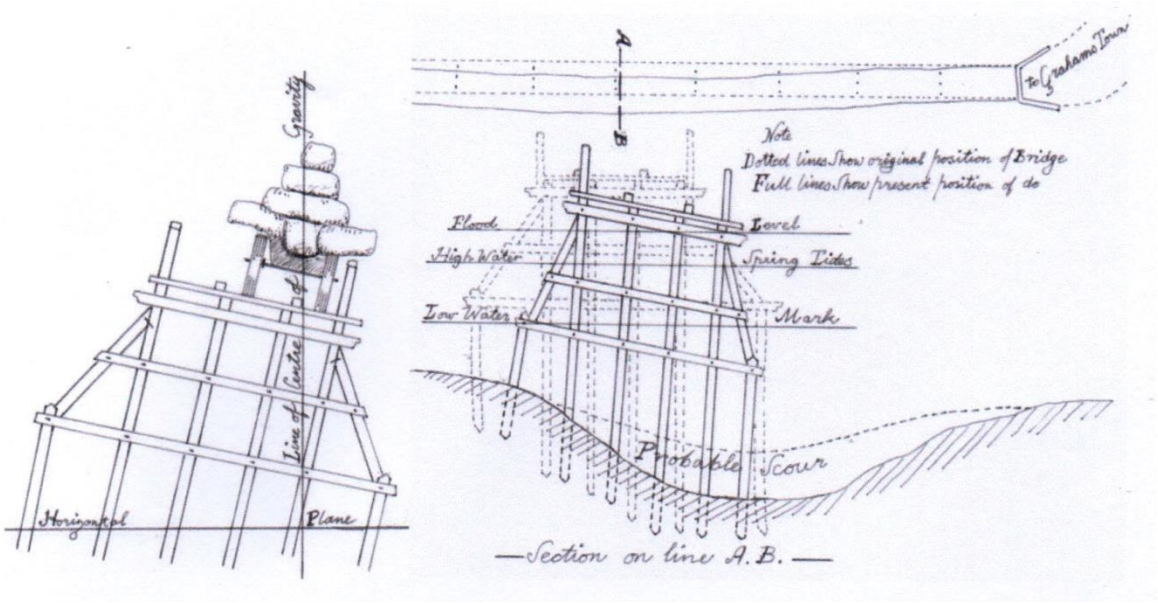

Fig 37: Rawson Bridge showing excessive tilt before collapse in 1876 [8]

[3] *G.21-'61 Report of the Commissioner of Roads for 1860*
[4] *A.35-'61 Bridge Returns of the Eastern and Western Province to the House of Assembly, 1861*
[5] *G.34-'63 Report of the Commissioner of Roads for 1862*
[6] *G.15-'70 & G.31-'71 Reports of the Commissioner of Roads for 1869 & 1870.*
[7] *W.S.J.Sellick, Uitenhage Past and Present, (Published by Uitenhage Times, 1905), p.111.*
[8] G.42-'77 Report of Chief Inspector of Public Works for 1876

2 – CARLISLE BRIDGE AT ESPAGS DRIFT OVER THE GREAT FISH RIVER

The annual reports of the Central Road Board in 1854 and 1855 made urgent calls for bridges over the Fish River at Espag's Drift and over the Koonap River at Tomlinson's Post. This was followed by the report of 1856 which provided the Colonial Engineer, Capt Pilkington's cost estimate of £3,630 for each of these bridges.[9] Construction of a bridge at Espag's Drift across the Fish River on the road from Graham's Town to Cradock was commenced during 1858, the final year of the Central Road Board. Work started by quarrying stone for the bridge pier and abutments. No less than six quarries were opened before suitable stone could be mined. The excavations amounted to 1,695 cubic yards using 25 lbs of gunpowder for blasting rock.[10] The clerk of works, Andrew Clarke, completed the two stone masonry abutments and single central pier during 1861 and then had to wait for the arrival of the ironwork. The bridge was designed by Henry Wakefield of Adelphi, London, who had previously been employed by I.K.Brunel on the Saltash Bridge at Plymouth, Devon in 1859.[11] The lattice girder ironwork, similar in configuration to the bridges at Committees and over the Berg River at Piketberg, was riveted together and launched into position under the superintendence of clerk of works David Ferguson during February 1863.[12] The Carlisle Bridge was built by the Colonial Government at a cost of £15,329 and consisted of two ironwork lattice girder spans of 120 ft each resting on a central masonry pier and end abutments. The roadway of the bridge was 40ft above normal river flow while the flood of 1863 came within 8ft of the bridge ironwork.[13] It was one of the bridges destroyed during the 1874 floods. The difficulty of bridging this site would have been similar to the upstream Gilfillan and Cookhuis Bridges, which also required excavating and building masonry piers in coffer dams and launching the girders into position without staging in the fast flowing Great Fish River.

[9] G.22-'57 Annual Report of the Central Board of Commissioners of Public Roads for 1856
[10] G.57-'59 Report of the late Central Board of Commissioners for Public Roads for 1858
[11] CAD PWD1/337 ICE obituary 1900 & Letter Wakefield to Chief Inspector of Public Works, 2 April 1874,
[12] G.34-'63 Report of the Commissioner of Roads for 1862
[13] G.39-'64 Report of the Commissioner of Roads for 1863

Fig 38: Carlisle Bridge, Espag's Drift, Great Fish River 1863

3 - THE SUNDAYS RIVER BRIDGE ON ADDO DRIFT AT TUNBRIDGES

Addo Drift was the first convenient natural crossing of the Sunday's River to be used by travellers. A military post built there in 1815 was followed by several inns from 1820. Before Edward Tunbridge purchased the Elephant & Castle Inn in 1848, Staines a previous owner recorded that as many as 150 wagons often passed in a day around the time the Zuurberg Pass was under construction. The name of the inn eventually became known as 'Tunbridges' where the owners also operated a pont before the bridge was built.[14] The bridging of the Sundays River was long delayed despite several deputations to the divisional council. During 1850 an 86ft long iron pontoon was ordered from England and placed in position at Tunbridges, close to Addo drift. A second pont was operated closer to the river mouth by John Capper, two miles above the future Mackay bridge at Colchester.

In 1855 the Colonial Civil Engineer, Capt Pilkington compiled an estimate of £5,000 to bridge the Sundays River. It was mentioned that the approaches to the pont were difficult to repair as the river bed and banks were composed of stones and mud.[15] Matthew Woodifield, the assistant colonial engineer completed the survey and cross sections of the site at Tunbridges in 1859 and submitted his report to the chief commissioner for approval. His design was for a timber bridge with stone abutments and piers and an estimate of £9,000. The Governor postponed the project in order for the proposed railway route to be finalised. The project was only revived in 1868. The design of the triangular-lattice girder bridge was undertaken in 1860 by the consulting engineer Charles Cheyne of Great George Street, Westminster, London. Cheyne also

[14] M.Harradine, 'The Inns of Addo Drift', *Looking Back, PE Historical Society*, (Sept 1996),p.5.
[15] G.19-'54 Report of the Central Board of Commissioners of Public Roads for the year 1853

designed the bridges over the Berg River near Piketberg and one at Capper's Drift. The latter was never built as a new pontoon was installed instead.[16]

4 – THE TARKA BRIDGE OVER THE TARKA RIVER

This bridge was erected across the Tarka River on the road that runs from Graham's Town to the Orange River, via Cradock. By 1862 an amount of £4,191 was spent, with the upper masonry of the abutments and single pier was almost completed under the superintendence of the clerk of works Colin Lawrence.[17] The ironwork for this lattice girder bridge of two spans of 85ft costing £1,752 was shipped on the *Rubens* which arrived during November 1863 at Algoa Bay, transported to site in December while timber was ordered for the decking from the Katberg forest.[18] The Tarka Bridge was completed and opened to traffic on 1 January 1865 at a final total cost of £7,914. The chief inspector remarked that because of the small amount of ironwork used and the 'cheapness of erection', similar solutions should be considered on other projects.[19] Iron lattice girder bridges became the preferred option for crossing the larger and more important rivers, while timber bridges were erected over all lesser rivers.

5 – THE COOKHUIS BRIDGE OVER THE GREAT FISH RIVER.

Once the Zuurberg Pass had been opened to the public during March 1858, the road from Port Elizabeth to Cradock crossed the Great Fish River at Cookhuis Drift was regarded as a suitable site for a bridge. The road from Somerset (East) to Bedford and Fort Beaufort also crossed the Fish River there and was reported to be in a dangerous state. The divisional councils of Somerset and Bedford agreed to share the cost to repair the drift. A large labour force was used on the project, excavating the deep approaches and filling-in the holes in the river bed with large rocks.[20]

16 A.35-'61 Bridge Returns of the Eastern and Western Province to the House of Assembly, 1861
17 G.34-'63 Report of the Commissioner of Roads for 1862
18 G.39-'64 Report of Chief Commissioner of Roads for 1863
19 G.37-'65 Report of Chief Commissioner of Roads for 1864
20 G.32-'60 Report of the Commissioner of Roads for 1859

Fig 39: Cookhuis Bridge over the Great Fish River 1868

Matthew Woodifield, the assistant colonial engineer was instructed to locate a bridge site in April 1859 and to survey a cross section at the preferred position in order to frame an estimate of costs. Notwithstanding the deep river channel, he reported that the good stone, lime and sand deposits to be found in the vicinity made it a favourable site.[21] The tender to build this bridge consisting of three spans of 90ft, was awarded to James Jardine of Cape Town in the amount of £11,500. The stone masonry abutments and two piers were to support the iron lattice girder bridge complete with a sneeze wood bridge deck.[22] The masonry contractor commenced work in April 1866 and as to be expected when working in the strongly flowing Fish River, progress on building the two central piers in the middle of the river was slow. The construction of the two approaches to the bridge took six months between July and December 1866, at a cost of £379. Sneeze wood timber for the decking planks was supplied under contract by William Wattrus. An accident occurred while launching the first ironwork span of the bridge which collapsed and necessitated the unriveting, repairing and reversing the whole superstructure. Due to this setback the bridge was only completed on 31 December 1868. The final completed cost amounted to £10,816.[23] The construction of this bridge was very difficult, firstly building the two masonry piers in the river bed of the Fish River, required coffer dams and steam pumps. Secondly, the partially completed iron girders had to be launched across three spans without the use of timber staging false work.

[21] G.32-'60 Report of the Commissioner of Roads for 1859
[22] G.14-'66 Report of the Commissioner of Roads for 1865
[23] G.21-'67 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1866,

6 – THE GILFILLAN BRIDGE OVER THE GREAT FISH RIVER, CRADOCK

The great difficulty in crossing the Great Fish River at the town of Cradock when in flood caused local farmers on the west side of the river great inconvenience. In the late 1850s the Municipality decided to build a bridge and commissioned an engineer to design the bridge which was to comprise of two 90ft iron lattice girder spans supported on a central dressed stone masonry pier. The engineer in July 1861 estimated an amount of £4,913 to complete the project. The commissioners of the Cradock municipality raised an amount of £1,100 at the Cradock Bank at 10% interest against personal sureties. The government delayed making its initial contribution £1,000 short of the £2,000 agreed to in 1863. New tenders were called to complete the works for which an amount of £3,260 had already been incurred to make the final cost of £5,600.[24] Chief Inspector Robinson visited Cradock in October 1865 after which the commissioners of the municipality issued the following resolution: '….With reference to the completion of the bridge over the Fish River, this board is prepared to hand over to the Government the iron work of the bridge, which cost £3,378 with the understanding that the Government will relieve this board from the remaining liability on it, amounting to £1,250….'[25] Robinson's estimate to complete the bridge was £8,800.

Fig 40: Gilfillan Bridge over the Great Fish River, Cradock 1869

[24] G.14-'66 Letter from the Cradock Bridge Committee to the Colonial Secretary, 19 August 1865 contained in the Report of the Chief Inspector of Roads, Bridges and Buildings for 1865.
[25] G.14 –'66 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1865

Once the previous costs and loans had been subtracted the government would need £7,671 to be paid from the general revenue budget.[26] The Divisional Council was authorised by Act 6 of 1867 of Parliament to take over from the Commissioners of the Municipality of Cradock an Iron Bridge, and to borrow Moneys upon the security of Road Rates and Tolls for the erection of the same across the Fish River at Cradock. The preamble to this act outlined the problem confronting the commissioners of the municipality who had purchased an iron bridge for erection across the Fish River at Cradock and for which certain sums of money was contributed by grants from municipal general revenue, funds of the divisional council and voluntary subscriptions, but were unable to complete the bridge for want of necessary means. The divisional council proposed to take over from the municipality and erect the bridge with money borrowed on the security of the road rates of the Cradock division to be levied under Act No.9 of 1858, and the tolls intended to be levied at the bridge. The rates and tolls were to be mortgaged for securing the repayment of the borrowed moneys for which Parliament provided the authority and stipulated a maximum sum of £6,000 to be expended.[27] This complicated scenario came about due to the Cradock municipality urgently requiring the bridge and the original engineer providing them with an unrealistic estimate of costs. Their first problem would have been erecting the single central masonry pier in the fast flowing Great Fish River, as encountered at Cookhuis Bridge. All other bridges of the region were implemented by the government through either the Colonial Engineer, the Central Road Board or the PWD.

In addition, once the bridge was completed and open to the public, all fords along the Fish River within two miles of the bridge were to be closed.[28] The bridge was completed in 1869 and opened by Sir Philip Wodehouse, the Governor of the Cape Colony. It was named the Gilfillan Bridge after William Gilfillan, the first Civil Commissioner and Magistrate of Cradock.

The Divisional Council of Cradock were empowered to erect the Gilfillan Bridge over the Fish River at Cradock and establish a Toll as per Act No.9 of 1858, in addition, they were empowered to close all fords across the river within two miles of either side of the bridge. Vorster, the lessee of the bridge, had Threepence (his name as recorded in the court papers), an amaXhosa wagon driver prosecuted for evading the toll by crossing the river within two miles of the bridge and thereby evading the payment of the toll. In

[26] G.14 –'66 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1865
[27] G.14-'66 Letter from the Cradock Bridge Committee to the Colonial Secretary, 19 August 1865
[28] J.Foster, H.Tennant, E.M.Jackson (ed), *Statutes of the Cape of Good Hope*, 1652-1886, (Vol. II, WA Richards & Sons, Cape Town, 1887), pp.2595-2597.

spite of pleading not guilty, he was convicted and sentenced. The conviction was quashed on appeal on 23 May 1878 on the grounds that section 15 of the Act referred only to evasions of the toll on the bridge and while section 7 of Act No.6 of 1867 could close all the fords, there was no penalty for anyone using such fords. Six previous and similar cases in England were shown not to be evasions of the law.[29] As a result of this ruling several other fords were either barricaded or chained to prevent crossing by toll keepers.

7 – THE CATHCART BRIDGE OVER THE KLAAS SMITS RIVER

This timber bridge was built for the contract price of £2,290 by James Jardine, on two 15ft high stone masonry piers and abutments comprising three 46ft spans of teak timber, adapted to the lesser colonial rivers where spans are less than sixty feet. This bridge completed in March 1869 was on the great northern road from Katberg to the Orange River at Aliwal North. The timber bridge specification required that the main beams be of teak while colonial timber of sneeze wood, pear, and ironwood used for all other timber and decking.[30] Timber bridges were economical because timber was much cheaper than iron, it was faster to build, only required carpenters and were built to standard PWD designs.

8 – THE WODEHOUSE BRIDGE OVER THE ZWART KEI RIVER

Another timber bridge was built at the same time 5½ miles from the 'Cathcart' bridge, also under contract by James Jardine for £3,100 and comprising four 46ft spans on three stone masonry piers and side abutments.[31] Construction started late in 1868 and was completed in June 1869. This was another economical timber bridge across a 'river' that only flowed when it rained.

9 – THE BUFFALO RIVER BRIDGE, KING WILLIAM'S TOWN

After the British Crown Colony of Kaffraria (1847-66) was re-incorporated into the Cape Colony, more attention was focused on the need to bridge the Buffalo River at King William's Town. Designs and estimates for timber bridges over the Buffalo and Keiskamma Rivers were submitted to the government in 1869. In 1870 tenders were invited for the construction of a timber bridge over the Buffalo Bridge at King William's Town. Two tenders were received with the lowest amounting to £5,100 which was well

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29 E.J.Buchanan, *Cape of Good Hope Supreme Court Cases during 1878,* Vol 3 (Cape Town: Juta, 1894), p.55.
30 G.23-'69 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1868
31 G.23-'69 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1868

above the normal price of similar timber work and was approaching the cost of an iron bridge. As a consequence, Chief Inspector Robinson recommended that an iron bridge be used, which was approved by the Governor.[32] The Colonial Secretary engaged the Crown Agents to initiate the process of having an iron bridge erected. The Buffalo River Bridge was designed by the London Consulting Engineer, Henry Wakefield, and was fabricated by Walter Williams of the Wednesbury Oak Ironworks of Tipton, Staffordshire. The single lane, two 90ft span, wagon bridge was built to join the east bank and the west bank portions of the town along Bridge Street, close to what became the King Tannery building, and to provide a dependable wagon and post cart access to the postal roads to Graham's Town and the former military garrison at Fort Beaufort. On the east side an 'escape' arch bridge 18ft wide and an arched stone culvert 6ft wide across the municipal water furrow was also built.

Limited work with hired labour commenced during 1872 under the direction of Adam de Smidt, the local road inspector. Excavation of the western abutment out of solid rock commenced and the quarrying of 'excellent quality' stone for the masonry.[33] By the end of 1872 the stone masonry of the abutments and single pier was completed and ready for the ironwork which had arrived for erection. The fabricated ironwork was first dispatched in February 1873 and the order was completed two months later at a final cost of £2,635 11s 6d.[34]

The newly arrived bridge erector Joseph Newey, immediately took control of the Buffalo River Bridge Works from the Road Inspector, Adam de Smidt, and issued a long list of items required for the erection of the bridge. They included ratchet wrenches, 10 and 20 ton lifting jacks, pulley blocks, hemp ropes, chains and clamps all the items required to launch the bridge girders into position. The method to be used was to assemble the bridge's two side girders at the east side approach abutment. When partially riveted the two 90 ft wrought iron lattice girder spans were to be incrementally launched across on rollers, using ratchet wrenches, jacks and lever power. De Smidt reported the successful launching of the Buffalo Bridge in a report to the chief inspector, as follows:

> '…launching commenced at sunrise on Tuesday 10 June 1873 when a distance of 12ft 6in was moved in 10 minutes on rollers only. On Wednesday having attached each for hauling and guiding the framework across as shown on the diagram, the launching was resumed at 9:30am and the centre of the pier was reached at 12:30pm….. the wind and delays until 1:00pm when wind fallen, launching resumed……next morning remaining 60

[32] G.31-'71 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1870

[33] G.28-'72 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1871

[34] CAD PWD1/173 Letter from Crown Agents to Colonial Secretary, 9 October 1972.

ft launched in 45 minutes……the vertical deflection of the framework when suspended 88 ft was 3½in…' [35]

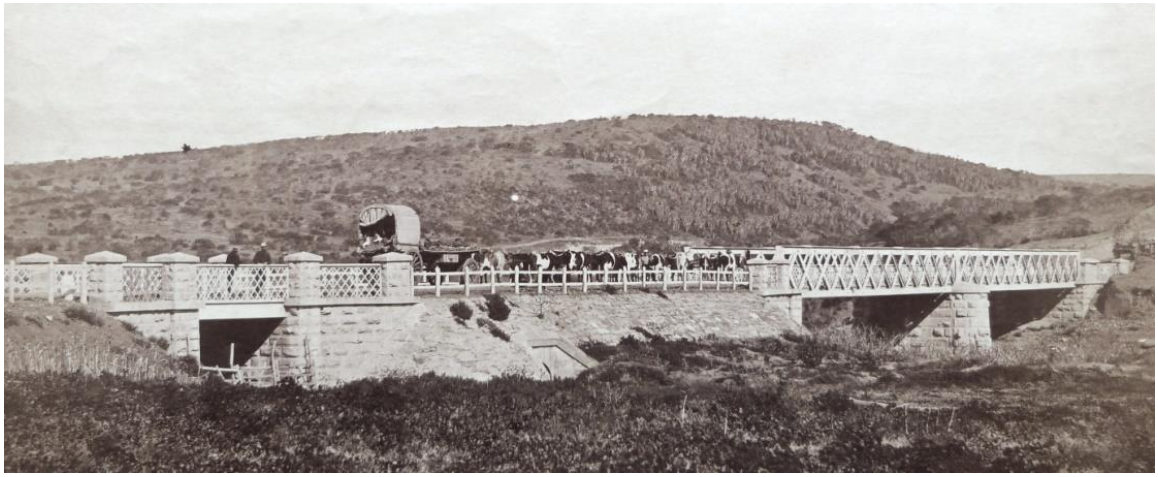

Fig 41: The Buffalo River Bridge, King William's Town 1873

The *Kaffrarian Watchman*, one of the two local newspapers, kept track of the bridge building activities, outlining the following in an article,

> …The iron frame-work of this beautiful bridge having been so far adjusted as to be ready for launching, operations were commenced yesterday afternoon, under the able superintendence of Mr A de Smidt and Mr J Newey, and the massive structure was by means of ratchet rollers moved by lever power, projected with ease some ten or twelve feet over the stone work on the east side, the process occupying about ten minutes. This was merely intended as a preliminary move, the final launch being left for to-day, when, at 9 am, the framework began again to move forward and span the breadth of the river, some 180 feet….[36]

So without pomp and ceremony, the Buffalo Bridge was simply opened to public traffic, and Newey packed up his household and set off to Committee's Drift on the Great Fish River during August 1874. During construction of the bridge a strike by workers on roads and bridges for higher wages petered out as the two ring-leaders were dismissed and the workers returned to work at the old rate of 1s 6d per diem.[37] The Buffalo Bridge, which cost a final total of £8,569.17s.6d, would serve the community until it was finally demolished in 1935 to be replaced by a two-lane reinforced concrete bridge on the same site and using the same stone abutments, as the old wagon bridge was too narrow with only a single lane and had become dangerous and rickety with the increase in the number of heavier motor vehicles.[38]

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[35] CAD PWD1/152 Letter de Smidt to Robinson. 14 June 1873.
[36] Kaffrarian Watchman newspaper, 10 June 1873
[37] G.42-'74 Report of the Chief Inspector of Public Works to the Cape Parliament for 1873 and CAD PWD1/153 letter A de Smidt to Chief Inspector of Public Works, 17 November 187.3
[38] Walters, *Bridging the Eastern Cape*, p.43.

10 - THE JANSENVILLE BRIDGE OVER THE SUNDAYS RIVER

The agitation for a bridge over the Sundays River was in progress even before the town of Jansenville was laid out in 1855. When in1859 it became common knowledge that the authorities had suggested building a bridge at Noorse Doorn Plaats, a storm of protest erupted. At a meeting of the Uitenhage Divisional Council in August 1859 a petition was presented by the residents of Jansenville requesting that the proposed bridge over the Sundays River be sited at the entrance to the village of Jansenville and not at Norse Doorn Plaats as planned. It was argued that the shortening of the route of the proposed road to Graaff Reinet would be more economical. The Council took up the matter with the government, citing the low levels of the river banks at Norse Doorn Plaats which led to frequent flooding of the large surrounding area thus rendered impassable for traffic. Statistics compiled and presented by merchants of Port Elizabeth showed the importance of the road. The road inspector, Adam De Smidt completed the site survey and two sections of the possible bridge position in 1873. In addition, he indicated a favourable source of rock for the two piers and abutments about 700 to 800 yds from the site.[39] In a second letter, de Smidt commented on the Chief Inspector's counter proposal of basically preferring a longer bridge. De Smidt thought this a waste of money; however severe flood damage would later prove his Chief correct. In addition, de Smidt gave as his reason for preferring the Norse Doorn Plaats was that the entire site was founded on solid rock.[40]

Fig 42: The Jansenville Bridge over the Sundays River 1875

The work on the dressed stone masonry abutments and two central piers was commenced under the superintendence of C.G.Lawrence on 18 November 1873. James Jardine took control in August 1874 to complete the stonework and erect the ironwork.[41] The devastating floods of December 1874 saw the floodwaters of the

[39] CAD PWD1/153 Letter A de Smidt to Chief Inspector of Roads and Bridges, 6 Sept 1873.
[40] CAD PWD1/153 Letter A de Smidt to Chief Inspector of Roads and Bridges, 15 Oct 1873.
[41] CAD PWD1/155 Letter J Jardine to Chief Inspector of Roads and Bridges, 28 Aug 1874.

Sundays River overtop the piers without any damage. Early in 1875 twelve wagon loads hauling 110 tons of ironwork designed by Henry Wakefield of London and fabricated by Fleet & Newey of West Bromwich UK,[42] arrived on site by ox wagon at the exorbitant cartage cost of £743. Jardine completed launching the three 80ft spans of the triangular-lattice girder bridge on 22 July 1875 without mishap and it was opened to traffic on the 23 August 1875.[43] The bridge which was officially declared open at a ceremony by the wife of the magistrate Mr W. Maskew on 5 April 1875. The cost of the bridge up to the 31st August 1875 was £3,306.10.00.[44] A large flood in early1900 undermined and destroyed the town side stone masonry abutment and its nearest iron span which was replaced with a timber trestle span. The proposal for a wider bridge by the chief inspector may have averted the destruction of the LH abutment and span. Here the subject of risk could now be debated as a longer bridge would have had a larger waterway through the bridge opening as opposed to a shorter, lower bridge deck and a reduced waterway. Smaller water ways led to higher flow velocities with greater scour potentials, as was later to prove correct when the left hand abutment was washed away.

11 – THE COMMITTEE'S DRIFT BRIDGE OVER THE GREAT FISH RIVER

Committee's Drift comprises a natural flat rock shelf across the Great Fish River, which became a reliable point where wagons and carts travelling along the north or upper main road from Graham's Town to King William's Town crossed the river. It was also the site of the 'Comittays' Drift Military Post which was a strategic location along the dense Fish River bush. To reach the Fish river and the military post from Graham's Town, the traveler had to follow a leg of the Queen's Road, along one of Andrew Geddes Bain's first military roads. The route passed along Governor's Kop road over King's Flats, over Botha's Hill and from there down the steep and hazardous descent of Pluto's Vale mountain to Committee's Drift, and then on to Breakfast Vlei, eventually terminating at King William's Town.[45]

A proposal to erect a light wire suspension bridge over the Fish River at Committees was made in 1870. This would allow safe passage to foot passengers and mail bags during floods. Carts and wagons could be taken apart and carried over while oxen and

[42] CAD PWD1/337 Letter H Wakefield to Chief Inspector of Roads and Bridges, 2 April 1874.
[43] CAD PWD1/358 Monthly Report for August 1875.
[44] W.S.J.Sellick, *Uitenhage Past and Present*, pp.96,111.
[45] Walters, *Bridging the Eastern Cape*, p.46.

horses could swim across as per common practice. The sum of £500 voted was insufficient as at least £1,000 to £1,200 was required for the project.[46]

It had become clear that a bridge over the Great Fish River was needed for the increased amount of traffic to Fort Beaufort and King William's Town, when in 1872, George Clough, a Member of the Legislative Assembly for Graham's Town, motivated for a bridge to be erected over the Great Fish River at Committees drift. The Cape Parliament agreed with the motion which was adopted and a sum of £15,000 was placed on the estimates for the commencement of the work. Nothing was done before the next session when in reply to Clough, who demanded to know the reason for the delay, the Government officials stated that the Crown Agents in London were waiting a favourable turn in the iron market price before placing an order for the bridge. In November 1873, tenders were invited from suitable bridge building companies to fabricate a 'Wrought Iron Lattice Girder Bridge and Four Wrought Iron Cylinders for the Great Fish River Bridge at Committees' by the Crown Agents for the Colonies from the cross sectional surveys provided by Chief Inspector Robinson. The design and specifications were prepared by the Crown Agent's consulting engineer, Henry Wakefield.[47] The successful bridge fabricator was Fleet & Newey of Swan Village, West Bromwich, Newey's late father's firm and where he had served his 'apprenticeship'.[48]

Fig 43: Committees Drift Bridge over the Great Fish River 1877

The following detailed specification for the fabrication of this bridge is provided as it served as a template for all of the many iron bridges that were erected in the Cape Colony and provides a detailed insight into the procedure of fabricating a lattice girder bridge. The Committees Drift Bridge called for two side girders each 385ft long x 10ft 6in deep, comprising a centre span of 130ft and two end spans of 127ft 6in to be placed at a distance of 17ft 9in apart. The two bridge pier columns were to comprise of two twin

[46] G.28-'72 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1871
[47] CAD PWD1/337 Letter Wakefield to Chief Inspector of Public Works, 2 April 1974.
[48] Walters, *Bridging the Eastern Cape*, p.46

wrought iron cylinders fabricated from 5/8in thick plate with a 6ft diameter at the base reducing to 5ft diameter at the girder connection, all with suitable transoms and cross bracing.[49] The specifications called for the entire bridge and cylinder piers to be assembled at the contractor's works in every detail before being inspected by the consulting engineer. In addition, as was customary, twelve large photographs of the assembled bridge works were to be furnished by the contractor.

The method of erection was to finally assemble and rivet the iron bridge girders permanently together in two halves, one on each bank of the river on suitable timber scaffolding. The two bridge girders were to be launched across the river until they met at a point not less than 10 ft from the centre of the bridge. The whole of the wrought ironwork of the bridge was be of the best Staffordshire Iron or of a make of equal quality to be approved by the inspecting engineer and the brand of iron with the maker's name to be submitted with the tender. The quality of all the iron was to be attested, if required by the Crown Agents or the inspecting engineer, by the wrought iron suppliers, whose trademarks were to be stamped on the iron sections. The iron sections could at any time be tested by the inspecting engineer in such a manner as he may think fit, any iron which did not have a tensile strain (stress) of 21 tons per square inch (324 MPa) of sectional area would be rejected. Every section and part of each girder and cylinder was to be distinctly marked with both paint and punch marks so as to facilitate the final erection of the work, complete reference plans to the marks relating to all the parts to be prepared and four copies on tracing linen to be handed to the inspecting engineer on the completion of the works. Finally, all the iron parts were to be painted with boiled linseed oil followed by two coats of anti-corrosive lead paint and packed in secure wooden crates, and shipped to Kowie Harbour, Port Alfred, Cape of Good Hope.[50]

Work commenced on site from November 1873 with the building of workshops, quarters for the superintendent, Joseph Newey and the PWD artisans and workers newly arrived from the Buffalo River Bridge at King Williams's Town. The old military barracks and the tower of the Committee's Drift military post were demolished, yielding dressed stones for the construction of the western abutment of the bridge.[51]

[49] CAD PWD1/337 Letter Wakefield to Chief Inspector of Public Works, 2 April 1974
[50] CAD PWD1/337 Specifications prepared by consulting engineer, Henry Wakefield of London, 2 April 1874.
[51] G.42-'74 Report of the Chief Inspector of Public Works for 1873

Newey's November 1874 monthly progress report outlined the progress that had been made prior to the flood. Approximately 40% of the bridge had been completed over the preceding 12 months.[52]

Consequent to the flood was that Newey raised the final level of the bridge by a further 11ft 6in.[53] This necessitated the bridge having to span a low area on the west bank of the river, and a 123 ft section was subsequently ordered from England. The Consulting Engineer, George Berkley designed this additional section, which was also fabricated by Fleet & Newey.[54] This was Berkley's first of many bridge designs that he was to undertake for the Cape Colony, as a member of the George Street 'clique', another Crown Agent 'favourite'.[55] The bridge was finally opened on 30 April 1877 at a final cost of £33,080 and named the Clough Bridge after the member of the legislative council who had agitated for the bridge to be built.[56]

12 - THE WYLDE BRIDGE OVER THE ZWARTKOPS RIVER

After the final destruction of the decayed timber trestle Rawson Bridge by a combination of woodworm, scour and flood in 1876 (see fig 33 above), Graham's Town traffic had to revert to a pontoon to cross the Zwartkops River. Soon after the destruction, Chief Inspector Fforde had a three 100ft span iron bridge on cylindrical piers designed and ordered from England during 1878.[57] The bridge was manufactured by Westwood Bailey & Co of Milwall, London and erected by William Grier and George Jarvis of the Public Works Department. After the concrete-filled cast iron piers had been installed, the bridge deck girders were floated out on a barge and jacked into position, like the Britannia Bridge in the United Kingdom in 1850. The replacement iron bridge was opened by Civil Commissioner and Resident Magistrate of Port Elizabeth, Alfred Carrington Wylde after whom the bridge was named on 27 September 1879. The total cost to the Divisional Council was £8,000 to which the colonial government contributed £ for £.[58]

52 CAD PWD1/356 Monthly progress report for November, dated 19 December 1874, Newey to Robinson.
53 CAD PWD1/270 Letter Newey to Chief Inspector of Public Works, 26 April 1875.
54 CAD PWD1/339 Letter Berkely to Chief Inspector of Public Works, 9 November 1876
55 Refer to chapter seven describing the British civil engineering profession
56 CAD PWD1/280 Letter Newey to the Chief Inspector of the Public Works, 5 May 1879
57 G.42-'78 Report of the Chief Inspector of Public Works to the Cape Parliament for 1877
58 Sellick, *Uitenhage Past and Present*, p.114.

13 - THE GREAT KEI RIVER BRIDGE, KOMGHA

The Kei River has a drainage basin comprising two branches, the Zwart (Black) Kei in the west and the White Kei in the east, the confluence of which becomes the Great Kei River which eventually drains into the Indian Ocean. In 1869, Captain Matthew Blyth, late of the 73rd Regiment, and nephew of Governor Sir Benjamin D'Urban, was appointed the 'Fingo Agent', stationed at Nqamakwe, Transkeian Territory. It was mainly as a result of Blyth's persistent representations to the Cape Colonial authorities that the Cape Parliament in their session of 1876 approved the construction of a bridge over the Great Kei River, at the time the eastern boundary of the Cape Colony. His assertion was that wagons crossed by drifts, carrying much needed goods to the traders of the Transkei, and when the Kei river was in flood, they might be delayed for several days, leading to the encampment of dozens of wagons on either side of the river.[59]

The District Inspector of the PWD at Graham's Town at the time, Sydney Stent,[60] was instructed to locate a suitable crossing for a bridge over the Great Kei River. In his report to the Chief Inspector, Stent recommended a bridge at Victoria drift, comprising seventeen spans of 80ft, with an iron Warren girder configuration and a 16ft wide roadway, at an estimated cost of £45,000. Stent made topographical surveys and took sections of two preferred sites beyond Komgha for a bridge over the Great Kei River at Victoria Drift during 1875 [61] Newey, was appointed to erect the bridge in preference to Stent, who was disappointed as he had been led to believe that he would be the engineer in charge after starting the bridge pier and abutment excavations. In March 1877, the two paid a preliminary visit to the Great Kei bridge site to inspect the preferred position of the bridge, and the location of trial holes that had been excavated for some of the piers and abutments. Newey finally left Committees Drift with a large entourage of wagon loads of men and equipment, and took control of the Kei Bridge site on 1 May 1877, while the excavations for the piers continued and concreting of the pier bases commenced during June.

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[59] Address of Murray McGregor, former head teacher on Blythswood, *Coelecanth*, 17,1, (April 1979)

[60] Sydney Stent was born in 1845 in Warminster, UK, the son of an architect, WJ Stent. He trained as an architect and civil engineer in his father's office and in the office of WW Moore of Cheltenham to whom he was articled from 1863. He set up his own practice before leaving for the Cape Colony in 1869 where he also practised on his own. In 1873 Stent was appointed resident architect in Griqualand West for the Cape Government for 'all such architectural works as were required'. He was appointed District Engineer for the PWD based in Graham's Town from 1874 to 1885 where he planned bridges over the Orange and Great Kei Rivers. He also designed the Graham's Town and Queenstown town halls. He left for Kimberley where he designed the Kenilworth village for the De Beers. He finally ended up in Cape Town in 1893 where he died in 1898.

[61] G.42-'75 Report of the Chief Inspector of Roads, Bridges and Buildings to the Cape Parliament for 1874

The Crown Agent, Penrose Julyan, commissioned the Consulting Engineer George Berkley of Charing Cross, London, to design the bridge over the Kei River. The ironwork lattice girder design was completed, drawings and specifications prepared, and tenders invited from suitable bridge fabricators.[62] The following tenders were received by the Crown Agent as outlined in a letter to the Chief Inspector of the PWD, dated 16 November 1876, in which it stated that the tender of Messrs Westwood Baillie & Co for £16 856-10-00 was awarded on the 11th instant.[63] The five tenderers were of the most well known bridge builders in England at the time, veritable heavyweights, having collectively supplied dozens of bridges throughout the British Empire and indicates the calibre of bridge manufacturer that the Crown Agents were prepared to engage with to fabricate the bridges under its control.

FABRICATOR :	ex Liverpool	ex London
Westwood Baillie & Co :	£18,437-10-00	£16,856-10-00
Thomas Brassey :	£16,704-00-00	£18,637-05-00
Patent Shaft & Axletree	£17,114-10-00	£17,240-17-06
Horseley & Co	£17,497-15-00	£17,240-17-06
Cochrane & Co	£19,273-17-06	£19,537-07-06

The bridge was to consist of 13 spans of 94ft 11in from centre to centre of piers with an iron triangular-lattice girder superstructure and double iron cylindrical piers filled with concrete. The contract for the fabrication of the bridge was awarded to Messrs Westwood Baillie & Co of Millwall, London, who are were also the contractors for the Colesberg and Hope Town bridges over the Orange River.[64]

While the bridge was under construction, the 9th Frontier War broke out. In his September 1877 report, Newey recalled that in the early part of the month the disturbances which had interrupted the works had later subsided and the garrisoned tradesmen had returned to work. The ironwork arrived from East London and was safely stored in the event of transport being suspended by the war. A few Mfengus were then induced to return to work when cylinder plates were riveted together, and fixed in position. By that time 650 cubic yards of stone had been broken for concrete, to prepare for fixing the cylinder piers. Excavation for the piers amounted to 24 cubic yards of rock blasted with black powder. The Commissioner of Crown Lands and Public Works, John X. Merriman, also visited the works on his way to the military headquarters.

62 CAD PWD1/339 Letter Berkley to Commisioner Crown Lands & Public Works, 9 November 1876.
63 CAD PWD1/339 Letter Crown Agent Julyan to Commissioner of Crown Lands & Public Works, 14 November 1876
64 G.42-'77 Report of the Chief Inspector of Public Works for 1876

In November 1877 Newey completed the task of constructing a 300ft wooden temporary military bridge across the Kei river, which was authorised by Mr Merriman, on instructions of the Colonial Military Secretary, with an allowance of £500 that was eventually exceeded by £105. Newey was mentioned in dispatches by the Military for his efforts in assisting with the transport of military commissariat during the war.[65]

The hoisting of the main girders commenced in October 1877. The transport contractor, Edward Hughes kept eight wagons as transport and made one weekly trip with delivery equal to demand. '…When I took over the work in May 1877, I hoped that by this date I should be able to report the bridge ready for traffic; but the late war, and its many consequences direct and otherwise was not contemplated at the time…'[66] Newey complained about the poor delivery of ironwork to the site by the six wagons of Hughes, who replied that he had experienced problems acquiring more oxen. Newey insisted that his oxen were in bad condition, with lots of standing time at the bridge because of the lack of ironwork, as six wagons were not enough. The Ironwork was transported from Kei Road station to the site at Kei Bridge, a distance of about 31 miles.[67]

An accident occurred while placing the seventh girder from the Transkei side, when the block hook snapped. The same hook had been used to pull the Carlisle Bridge out of the Fish River after the 1874 flood. Three weeks later Newey reported that the same girder had been straightened, painted and hoisted into position, using crab winches and chains.[68] On the night of 16 February 1878, the ship '*Olive'* was wrecked a sea. The entire shipment of 179 tons of ironwork including three spans for the bridge was lost, with no possibility of recovering any of the shipment.[69]

On the 2 April 1879, a massive flood washed away the temporary timber bridge across the Kei River after three weeks of almost continuous rainfall. Four completed girders that were on the ground were damaged and buried in mud, resulting in a further delay of two months to affect the repairs.[70]

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65 CAD PWD1/275 Letter Newey to Commissioner of Crown Lands & Public Works, 12 October 1877.
66 CAD PWD1/280 Letter Newey to the Chief Inspector of the Public Works, 6 January 1879.
67 CAD PWD1/280 Letter Newey to the Chief Inspector of the Public Works, 6 January 1879.
68 CAD PWD1/280 Letter Newey to the Chief Inspector of the Public Works, 31 January 1879.
69 CAD PWD1/277 Letter Newey to the Chief Inspector of the Public Works, 18 February 1878.
70 CAD PWD1/280 Letter Newey to the Chief Inspector of the Public Works, 4 April 1879.

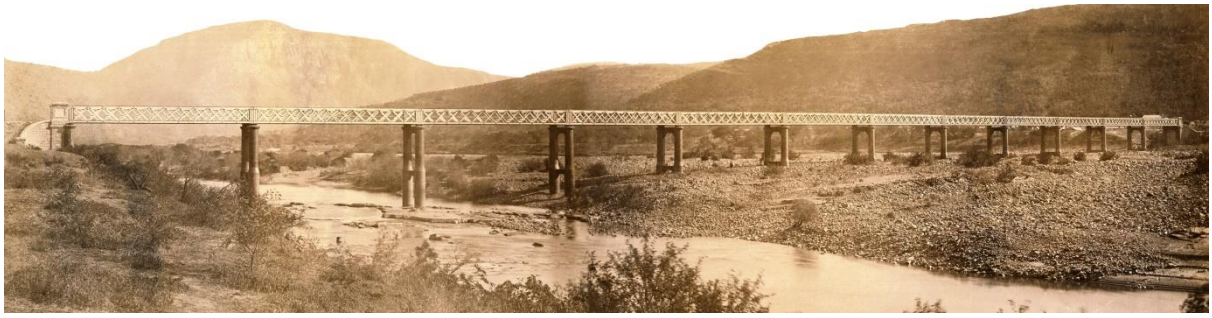

Fig 44: Kei Bridge, Great Kei River 1879

At noon on 13 June 1879, the last girder of the bridge was placed in position by the Bridge Erector, William Deason. Later on 30 September it was reported that the Great Kei Bridge was completed in all respects. The final cost of construction to completion was £45 758 17s 0d.[71] Newey finally reported that the Great Kei Bridge was ready for traffic after a successful proof loading test.[72] '..The expansion per span from coldest night to hottest day is exactly as calculated, viz, 0.044 ft……and the deflection at the centre of a main girder was 0.01 ft (⅛ inch) when a waggon containing a load of 7,800 lbs (as per waybill) was standing on the centre of the span, the oxen occupying the span from the centre to the end. On loads passing there is no permanent set perceptible with a spirit level…'[73] All bridges erected under the authority of the PWD had to pass a proof load test of loaded wagons which was used to confirm the adequacy of the original structural design.

THE ORANGE RIVER BRIDGES AT BETHULIE, ALIWAL NORTH, COLESBERG & HOPETOWN

The Government of the Orange Free State was the first to actively consider bridging the Orange River given the fact that all its merchandise and supplies had to cross at numerous fords and drifts. Considerable delay was occasioned when the river was in flood. The OFS *Volksraad* (Parliament) passed several resolutions on 2nd June 1869, 20th May 1872 and 13th June 1874 regarding the need for bridging the Orange River.[74] No doubt the influx of thousands of fortune seekers to the recently discovered diamond fields at Kimberley from 1868 would have been a major incentive to have a permanent passage across the river. The Cape Government, in turn, was also proactive in passing several pieces of legislation to pave the way for the bridging of the Orange River. The

[71] CAD PWD1/283 Letter Newey to the Chief Inspector of the PWD, 5 January 1880.
[72] CAD PWD1/280 Letter Newey to the Chief Inspector of the PWD, 30 July 1879.
[73] CAD PWD1/280 Letter Newey to Chief Inspector of Public Works, 30 July 1879. Proof load tests are performed on bridge decks to demonstrate the adequacy/fitness of the load bearing structure and to physically demonstrate that the bridge is able to perform within its predetermined limits of loading
[74] Convention entered into between the Cape Colony and the Orange Free State Government, 24 December 1874, from: *South African Treaties, Conventions, Agreements and State Papers*, (Cape Town: Richards & Son, 1898).

first piece of legislation was Act No.15 of 1871 '…to Promote the Construction of a Bridge or Bridges over the Orange River'.[75]

In February 1874, Murrel Robinson the chief inspector of public works presented four sets of designs, cost estimates, cross sections and preliminary plans for bridging the Orange River at four locations to the Commissioner of Crown Lands and Public Works, Mr C Abercrombie-Smith. These locations were at Aliwal North, Bethulie, Colesburg and Hope Town. The detailed proposals were compiled by the Graham's Town based District Inspector Sydney Stent. The preliminary designs and cost estimates prepared for these bridges varied in cost between £40,000 and £65,000 and were subject to the prevailing cost of iron in England and the ox wagon transport from Port Elizabeth harbour, the latter being a not insignificant component of the bridge construction cost. Days after the proposals were presented, severe floods in the Orange River raised flood levels beyond those design levels selected by Stent in his reports. At Colesberg the maximum rise was 57ft above ordinary low level and 24ft 6in above the previous recorded flood level. As a result of the flood it was deemed necessary to raise all the bridges by at least 11ft which would require all the bridges to be re-designed, with concomitant increases in their cost estimates.[76] The Department of Public Works through the Crown Agents for the Colonies commissioned the London consulting engineer George Berkley, to design all four the bridges over the Orange River.

14 – THE BETHULIE BRIDGE

The Orange River at Bethulie, increased by the waters from the Caledon and Stormberg River tributaries, had a waterway of 1,050ft between the abutments. Stent's design provided for a wrought iron superstructure of ten equal spans of 105ft carried on iron cylindrical piers. The cost estimate presented amounted to £40,000. The outcome of the February 1874 floods was to raise the level of the bridge and increase the cost estimate to £50,000.[77]

The Crumlin Viaduct Works Company (Limited), of Crumlin, Wales, was the appointed contractor for both the Bethulie Bridge and the Aliwal North Bridge over the Orange River. The firm undertook to manufacture, transport, erect and complete the two wrought iron bridges. The Bethulie Bridge designed by George Berkley was to comprise of eighteen 63 ft spans of Warren truss pattern ironwork girders spanning between

[75] H.Tennant and E.M.Jackson, Statutes of the Cape of Good Hope, Vol.II (1872-1886), pp.1187-1191.
[76] A.-'74 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, July 1874.
[77] A.-'74 Correspondence regarding the construction of bridges over the Orange River.

ironwork piers with an average height of 60 ft above the bed of the river, and two masonry land arches of 25ft each. Two additional spans of the same dimensions were found to be necessary resulting in the contractors having to import a steam drilling machine for excavating in solid rock.[78]

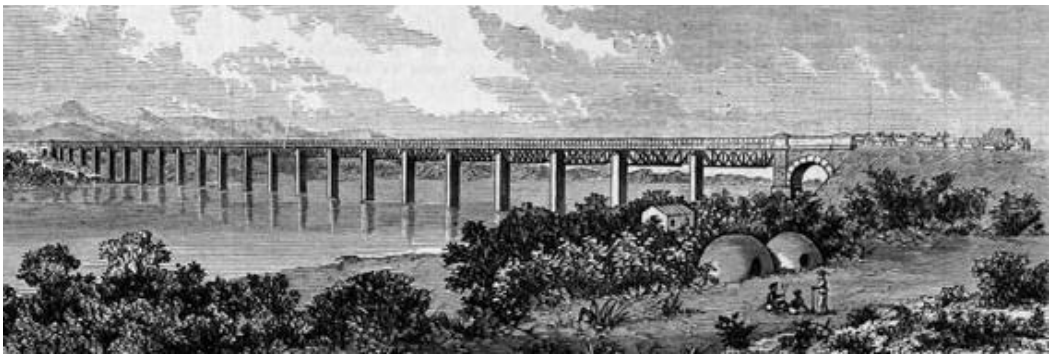

Fig 45: Bethulie Bridge over the Orange River 1878

The Contractor experienced severe financial difficulties stemming from problems at their Welsh headquarters, and requested an advance on their contracts. The consulting engineer placed the responsibility of the decision on Chief Inspector Fforde, newly arrived in the Cape, who declined. The Chief Inspector then urged the Contractor to commence work at Aliwal North, complete it as rapidly as possible and then be entitled to the whole amount. No commencement was made at Aliwal North in spite of a favourable dry season of low flow in the river. A final notice was served on Crumlin on 13 October 1877, after which the contract was terminated and the project was taken over by the PWD. At the time the works at Bethulie Bridge was at an advanced stage as on the colonial side the abutment was complete, thirteen iron piers were at full height and four spans were fixed in place. The Crumlin Company finally went into liquidation during 1878.[79]

[78] G.42-'77 Report of the Chief Inspector of Public Works to Parliament for 1876

[79] The Crumlin Viaduct Works Company Limited was started by Thomas W Kennard in 1853, producing the Warren truss ironwork for the Crumlin Viaduct, Wales, which was completed in 1857. They also fabricated the ironwork for the first Blackfriars Railway Bridge, 120 bridges in Buenos Aires, Argentina, 69 bridges for the Rome and Ancona Railway in Italy, 5 multi-span bridges for railways in India, a 17 span bridge in Pernambuco, Brazil as well as bridges at New Ross, Ireland, the Murray River Australia and Wolkoff for the Great Russian Railway. In 1871 a new private company, led by Henry Maynard, took over from the Kennards. The shares were taken up by many local people including H M Kennard of Blaenavon Iron and Steel Co. Although the order books may have been full during 1877, the company was making a loss; and ran out of cash. The Blaenavon Iron and Steel Co was forced into liquidation when the West of England Bank collapsed and as there was no help from the Kennards, while the Crumlin Works were heavily in debt to the same bank. In 1878 in spite of a full order book and for want of a mere £10,000 bridging loan, the company went into liquidation, and all the remaining stock was auctioned. J.Elliot, *The Crumlin Viaduct Works 1853-1878, from World Leader to Welsh Tragedy,* (Journal of Gwent Local History Council No.80, Spring 1996), pp.4-15.

Great difficulty was experienced in founding the masonry abutment on the Free State side due to the great depth down to solid rock formation and the continual ingress of water requiring several steam powered pumps working day and night dewatering the excavations. The construction of the bridge was severely hampered by the extreme drought that affected the ox wagon transport of delivering the ironwork from the ports. P.S.Hyslop of the PWD was commended by the chief inspector for the meticulous manner in which he carried out the work of erecting the Bethulie Bridge.The bridge was finally opened for traffic on 14 March 1878.[80]

15 – THE ALIWAL NORTH BRIDGE

The village of Aliwal North was established on the banks of the Orange River with the proposed bridge site directly adjacent to the town. The width of the river at flood level is within its banks and amounts to not more than 720ft and an average depth of 37ft. A large volume of traffic crossed the river at Aliwal North as it was the chief route to the Orange Free State and the Diamond Fields from the Eastern Province ports of Port Elizabeth and East London. Stent's proposed bridge comprised of nine spans of 80ft wrought iron girders supported on cast iron cylindrical piers and stone masonry abutments. The roadway deck was to be supported by the top chord of the bridge, a so-called deck truss bridge. The outcome of the February 1874 floods was to revise the bridge design and increase the cost estimate to £40,000.[81]

Berkley's design of the Aliwal North Bridge was to comprise of thirteen 63 ft spans supported on twelve wrought ironwork piers 70 ft high, with supporting ironwork girders in a Warren truss pattern.[82] By the first quarter of 1878 very little work had been carried out on this bridge due to the contract with the contractors Crumlin Viaduct Works Co Ltd, having been terminated. When Matthew Woodforde's contract expired, Joseph Newey was sent to superintend the project as the site engineer.

[80] G41-'80 Report of the Chief Inspector of Public Works to the Houses of Parliament for 1878, 28 April 1879.
[81] A.-'74 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, July 1874.
[82] CAD PWD1/358 Berkley to Crown Agents, Specification of the Bethulie and Aliwal North Bridges, 12 Feb 1876

Fig 46: Frere Bridge, Orange River, Aliwal North 1880

Building bridges over the Orange River was a hazardous business, as floods plagued the works on a regular basis. Each pier construction had to be installed within a timber coffer dam, complete with 8 in and 14 in steam-powered pumps which were regularly submerged. A flood during February 1880 raised the water level perilously and submerged the steam pumps in the coffer dams. In order to save two uncompleted piers from washing away, Newey shot holes in the empty piers with his Martini Henry rifle to let water in and therefore destroy their buoyancy. He had saved the piers by his ingenuity and marksmanship.[83]

The Orange River Bridge at Aliwal North, was named the Frere Bridge, after the Governor of the Cape Colony, Sir Bartle Frere. It was opened to traffic on 21 July 1880. It was replaced by the present adjacent two-lane steelwork Herzog Bridge.

16 – THE COLESBERG BRIDGE

Stent's preliminary report tabled during 1874 stated that the advantage of this bridge site was that it was on the main road through the Cape Colony to the Orange Free State and the Diamond Fields of Kimberley. His preliminary design was for a rolling load of one ton per foot, in order to accommodate a future railway line and was adapted for local conditions for transporting girder components in suitable lengths for ox wagon transport and on-site operations of assembling and launching into position. Stent's estimate of cost included the iron work, shipping freight, inland transport, constructing stone masonry piers and abutments, toll keeper's house, roadway earthworks, superintendence and others, amounted to £53,000. His proposal was that the roadway of the bridge be supported along the bottom of the girders, a through-girder 'Warren' truss bridge.

83 CAD PWD1/283 Letter Newey to Chief Inspector of Public Works, 23 February 1880.

Stent's estimate of the total length of the bridge, including the abutments was 1,205 ft. Following the February 1874 floods the bridge design was amended to raise the level of the bridge and increase the cost estimate to £65,000.[84]

Fig 47: Colesberg Bridge over the Orange River 1880

During September 1875 Berkley sent his preliminary design for the Colesberg Bridge to the Crown Agents.[85] Tenders for the construction of the two bridges at Colesberg and Hope Town were invited from the following bridge building firms: Westwood Baillie & Co, Andrew Handyside & Co, the Horseley Co, Cochrane & Co, Thomas Brassey & Co, Campbell, Johnstone & Co, and the Crumlin Viaduct Co. The accepted tender of £105,436 for the fabrication & delivery of ironwork to site & erection, including wagon transport was to Westwood Baillie & Co of the London Yard, Isle of Dogs, Poplar, a bridge fabricating firm that was to later to secure dozens of bridge contracts throughout the Cape Colony and Natal. An engineer F.M.Mallalieu, was sent out from England by Berkley to superintend the works while Jonathan Baillie was the contractor's site agent and representative. The final configuration of this bridge was a central span of 197ft two adjacent spans of 76ft 6in. and thirteen spans of 75ft 6in. measured from centre to centre of the piers. Ironwork was delivered to site under a local ox-wagon transport contract of 12s 5d per 100 lbs. The erected bridge had a few variations to Stent's original proposal, in that the bridge piers comprised of elongated circular iron cylinders filled with concrete. In addition the bridge girders were deck truss 'Warren' girders with the roadway located on top of the girders.[86] The Colesberg Bridge was completed and opened to traffic on 7th July 1880.

[84] A.-'74 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, July 1874.
[85] Letter from Berkeley to the Crown Agents, 3 September 1875 in A.14-'76 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, May 1876.
[86] G.36-'79 Report of the Chief Inspector of Public Works to the Cape Parliament for 1878

17 – THE HOPE TOWN BRIDGE

Stent's preliminary design located this bridge two miles downstream of the village of Hope Town where the river was confined to a narrow channel of 90 ft at low level. The proposed bridge was similar to the Colesberg Bridge design in most respects. His estimate of the total length of the bridge, including the abutments was 1,229 ft, at an estimated cost of £52,000. Following the February 1874 floods, the bridge design was amended to raise the level of the bridge and increase the cost estimate to £63,000.[87]

Fig 48: Hope Town Bridge, Orange River 1882

In February 1875 Berkley submitted preliminary drawings of the Hope Town Bridge to the Crown Agents as the detailed construction drawings were being finalised. He made the following remarks by way of explanation of his design philosophy and approach. In the initial brief it was stated that the channel at low water flow was 90ft wide, the required length of the proposed viaduct was 1,320ft between abutments to accommodate the maximum floods and that the roadway was to be located on top of the girders, a so-called deck truss bridge. In addition, he selected the configuration of the main girders to be 'Warren Girders', the most economical, in his opinion. In order to have as much duplication as possible Berkeley selected a span of 112ft from centre to centre of piers which was governed by the need to span the low level river channel. There were to be 11 openings to make up a total viaduct length of 1,344ft, with the flooring to consist of wrought iron plates. The bridge piers were to be constructed out of dressed stone masonry as recommended by chief inspector Robinson. The final height of the piers was to be set at such a level to allow six feet between the bottom chord of the main girders and the highest flood recorded. His estimate of cost for the completed viaduct at Hope Town was £56,448 somewhat under the estimate of £60,000 of the

[87] A.14-'76 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, May 1876.

Chief Inspector.[88] A well experienced 'mechanic' would be engaged through the contract to ensure that the iron superstructure of the bridge was assembled and erected properly and to specification.[89] The constructed bridge as outlined on a surviving 'as-built' drawing has the bridge piers comprised of elongated circular iron cylinders filled with concrete and with 19 spans of 75ft 6in ft. The bridge was opened to traffic on 9 April 1882.[90]

18 – THE WHITE KEI RIVER BRIDGE, ST MARKS MISSION

The first large stone masonry arch bridge built by the Department of Public Works was over the White Kei River near St Marks Mission, on the road between Queenstown and Cofimvaba. The new Chief Inspector of Public Works James Fforde, visited the site in May 1877 and had a survey of the most suitable position prepared by Patrick Fletcher. Fforde prepared a design comprising of six stone arch spans of 40ft each clear opening, the crown of the arches being ten feet above the largest known flood with an estimated construction cost of £8,000. The first ceremonial foundation stone was laid by the wife of the Civil Commissioner of Queenstown, Mrs Hemming on 4th July 1877. George MacLellan was the PWD superintending engineer on site, while James Jardine was the clerk of works.[91]

The foundations of the bridge had been completed and the piers and west abutment completed up to the springing of the arches, when the 1877/78 9th Frontier War of Dispossession broke out and the works were abandoned. The works resumed in July 1878 and by April 1879, the abutments, all five piers, and one arch were complete. Difficulty was experienced by the stone masons in cutting and dressing the very hard stonework. By March 1880 carts and light vehicles were allowed passage, while the bridge was finally completed by the end of the year at a total cost of £10,403.9s.4d.[92] The bridge later had a railway line installed across it, and the stone parapets were removed.

88 Letter from Berkeley to the Crown Agents, 26 February 1875 in A.14-'76 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, May 1876.
89 Letter from Berkeley to the Crown Agents, 7 April 1875 in A.14-'76 Correspondence regarding the construction of bridges over the Orange River, presented to the Cape Parliament, May 1876.
90 G.52-'83 Report of the Chief Inspector of Public Works to the Cape Parliament for 1882
91 CAD PWD1/284 Report McLellan to Chief Inspector of Public Works 31 January 1880
92 CAD PWD1/284 Report McLellan to Chief Inspector of Public Works 31 March 1880

Fig 49: St Marks Bridge over the White Kei River, 1880

19 – THE SAUER BRIDGE OVER THE KRAAI RIVER, ALIWAL NORTH

Patrick Fletcher, the inspector of roads based in Queen's Town selected the site and made topographical surveys of the proposed crossing of the Kraai River 6 miles from Aliwal North on the road to Lady Grey and Barkly East during 1875.[93] An estimated cost of £17,580 was presented with the added incentive being that the current revenue from the pontoon and the toll amounted to £720 per annum.

The Aliwal North Divisional Council Loan Act 11 of 1878 authorised the Divisional Council of Aliwal North to borrow a maximum of £5,000 upon security of future road rates and tolls for the erection of a bridge over the Kraai River at a location known as the 'Poort' (gorge). In addition, in terms of Act 9 of 1858 the Council were allowed to erect a toll house at the bridge and it was stipulated that pontoons were not allowed to operate within five miles of either side of the bridge. The Act also confirmed the Government's commitment to contribute an equal amount of £5,000 towards the construction of the bridge.[94]

At the conclusion of the Great Kei River Bridge construction at the end of September 1879, Joseph Newey took over the position of superintending engineer at the Kraai River and Orange River bridges at Aliwal North from George Woodforde, who returned to London at the expiry of his contract.[95] In the estimates for 1878, James Fforde, the Chief Inspector of Public Works allocated £8,790 of the total estimate of £17,580, to commence construction of the 'Kraai Bridge', as it was first called. It was an important bridge because of the number of wagons and carts that used the route to the North Eastern Districts and Basutoland to the east. The £5,000 that the Divisional Council of Aliwal North was allowed to borrow through an Act of Parliament proved to be insufficient to complete the bridge.

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93 G.42-'75 Report of the Chief Inspector of Public Works for 1874 & letter PWD 1/275 CAD

94 J.Foster, H.Tennant, E.M.Jackson (Ed), *Statutes of the Cape of Good Hope 1652-1886*, (Vol 2, Juta & Co, Cape Town, 1887), pp.1555-1558.

95 CAD PWD1/282 Letter from Eliot to Chief Inspector of Public Works 16 May 1881

Construction at the Kraai river bridge commenced on11 June 1879 with the pier excavations, the opening up of stone quarries and the erecting of living quarters and workshops out of wood and corrugated iron. One of the quarries was in a broad rock outcrop at the river's edge so that stone could be floated to the bridge site. The local road inspector Fletcher had selected the site where the bridge was to cross a deep gorge of the Kraai river, and was to consist of six sandstone arches, 40 ft each span, set on high piers, similar to semi-circular Roman bridge construction practice. The cost estimate was £17,580.

In June 1880, Pearson submitted a tender to the PWD in the amount of £5,500, '…to complete the construction of the Kraai River Bridge in every respect, from springing level to parapet capping, and the road from junction with present road to Lady Grey side of the bridge to stake 237.6 ft from face of north abutment, according to the Drawing, Specification and memoranda…' In addition,'...the whole to be completed in eighteen months from acceptance of Tender…'[96]

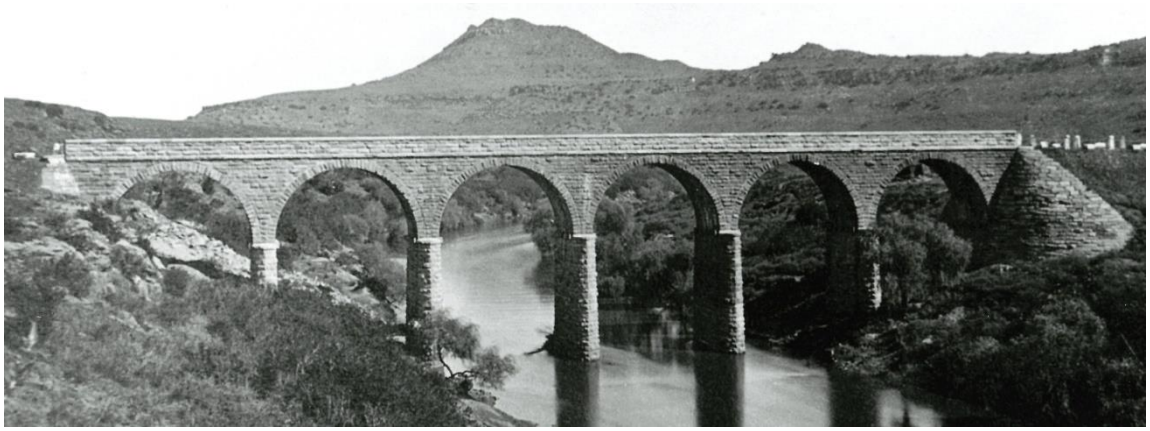

Fig 50: Sauer Bridge over the Kraai River, Aliwal North 1881

As superintending engineer, Newey was on site for eleven months, and then took eight months leave to return to England during August of 1880 to attend to his mother's business. John Eliot replaced him temporarily as the superintending engineer during his absence, at which stage all the piers had been completed, and the first arch was keyed-in on 24 September 1880. Newey returned in May 1881 and assumed control once more, to finally complete the bridge which was officially opened on 28 September 1881.[97] The Kraai river bridge was named the Sauer Bridge after the local member of the Cape House of Assembly, J.W.Sauer, Secretary for Native Affairs, and later Colonial Secretary.

[96] CAD PWD1/292 Letter Newey to Chief Inspector of Public Works, 26 May 1880.
[97] G.11-'82 Report of the Chief Inspector of Public Works for 1881

20 - THE XALANGA BRIDGE OVER THE TSOMO RIVER, CALA

The Xalanga Bridge over the Tsomo River on the outskirts of Cala on the road to Lady Frere and Queenstown comprises five stone arches, elliptical in shape, each 40 ft clear span, with the arch soffits being 12 ft 8in and the roadway 16ft 8in above the highest previous flood level recorded at the time. Soon after becoming the District Inspector of Public works in 1883, Joseph Newey personally designed and produced the construction drawings, specifications and cost estimates of this bridge. He initially prepared two designs and specifications, one of iron girders on stone piers, and one made entirely of stone, and which was eventually approved. In January, Newey reported minor changes to his arch bridge design and specifications which needed adjusting in the light of the stone blocks produced from the nearby quarry.[98] Construction commenced during 1884, after Mrs Levey, the wife of the Civil Commissioner and Magistrate of Southeyville, Charles Levey, laid the foundation stone on 22 May 1884.[99] Work progressed with the four piers being built up to a height of ten feet, the height of ordinary floods. However, work stopped during June 1884 as no money had been voted to complete the bridge, the second interruption to date.

The severe financial conditions in the Cape Colony, caused by the mid-1880s recession described in chapter eight, led to the project being shelved for a number of years, together with various senior staff being retrenched. A few years later, when the Colony experienced more prosperous times due to increased revenue, construction could continue. The works however could not continue in 1888 as there was a shortage of stonemasons. Fortunately, a few immigrant masons were eventually dispatched from Cape Town. Quarrying for stone on the east bank for the eastern abutment was able to restart. William Birnie, an immigrant tradesman from Peterhead, Aberdeenshire, Scotland, who was initially hired as a carpenter on the Committees Drift Bridge, was promoted by the PWD to the post of Clerk of Works. Birnie lamented the scarcity of tradesmen in almost all branches and his problems with those that he was able to recruit, were constantly threatening to strike for higher wages.[100] During September 1889 fifteen new immigrant masons and two carpenters arrived on site to commence work. With the arrival of stone masons sent out from England, the works progressed to the point that by October 1889, all the piers were almost up to springing level, the voussoirs were cut for one arch and the erection of centering for another arch was

98 CAD PWD1/296 Two letters Newey to Chief Inspector of Public Works, 4 and 7 Jan 1884.
99 Inscription on foundation stone.
100 CAD PWD1/302 Newey monthly report to Chief Inspector of Public Works, August 1889.
100 Inscription on foundation stone.

complete. Progress on the remaining work was speedy, as on 29 December 1890 the bridge was finally completed.

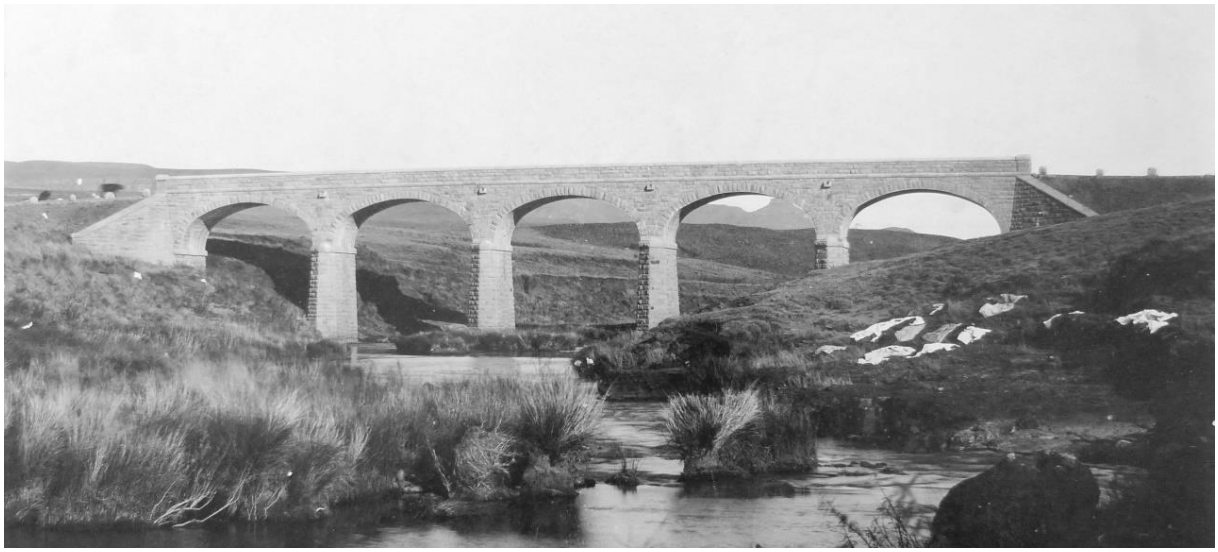

Fig 51: Xalanga Bridge over theTsomo River, Cala 1890

21 - THE LOCH BRIDGE OVER THE KRAAI RIVER, BARKLY EAST

This stone arch bridge is an exact replica of the bridge at Cala, with five elliptical 40 ft spans. The need for a bridge was very forcefully demonstrated in 1881 when Colonel Wavell's column, en route to Basutoland, was delayed for three weeks on the banks of the Kraai river near the present site of the bridge, at a cost to the Government of £15,000. As a result, the Colonial Government had been urged to select a site and build a bridge over the Kraai River. Newey selected the site for the bridge near Vorster's mill, and was instructed to complete designs for both a stone arch and an ironwork bridge, complete with comparative cost estimates. The estimated cost of a stone masonry bridge of £14,000 was approved, especially as Newey had found a good sandstone quarry site within half a mile from the site.[101]

Construction finally commenced during November 1891, under William Birnie, the Clerk of Works. The last arch was keyed in on 5 December 1892, and the bridge was finally completed during March 1893. An unskilled labour shortage resulted in the approach roads only being completed by September 1893. The workforce comprised of 24 stone masons, three carpenters, and about 150 amaXhosa men employed on the works. An additional 300 more amaXhosa workers were employed on the construction of the approaches on either side. The final bridge consists of five elliptical arches of 40 ft each, the length of the masonry portion of the bridge is 264 ft and the full length of the bridge

[101] G.24-'92 Report of the Chief Inspector of Public Works for 1891

is 640 ft. The roadway is 16 ft wide, and is 43 ft above the riverbed. The highest known flood reached 21 ft below the roadway. Wing walls were added to the bridge after the floods of January 1898 which had damaged the abutments. The final total cost of the bridge amounted to £14,722, while compensation costs of £1,509 were paid out to adjoining landowners after arbitration awarded them sums for the cession of portions of their farms. Birnie's good management and accurate work was praised as the project was completed within the cost estimate, and when the last stone was laid, there were only two left out of the thousands that had been cut and dressed.[102]

Fig 52: Loch Bridge, Kraai River, Barkly East 1893

The bridge was opened on 6 December 1893 by Mrs Gie, the wife of the Civil Commissioner and Resident Magistrate of Barkly East, Mr J.C.Gie, amid great festivities attended by almost a thousand people. The bridge was named after the Governor of the Cape Colony, Sir Henry Brougham Loch.[103]

22 – THE GOURITZ RIVER BRIDGE, BETWEEN ALBERTINIA & MOSSEL BAY

Acting chief inspector Grier examined several sites for the river and decided on the one near Aasvogel Berg with an opening of about 600 ft at road level.[104] During 1888 a final survey, with sections and descriptions of the site were prepared where the bridge was to be built and forwarded to the Agent General for the purpose of obtaining competitive designs and tenders for the large work.[105] Designs and working drawings were prepared by Benjamin Baker in conjunction with Sir Charles Gregory from the recently prepared information of the site. This bridge was designed by Sir Benjamin Baker who had recently designed the Forth Rail Bridge with Sir John Fowler in 1882-1890.[106] The bridge was designed on the cantilever bridge principle, where cantilever beams project horizontally into space, only supported at one end. Cantilever bridges were a major

[102] Barkly East Reporter newspaper, 10 December 1893
[103] Barkly East Reporter newspaper, 10 December 1893
[104] G.11-'82 Report of the Chief Inspector of Public Works for 1881
[105] G.21-'89 Report of the Chief Inspector of Public Works for 1888
[106] CAD PWD1/690 Letter Grier to Commissioner of Crown Lands and Public Works, 21 March 1892

engineering feat when first used from the 1870s, as they were able to span large distances (over 1,500ft). Another advantage was that they could be constructed over deep and wide crossings by virtue of using no support (false) work.

The site establishment such as stores and dwellings were completed and the excavations for the abutments and steel cylinders started, including the quarrying for stone.[107] The bridge was a total of 702 ft long and the main central span of 420 ft long and two side spans of 141 ft with a depth of 210 ft from the roadway down to the river bed. The ironwork of this cantilever bridge was fabricated by Andrew Handyside & Co of Derby, England. It was further feared that the enormous increase in the price of iron and steel at the time would have a material effect on the cost of the bridge.[108] During 1890 the four main cylinder columns were fixed and riveted up and concreted up to about 21 ft of the top.[109] Progress during 1891 indicated that the Mossel Bay side abutment was completed up to the top of the anchor girder which had been fixed in position. The Riversdale side abutment was excavated and stone had been quarried and dressed for both abutments, all under the daily superintendence of the clerk of works James Chadwick.

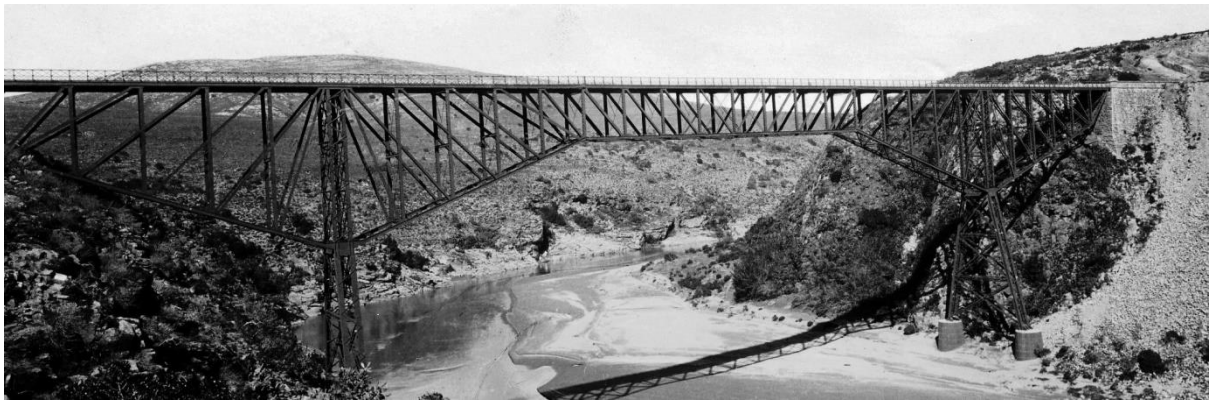

Fig 53: The Gouritz River Bridge, Albertinia 1892

This bridge was nearing completion during 1892 under the supervision of Wilhelm Westhoven, the resident engineer, who between 1885 and 1890 had been directly involved in the construction of the Fort River Bridge in Scotland, another Benjamin Baker designed bridge.[110] The expenditure on this bridge between 1st July 1890 and 31st December 1891 amounted to £46,480. The bridge was finally opened to traffic on

107 CAD PWD1/690 Letter books from site engineer to Chief Inspector of Public Works, from October 1889
108 G.15-'90 Report of the Chief Inspector of Public Works for 1889
109 G.21-'91 Report of the Chief Inspector of Public Works for 1890
110 CAD PWD1/305 Monthly Reports Westhoven to Chief Inspector of Public Works, April – December 1891

the 30th March 1892 by the Commissioner of Crown Lands and Public Works, for a total cost of £59,648.[111]

23 - THE LITTLE FISH RIVER BRIDGES, SOMERSET

Designs were prepared for the first bridge and tenders invited during 1889. During the 1890-91 financial year £4,667 was spent on the construction of this single 100 ft span triangular-lattice girder bridge where the abutments and approaches were completed under contract, the ironwork was delivered and a contract for its erection was concluded.[112] This bridge was built on the outskirts of Somerset East on the road to Cookhouse. During April1891 this bridge was completed and handed over to the Divisional Council of Somerset East having cost a total of £5,822 to complete.[113] A second single 143 ft span triangular-lattice girder bridge over the same Little Fish River was also built in 1891 and was destroyed by flood in 1932.

Fig 54: Little Fish River Bridge, Somerset 1891

24 – THE KOONAP RIVER BRIDGE, ADELAIDE

District inspector Stent carried out the preliminary investigation for the site during 1880, over the Koonap River at a point where the road leaves the village of Adelaide in the direction of Bedford. He excavated trial holes and made borings, with satisfactory results as good rock foundations were exposed, after which tenders were invited from fabricators.[114] The information was sent to George Berkley who completed the bridge design, drawings, specifications and the tender document for the erection of the iron work.[115] After completing the St Marks Bridge, George McLellan the PWD clerk of works, was put in charge of this bridge. He made steady progress with the stone

111 G.24-'92 Report of the Chief Inspector of Public Works for 1891
112 G.21-'91 Report of the Chief Inspector of Public Works for 1890
113 G.24-'92 Report of the Chief Inspector of Public Works for 1891
114 G.28-'81 Report of the Chief Inspector of Public Works for 1880
115 CAD PWD1/339 Letter Berkley to Chief Inspector of Public Works, 14 July 1887.

masonry portions which were completed just as the ironwork superstructure, fabricated by Cochrane & Co of Dudley, was being delivered at the beginning of 1882.[116] The erection of the ironwork triangular-lattice girder work was let on contract to John Mackay of Port Elizabeth with Mr Macintosh as his site agent. The work was completed within the estimate and handed over to the Divisional Councils of Fort Beaufort and Bedford as it straddled the river joining these districts and were responsible for its maintenance.[117]

25 - THE BURGHERSDORP BRIDGES

A sum of £8,500 was voted by the Public Works Act No. 11 of 1892 to build this three 100 ft span triangular-lattice girder bridge across the Stormberg Spruit, a mostly dry river course that became a torrent when in flood, something that happened frequently. Preliminary work commenced during October 1892 on the outskirts of the village of Burghersdorp.[118] The bridge was fabricated by Joseph Westwood & Co of London and erected by Messrs Robertson and Shaw during 1893.[119] The bridge was supported on masonry abutments and piers. A second bridge at Burghersdorp was over the Buitendag Spruit which linked the town to the new railway station. This bridge comprised of a single 100ft triangular-lattice girder supported by stone masonry abutments. The £1,540 tender for the abutments was awarded to D.Blue. The iron lattice girder ordered from England was erected and taken over by the Divisional Council of Albert on 21st August 1895 with the total cost amounting to £3,268.[120]

26 – THE BASHEE RIVER BRIDGE, IDUTYWA, TRANSKEI

Shortly after assuming the role of district inspector, Newey provided suggestions for bridging the Bashee, Butterworth, Umtata and all the rivers along the main trunk road towards Natal.[121] During 1890 designs and specifications were prepared and tenders were called for the construction of the stone abutments for which there was no response, possibly due to its remote location. This bridge was to comprise of six 100 ft spans supported by five double cylinder iron piers. A sum of £15,700 was voted by the Public Works Act No. 11 of 1892 to complete the bridge. The concrete bases cast on solid rock in the river bed were completed during September 1892 ready to receive the iron cylinders. The contract to erect the six spans of ironwork fell through and resulted in

116 G.11-'82 Report of the Chief Inspector of Public Works for 1881
117 G.52-'83 Report of the Chief Inspector of Public Works for 1882
118 G.12-'93 Report of the Chief Inspector of Public Works for 1892
119 CAD PWD1/302 Letter Newey to Chief Inspector of Public Works, 4 July 1893.
120 G.24-'96 Report of the Chief Inspector of Public Works for 1895
121 G.52-'83 Report of the Chief Inspector of Public Works for 1882

the entire project being completed departmentally.[122] The completed bridge was opened for traffic on 9th September 1893 by Charles Griffiths, the Chief Magistrate of Transkei and Tembuland and named after him.[123]

Fig 55: Bashee River Bridge, Idutywa 1893

27 – THE LINE DRIFT BRIDGE OVER THE KEISKAMMA RIVER, PEDDIE

A sum of £18,240 was voted by the Public Works Act No. 11 of 1892 for this bridge which was to comprise of four spans of 100 ft each supported on stone masonry piers built under contract. Preliminary operations were commenced during September 1892.[124] The ironwork was fabricated by Joseph Westwood & Co of London. By the end of 1893 all the masonry work was completed under contract and the ironwork was being erected. The bridge was completed during April 1894 at a cost of £16,000.[125] A single span of 100 ft was erected across the adjacent Tschoi Stream which was spare from the Great Kei River Bridge and cost £3,000 to construct, supported on concrete abutments.

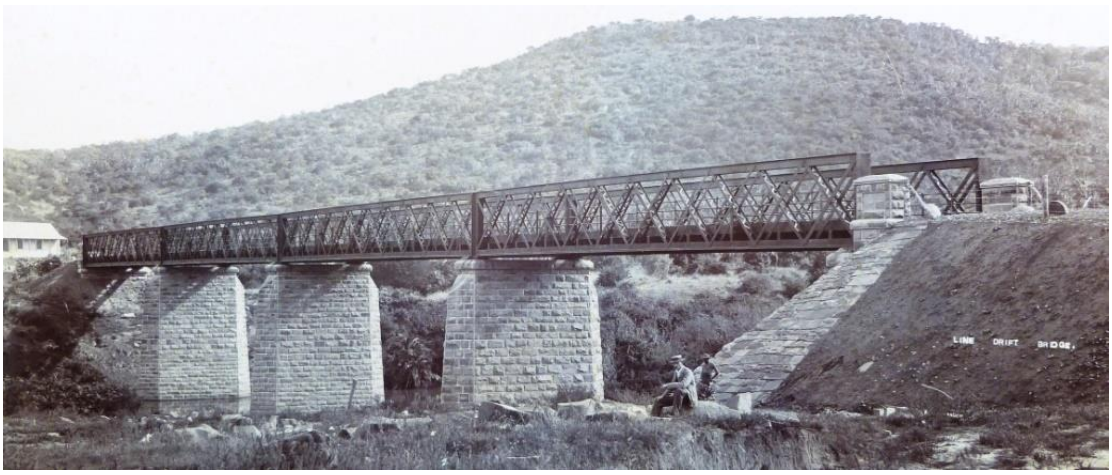

Fig 56: The Line Drift Bridge, Keiskamma River 1894

122 G.12-'93 Report of the Chief Inspector of Public Works for 1892
123 G.18-'94 Report of the Chief Inspector of Public Works for 1893
124 G.12-'93 Report of the Chief Inspector of Public Works for 1892
125 G.18-'94 Report of the Chief Inspector of Public Works for 1893

28 – THE ZWART KEI RIVER BRIDGE, QUEENSTOWN

After several timber bridges were erected and washed away during floods it was decided to erect a steel bridge at the site. A single span triangular-lattice girder bridge of 143 ft was erected on stone masonry abutments, which had to be raised by 2 ft after yet another flood exceeded the previous highest level. The bridge was fabricated by Andrew Handyside of Derby, England and was completed during May 1894 at a cost of £4,786.[126]

Fig 57: The Zwart Kei River Bridge 1894

29 - THE GAMTOOS RIVER BRIDGE, HUMANSDORP

During 1880 preliminary site topographical surveys, cross sections and trial borings of the river bed were taken at the preferred site of the future bridge in order to frame an estimate of costs of a bridge on the main road from Port Elizabeth to Cape Town. The old worn out pontoon was replaced as it was in constant use during the bridge construction.[127]

Estimates of construction were framed for the construction of this triangular-lattice girder ironwork bridge of 6 spans of 100 ft each supported on five pairs of iron twin cylinders filled with concrete and stone masonry abutments. Several additional borings had to be made of the river bed to determine the nature of the strata on which the piers were to be founded. The borings were continued down to a level of 34 ft below the low-water level, at which stage the borings had passed through 10 ft of stiff blue clay and was considered to be good enough to support the bridge piers. Designs for the bridge were prepared based on the data obtained and presented to Parliament for sanction which was only given in 1892 due to the delay caused by the recession.

[126] G.18-'94 Report of the Chief Inspector of Public Works for 1893
[127] G.41-'80 Report of the Chief Inspector of Public Works for 1879

A sum of £20,000 was voted by the Public Works Act No. 11 of 1892 towards the construction of this strategic bridge.[128]

In spite of the river bed borings being accepted as conclusive, it was always felt that this bridge would prove to be the most troublesome of the number of bridges which had been authorised. This expectation was fully realised later when the sinking of the cylinder piers was commenced. The ironwork superstructure was manufactured by Braithwaite & Kirk, the successors to Fleet & Newey of West Bromwich, England. The order made in August 1892 was delivered to site during April and May 1893. Preliminary work such as the site establishment of erecting stores, shops and living quarters including the approach road down the steep side of the valley leading down to the river was commenced during November 1892. Two jetties were erected on either side of the bridge works and temporary pile staging for the river piers were commenced.[129]

The sinking of the piers was accomplished by means of a superimposed load of 40 tons on each cylinder pier, including its own self-weight. The material was excavated from inside the cylinders as they descended, similar to caisson construction. The result of the pier sinking operation proved that the clay material at the specified depth was totally inadequate and incapable of permanently supporting a 40 ton load. Of the first 6 pier cylinders placed in position, five had exceeded their specified depth. The downstream cylinder of No.2 pier, encountered a stiff material at a depth of 40 ft below low-water level. This cylinder was excavated out, filled with concrete to a depth of 44 ft and found to settle another 1½ inches under its self-weight. The upstream cylinder of No.2 pier was piled to a depth of 60 ft 6in when stopped. A test bore was driven down to 141 ft and stopped as it exceeded the depth to which the cylinders could safely be used. At a depth of 85 ft the test bore encountered stratum of coarse sand and clay, a possible founding depth. At this depth additional cylinder piers would need to be ordered from England. Because of the above problems encountered with the foundations, Chief Inspector Newey resolved to leave nothing to chance, and accordingly loaded every cylinder with the imposed dead load and only accepted the situation of zero settlement for 5 days as proof of its safety. The expenditure up to 31st December 1893 was found to be £19,313 a little within the budgeted amount of £20,000 allowed for under Act 11 of 1892 of which the girders and cylinders amounted to £5,908, the cement to £1,135 and the freight and transport £1,007 and the approach roads £4,836. Chief Inspector Newey

128 G.12-'93 Report of the Chief Inspector of Public Works for 1892
129 G.18-'94 Report of the Chief Inspector of Public Works for 1893

reported '…that further provision will require to be made for covering the extra expenditure due to the deeper foundations, and also for taking certain precautions in the way of fortifying the bed of the river round and outside the cylinders against the effects of probable under washing by scour in this most untrustworthy river bed…'[130]

The Gamtoos Bridge was finally completed and opened to traffic on 3rd December 1895 by the wife of the Civil Commissioner of Uitenhage, Mrs A.H.Garcia after which it was taken over by the Divisional Councils of Uitenhage and Humansdorp jointly on the same day. Although the work was extended over three years amid great delays and difficulties with the foundations of the cylinder piers, the original estimate was only exceeded by a little over £3,000. All work, except the erection of the girders under contract, was done departmentally.[131]

Fig 58: The Gamtoos River Bridge, Humansdorp 1895

30 - THE UMTATA RIVER BRIDGE, UMTATA, TRANSKEI

The site for this bridge was personally selected by Chief Inspector Grier while on a trip to the eastern districts during 1892 and for which a sum of £8,000 was voted under the Public Works Act No.11 0f 1892.[132] Construction on this two 100 ft span triangular-lattice girder bridge supported on iron cylinders was commenced during 1893, having been delayed by 'quick-sand' conditions on the Pondoland side of the bridge. The work was being carried out departmentally under the superintendence of George Jarvis with traffic being able to use the bridge from November 1894.[133]

130 G.18-'94 Report of the Chief Inspector of Public Works for 1893
131 G.24-'96 Report of the Chief Inspector of Public Works for 1895
132 G.12-'93 Report of the Chief Inspector of Public Works for 1882
133 G.18-'94 Report of the Chief Inspector of Public Works for 1893

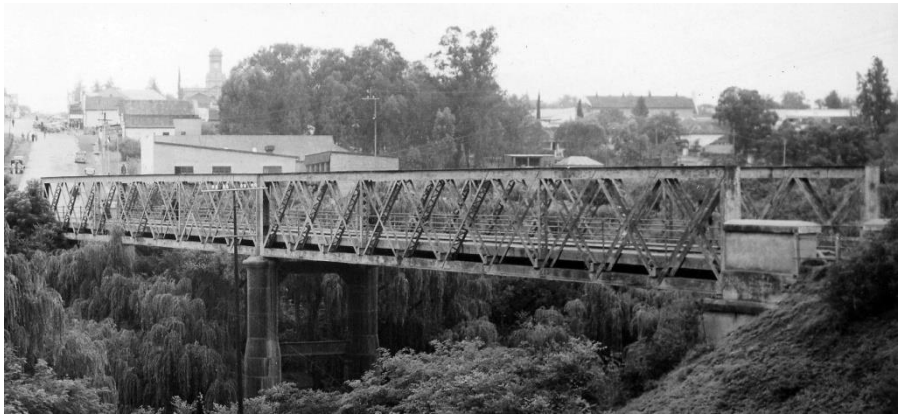

Fig 59: The Umtata River Bridge, Umtata 1894

31 – THE TINA RIVER BRIDGE, TRANSKEI

Road inspector George Jarvis reported that a wooden pont had been launched on this river on 26 July 1880, only to be cut adrift during the Mpondomisi rebellion and destroyed shortly after during a flood.[134] This bridge comprised three 100 ft spans of triangular-lattice girder supported on two iron twin cylinder piers, the erection being carried out by Harry Hiller. Construction was delayed due to the scarcity of ox-wagon transport as a result of the ravages of the Rinderpest epidemic, as the site had run out of cement.[135] The completion of this bridge on the main road between Umtata and Kokstad formed the final link in the chain of bridges connecting East London and Kokstad.

Fig 60: The Tina River Bridge 1880

32 – THE TSITSA RIVER BRIDGE, TRANSKEI

Road inspector George Jarvis reported that a wooden pont had been launched on this river on 28 June 1880, only to be cut adrift during the Mpondomisi rebellion and

[134] G.28-'81 Report of the Chief Inspector of Public Works for 1880
[135] G.44-'98 Report of the Chief Inspector of Public Works for 1897

destroyed shortly after during a flash flood.[136] This bridge was to comprise of five 100 ft triangular-lattice girder supported on iron cylinder piers. The ironwork was ordered during August 1896.[137] Much extra expense was incurred through the lack of draught oxen as a result of the Rinderpest epidemic, which raised the transport rates up to as high as 12/- to 13/- per 100 lbs.[138] The bridge was completed during 1897.

Fig 61: The Tsitsa River Bridge 1897

33 – THE UMZIMVUBU RIVER BRIDGE, TRANSKEI

A pont was under construction at the East London harbour works during 1882 and successfully launched the following year. This bridge comprised of six 100 ft triangular-lattice girder spans supported on Portland cement concrete 'laid en-masse' abutments. This bridge was similar in all respects to the Bashee River Bridge.[139] This bridge was erected departmentally at a cost of £17,140 and the first wagon crossed the bridge on 25th December 1896.[140]

Fig 62: The Umzimvubu River Bridge 1896

136 G.28-'81 Report of the Chief Inspector of Public Works for 1880
137 G.63-'97 Report of the Chief Inspector of Public Works for 1896
138 G.53-'99 Report of the Chief Inspector of Public Works for 1898
139 G.30-'95 Report of the Chief Inspector of Public Works for 1894
140 G.63-'97 Report of the Chief Inspector of Public Works for 1896

34 - THE BRABANT BRIDGE OVER THE GONUBIE RIVER, EAST LONDON

A contract was awarded to Messrs Maby and Haine of East London, however on the company's failure during September 1895 the whole works was taken over and completed departmentally. The bridge comprised of two 100 ft spans supported by stone masonry abutments and a single pier in the middle of the river.[141] This bridge was completed at a cost of £7,148 and handed over to the Divisional Council on 31st July 1896 and named after Maj Gen E.Y.Brabant MLA.[142]

35 - THE BLAINE BRIDGE OVER THE GONUBIE RIVER, KEI ROAD

This bridge was built on the road between Kei Road and Komgha and comprised one 75 ft triangular-lattice girder supported by stone masonry abutments at a cost of £2,206. The iron work was fabricated by Braithwaite & Kirk of West Bromwich, England. It was named after a well-known farmer from the district and handed over to the Divisional Council in July 1895.[143]

36 – THE DRIVER'S DRIFT BRIDGE OVER THE WHITE KEI RIVER, LADY FRERE

During 1894 tenders for the construction of this bridge were invited but none were acceptable. In addition, insufficient funds voted for the stonework meant that the construction had to be delayed for a further year.[144] The stone masonry work was constructed under contract during 1895 for the cost of £2,130 [145] This two 100 ft span triangular-lattice girder bridge was completed during 1896 at a cost of £5,319 and is situated close to Lady Frere on the road to Queens Town. The bridge was named after the one-time magistrate of Lady Frere, Mr C.H.Driver.

Fig 63: The Driver's Drift Bridge over the White Kwi River Lady Frere 1896

141 G.24-'96 Report of the Chief Inspector of Public Works for 1895
142 G.63-'97 Report of the Chief Inspector of Public Works for 1896
143 G.24-'96 Report of the Chief Inspector of Public Works for 1895
144 G.30-'95 Report of the Chief Inspector of Public Works for 1894
145 G.24-'96 Report of the Chief Inspector of Public Works for 1895

37 - THE PETERSEN BRIDGE OVER THE KWELEGHA RIVER, EAST LONDON

This two 75 ft span iron triangular-lattice girder bridge was supported on stone masonry abutments and a central pier which was built under contract by James McKenzie and completed in January 1898. The girders, which were fabricated by Braithwaite & Kirk of West Bromwich, were erected departmentally and completed in April 1898. A lack of funds delayed the completion of the approach roads and as a result of the ravages of the Rinderpest epidemic when a mule cartage train had to be used to deliver the gravel for the 'metalling' of the roads. A saving of over £1,000 was made by using skilled amaXhosa workers trained by the department instead of English riveters, for the erection of the girder work. The quality of their work was beyond reproach.[146] The bridge was handed over to the Divisional Council on 28th March 1899.

Fig 64: The Petersen Bridge over the Kwelegha River, East London 1899

38 - THE DU PLESSIS BRIDGE OVER THE ELANDS RIVER, TARKA

This bridge comprised two 75 ft triangular-lattice girder spans supported on a single stone masonry pier and raised abutments, the masonry work having been let on contract.[147] This bridge was finally completed at a cost of £4,920 and handed over to the Divisional Council in May 1895.[148]

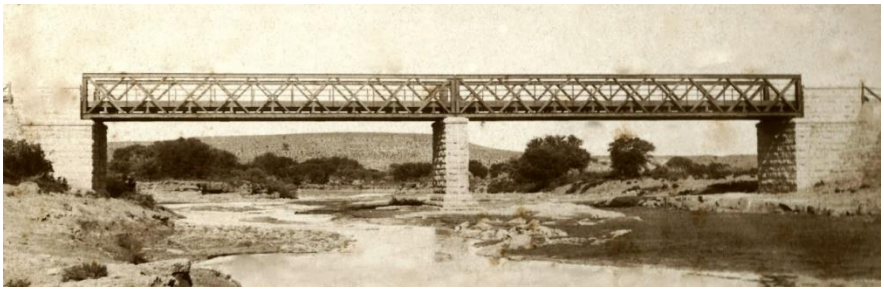

Fig 65: The Du Plessis Bridge over the Elands River, Tarkastad 1895

146 G.53-'99 Report of the Chief Inspector of Public Works for 1898
147 G.30-'95 Report of the Chief Inspector of Public Works for 1894
148 G.24-'96 Report of the Chief Inspector of Public Works for 1895

39 - THE NEWEY BRIDGE OVER THE KEISKAMMA RIVER, BREAKFAST VLEI

While District Inspector of Public Works at King William's Town, Newey conceived the idea of a suspension bridge to cross the Keiskamma River at Convict Station Drift, due to the delays and other problems the mail cart and other travellers were experiencing there when the river was in flood. Three small pedestrian suspension foot bridges had been designed in his office in 1893 and erected in 1894 over the Gxulu river at Keiskammahoek, at Alice over the Tyumie River and over the Tsomo River at Tsomo. The main road crossed the Fish River at Committees Drift en route from Graham's Town to King William's Town, and carried on to Breakfast Vlei, after which it forked. One could either cross the Keiskamma River at Line Drift, where a four span iron lattice girder bridge had been erected, between September 1892 and April 1894, or one could cross the Keiskamma river at Convict Station Drift which was equipped with a steel rope warp and a traveling cradle.[149]

Newey personally designed a cheap type of bridge to carry urgent light traffic only, such as post cart mails, right down to the final fabrication and construction detail, a suspension bridge, with a maximum design load of 4,000 lbs.[150] The structure comprised of two double cylinder support towers with a central span of 200 ft, and two outer spans of 100 ft off the abutments, with a deck width of 8 ft, half the normal width, and 57 ft above the river bed. The two piers were of steel cylinders 30 inches in diameter at the base level. The columns at base level were placed 25 ft apart from centre to centre, and were connected by lateral transoms 16 ft apart, and further stiffened by a system of diagonal bracing. The suspending cables of steel wire (cable), two in number on either side of the bridge, were 5 inches in girth. From these one inch diameter rods were suspended, spaced 10 ft apart, bolted to the channel iron bearers, which supported the angle iron from the runners carrying the roadway which was decked with planks. The relatively narrow Keiskamma River course along that section resulted in high flood levels, requiring a bridge with a high vertical clearance.[151]

All budgeted funds had been allocated to other bridge projects at the time, resulting in limited funds being available for a new bridge. Newey's proposal of a high level suspension bridge at an estimate of only £4,000, as opposed to a standard lattice girder ironwork bridge for heavy traffic costing £15,000, was carried as the authorities eventually approved the scheme in 1895. The required ironwork was ordered through

149 Walters, *Bridging the Eastern Cape*, p.101,102.
150 The Cape Times, 25 October 1897
151 CAD PWD2/5/225 Letter Newey to Chief Inspector of Public Works, 19 September 1895.

the Colonial Agent in England.[152] As noted in chapter 8, delays which affected all the current bridge projects were worsened by the Rinderpest epidemic of 1896, seriously affecting the transport of all materials and supplies by ox wagon, coupled with an engineering strike in England, delayed the delivery of structural ironwork by up to six months. The steelwork was manufactured by Messrs Heenan & Froude of Manchester, England, the same firm that manufactured the Blackpool Tower. Departmental construction commenced in November 1896 with the two cable anchors being cast in 'en masse' concrete, the whole of the iron work weighing nearly 70 tons, was erected within 6 weeks by Harry Hiller.[153]

The bridge was completed in April 1897 at a final cost of £4,330 18s 6d, and officially opened to public traffic on 18th August 1897. The bridge was designed to carry foot passengers and carts drawn by hand, while horses, oxen and mules were to cross through the water.[154] The construction was considered as experimental and was later adopted at Tsomo. The bridge was designed to carry a moving load of from 1,300 lb to 1,400 lb, the average weight of a loaded post cart, as well as an assumed load of 70 lb per square foot, or 500 lb per run of the bridge. The fact that the bridge structure had stood up to unexpected motor traffic for 30 years, involving at times rapidly moving loads of 15,000 lbs, showed that there was nothing wrong with the design.[155]

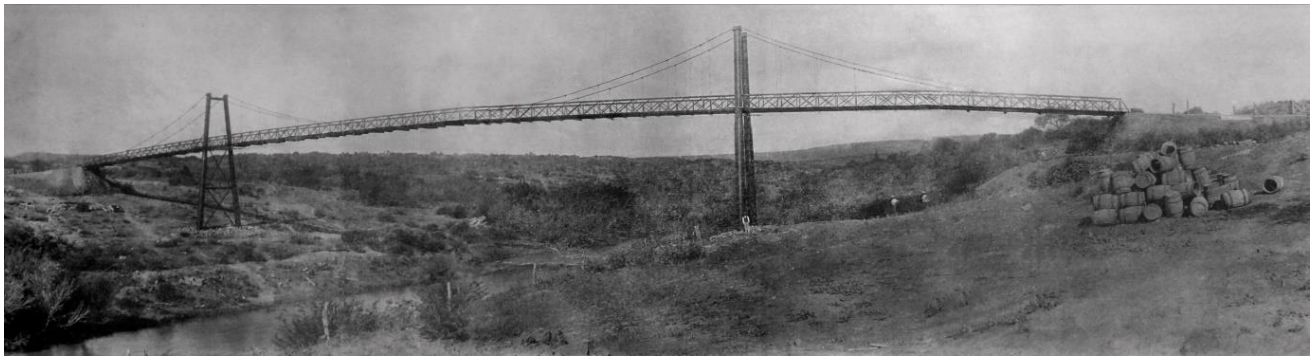

Fig 66: The Newey Bridge, Keiskamma River, Breakfast Vlei 1897

40 – THE YELLOW WOODS RIVER BRIDGES AT KEI ROAD & BREIDBACH

The two stonework abutments for this single 100 ft span triangular-lattice girder bridge was constructed under contract. This bridge was situated at the outspan close to the Kei Road village. This bridge was completed at a cost of £3,527 and handed over to the Divisional Council on the 3rd November 1896 and was named after J.F.Lonsdale, a

152 G.24-'96 Report of the Chief Inspector of Public Works for 1895
153 The Cape Mercury newspaper,12 December 1933
154 A.F.Newey, *My Story, the memoirs of Arthur Fradley "Tod" Newey*, (Private, 1936)
155 The Cape Mercury newspaper,12 December 1933

former mayor of King William's Town.[156] The second bridge over the Yellow Woods River at Breidbach had stone masonry abutments and a single central pier built under contract by James McKenzie, work commenced early in 1898.[157] The girder work was erected by Harry Hiller under a piece work agreement, while C.C.Thompson completed the approach roads. The bridge was handed over to the Divisional Council on 24th June 1899.[158]

41 – THE FORT BROWN BRIDGE RECONSTRUCTION, GREAT FISH RIVER

The old timber replacement bridge erected in 1876 after the original Royal Engineer built teak bridge had been washed away by the 1874 flood, was replaced by a new ironwork bridge.[159] The new bridge consisted of ten 58½ ft spans of triangular-lattice girders supported by double iron cylinder piers on raised stone masonry bases, remnants of the original bridges plus three new bases including two new stone masonry abutments. The girders which were fabricated by Joseph Westwood & Co of London were erected by Harry Hiller. The underside of the new bridge was 30 ft higher than the original Royal Engineer Bridge. The 1877 cost estimate was exceeded due to the high rates of cartage for both the ironwork from Algoa Bay and the distant stone quarry, and the increased depth of some 20 ft to which one of the new piers had to be excavated to reach a solid foundation. The bridge was finally completed and handed over to the Divisional Council in February 1900.[160]

Fig 67: The third Fort Brown Bridge over the Great Fish River 1900

[156] G.63-'97 Report of the Chief Inspector of Public Works for 1896
[157] G.44-'98 Report of the Chief Inspector of Public Works for 1897
[158] G.37-'1900 Report of the Chief Inspector of Public Works for 1899
[159] CAD PWD1/156 Letter from contractor who erected timber replacement bridge 'to Mr Newey's designs', 9 January 1875
[160] G.53-'99 Report of the Chief Inspector of Public Works for 1898

42 – THE TOLENI RIVER BRIDGE

The stonework abutments for this small bridge of a single iron plate girder of 54 ft span over a small deep gorge was in hand and was eventually completed departmentally in December 1895 at a cost of £1,700.[161]

43 – THE VLEKPOORT RIVER BRIDGE, TARKA

This bridge comprised two 100 ft spans of triangular-lattice girders on stone masonry abutments. The masonry work was executed under contract by C.C.Thompson, and the erection of the girder work by Harry Hiller under a piecework agreement. The structure was handed over to the Divisional Council on 2nd June 1899.[162]

44 – THE MACKAY BRIDGE OVER THE SUNDAYS RIVER, COLCHESTER

This bridge was constructed close to the old Capper's Drift ferry location over the Sundays River at Colchester and comprised four spans of 65 ft, 13 viaduct spans of 30 ft and one of 110 ft in a Pratt Truss configuration. This was the first departure from the common triangular-lattice girder pattern as it was able to span larger openings. The bridge was supported by rounded concrete piers. Henry Spindler was the clerk of works. Construction commenced in February 1894 and was completed and opened to traffic on 5th March 1895 by the wife of the Civil Commissioner of Uitenhage, Mrs A.H.Garcia. The final cost was £14,000 and it was named the Mackay Bridge after John Mackay MLA.

Fig 68: The Mackay Bridge over the Sundays River, Colchester 1895

[161] G.24-'96 Report of the Chief Inspector of Public Works for 1895
[162] G.37-'1900 Report of the Chief Inspector of Public Works for 1899

45- BARKLY BRIDGE OVER THE SUNDAYS RIVER, ADDO

Work on this, the second bridge near Addo was commenced during 1893 with the building of the stone masonry abutments under the resident engineer Mr Tippett. This bridge was completed in March 1895 at a total cost of £16,000 of which the Divisional Council of Uitenhage contributed £6,050 the remainder being paid by the government.[163]

46 – THE LONG KLOOF RIVER BRIDGE, BARKLY EAST

This bridge crossed the Long Kloof River, an upper tributary of the Kraai River on the road from Barkly East to Rhodes. The bridge was the first of four almost identical stone arch bridges designed by Newey. After Newey had selected the site, the surveys were carried out by Patrick Fletcher. Newey designed and prepared the drawings for this three 40 ft span stone masonry segmental arch bridge in 1892. The bridge has an overall length of 173 ft and a height of 22 ft from river bed to arch soffit. Work kept on being postponed as it was argued that a bridge at this point was not urgently required as opposed to other sites where surveys had also been completed. Stone quarrying started in February 1897, while actual departmental construction commenced in June 1897.[164] The dewatering of the excavations for the deeper central pier foundation using steam driven pumps increased the costs.[165] The bridge was completed in October 1898 at a final cost of £8,485 7s 11d and was handed over to the Divisional Council of Barkly East on the 11 October 1898.[166]

Fig 69: The Long Kloof River Bridge, Barkly East 1898

163 G.24-'96 Report of the Chief Inspector of Public Works for 1895
164 Barkly East Reporter newspaper, 16 December 1898
165 G.44-'98 Report of the Chief Inspector of Public Works for 1897
166 Barkly East Reporter newspaper, 14 October 1898

47 - THE WILDEBEESTE RIVER BRIDGE, UGIE

This bridge across the Wildebeeste River at the lower end of the village of Ugie, was built at the same time as the bridge over the Mooi River at the nearby village of Maclear, 13 miles away (see below). It consisted of three 40 ft span stone masonry segmental arches with an overall length of 162 ft and a height of 22 feet from the river bed to the arch soffit. In 1896 stone was being quarried and prepared near the site however in 1897 with the piers and abutments up to springing level, work was suspended pending the completion of the Mooi river bridge, when the centering for the arches became available.[167] The bridge which was also built departmentally, was completed in 1898 at a total cost of £7,250.

Fig 70: Wildebeeste River Bridge, Ugie 1898

48 - THE SIVEWRIGHT BRIDGE OVER THE MOOI RIVER, MACLEAR

This bridge across the Mooi River in the village of Maclear replaced a wire warp that had been installed across the river for transporting the mail in 1890. This bridge was almost identical to the one on the Wildebeeste river at Ugie (see above), and comprised three 40 ft span stone masonry segmental arches with overall length of 162 ft and height between river bed and the arch soffit of 28 feet. In 1896 stone was being quarried and prepared near site. In 1897 piers and abutments were completed and the centering for the arches was fixed. The Mooi river bridge was completed in 1898 at a total cost of £7,957 5s 10d and named after James Sivewright, the Commissioner of Crown Lands and Public Works.[168]

[167] G.44-'98 Report of the Chief Inspector of Public Works for 1897
[168] G.53-'99 Report of the Chief Inspector of Public Works for 1898

Fig 71: Sivewright Bridge, Mooi River, Maclear 1898

49 - THE DE WET BRIDGE OVER KARNMELKSPRUIT RIVER, LADY GREY

This bridge crosses the Karnmelk Spruit River on the road between Aliwal North, Lady Grey and Barkly East. In December 1896, authority was requested to build the Karnmelk Spruit Bridge, which would be '…similar to the Wildebeeste and Mooi River bridges as they are similar in every respect, and the same timber staging and centering could be used...'[169] Newey informed the Secretary of the Aliwal North Divisional Council, Mr Janisch, that he had fixed the site of the bridge and altered the design, building it in the excellent quality local dressed stone in place of a steel triangular-lattice girder bridge.[170] Newey confirmed the authority of February 1897 to build the Karnmelk Spruit Bridge departmentally.[171] The bridge has two 40 ft span segmental stone arches, with an overall length of 130 ft and a height of 32 ft between the river bed and the arch soffit. Bridge construction commenced in April 1897.[172] The original estimate of £7,500 was for two 100 ft ironwork spans, when the design was modified to two masonry stone arches. Tthe estimate was reduced to £7,000, with the eventual cost being £7,500. The extras were due to heavy flooding, when the foundation excavations were filled with silt. The builders were forced to use larger coffer dams with incessant pumping due to bedrock being found to be lower than the preliminary survey. Dressed stone wing walls had to substitute dry stone pitching, as rendered desirable by experience gained at the Loch Bridge construction. The work was carried out departmentally and handed over to the Divisional Council on 3rd March 1899, to be named the De Wet Bridge, at a final cost

169 CAD PWD2/5/15 Letter Newey to Chief Inspector of Public Works, 22 December 1896
170 CAD PWD2/5/16 Letter Newey to Mr Janisch Secretary of Aliwal North Divisional Council, 4 February 1897
171 CAD PWD2/5/16 Letter Newey to Chief Inspector of Public Works, 16 February 1897
172 G.44-'98 Report of the Chief Inspector of Public Works for 1897

of £8,711 0s 7d. This was the last stone arch bridge to be built in the Eastern Cape Colony due to the outbreak of the Anglo Boer War in October 1899.[173]

Fig 72: De Wet Bridge over the Karnmelkspruit River 1899

CONCLUSION

The foregoing two chapters have presented in detail the progress and achievements that bridge building in the Eastern Cape accomplished. Shortly after the Institution of Civil Engineers in London was established, Thomas Tredgold penned the following aphorism: 'Civil engineering is the art of directing the great sources of power in Nature for the use and convenience of man'.[174] Bridge building definitely falls into the category of confronting nature, as shown by the way in which the nine bridges were simply swept away by the great flood of 1874. The toil of the bridge builders was evident in trying to erect pieces of iron which had been fabricated 9,500 miles away by inserting thousands of red-hot iron rivets. Furthermore, the bridge designers were required to design these structures to withstand the African climate and vagaries of sub-tropical weather. These London-based 19th century bridge designers had much practical and theoretical knowledge regarding the structural design of the bridge components, given the anticipated loading conditions. However one aspect was a complete unknown and especially in Africa, and that was the ability to predict the anticipated flood discharges, the modern science called hydrology. Hence they had to depend on previously recorded highest water levels. If the bridge deck was set at an insufficient height, then they would have a potential problem, which proved true on several occasions. The evidence presented above has vindicated the argument that the construction of wagon bridges was absolutely indispensable for the free flow of wagons, people, and goods to the

[173] Barkly East Reporter newspaper, 16 December 1930
[174] Minutes of Council, Institution of Civil Engineers, 4 January 1828

newly developed towns and villages of the Cape. The loss of the flood destroyed bridges and the resultant transport standstill revealed the importance of bridges and the necessity of erecting adequate structures that would withstand the vagaries of the local climate and conditions of the Cape Colony.

The highly skilled and experienced British engineers, clerks of works, foremen, artisan carpenters, stone masons, riveters and blacksmiths were critical to the success of the construction of all these bridges. The difficulty in securing the employment of these immigrant engineers and artisans was as a result of having to compete with other British colonies, such as Australia, New Zealand, India and the rest of Africa who were engaged on similar works, and which eventually led to the employment of many locally trained workers. The hands-on approach of civil engineers such as Thibault, Michell, Skirrow, Lewis, Pilkington, Woodifield, Wakefield, Berkley, Robinson, Fforde, Grier, Newey, Westhoven and many other clerks of works contributed to the successful implementation of bridge projects throughout the Colony. These highly skilled engineers made a critical contribution to the infrastructural development and economic expansion of the Cape Colony.

Fig 73: Xalanga Bridge over the Tsomo River at Cala 1890 – a recent view

CHAPTER TEN – CONCLUSION

Bridge building went hand in hand with the political and economic development of the Cape Colony. Since the Dutch East India Company was unwilling to invest much in infrastructure for a colony they had never intended to establish in the first place, there was little road building and less bridge construction for the first 250 years of the Cape's existence. Nor did the British initially want to do more for a colony which they regarded merely as a strategic outpost for shipping. However, a steady trickle of immigrants, who gradually expanded north and east, forced their hand. Unfortunately the terrain was not encouraging since steep mountain ranges and numerous fast flowing rivers, inhibited physical communication as the settlers, in the form of the *trekboers*, pastoral farmers, moved eastwards,. For decades dangerous mountain passes, fords, drifts and ponts provided the only means of overcoming these barriers. The agitation and deputations of the farmer colonists for improved roads to transport their produce received scant attention.

In 1772 the new colonists first encountered Africans, the amaXhosa at the Fish River boundary. The boundary was established subsequent to this encounter, as it tried to regulate the transhumance and the settlers land hunger. Confrontation and conflict both resulted from the need of new grazing land for the livestock. The British authorities were now forced to intervene as the nine frontier wars were waged to subjugate the amaXhosa. The British introduced the 1820 Settlers to the frontier to act as a buffer against the amaXhosa who provided stout resistance. The subjugation of the amaXhosa was launched by the military as they annexed more of their territory to the Cape Colony. At the vanguard of the military expansion were the Royal Engineers who were tasked with designing and supervising the construction of buildings, fortifications, roads and bridges. The Royal Engineers built the Queens Road while bridging of the Fish and Kat Rivers with permanent bridges using funds from the military chest. These constructions along the eastern frontier emphasised the pivotal contribution that bridges made to the rapid transport of military forces and their commissariat to the various seats of conflict. With time several military posts and forts became towns such as Graham's Town, Fort Beaufort and King William's Town.

The appointment of John Montagu as the new Colonial Secretary in 1843 heralded a prosperous period of development as he overhauled the administration of the Colony

and established the Central Road Board. During its time of operation the Central Road Board introduced a programme of road, mountain pass and timber bridge construction. Funding was obtained from tolls, rates levied on property and grants from the colonial treasury. The shortage of labour was solved by using convicts to build the roads and mountain passes. When the Central Road Board which operated from 1843 to 1859 was disbanded, it left a positive legacy of 1,641 miles of main roads, six mountain passes which included the Montagu, Michells, Houw Hoek, Gydow, Bain's Kloof and Zuurberg passes, and over thirty bridges. It had a fundamental impact on the economy as farmers were now able to transport their produce to market along passable roads and over bridges without being held up by flooded rivers, which included the rapid transportation of goods and people into the hinterland of the colony.

The middle years of the 19th century saw significant changes in the Cape Colony. For one thing, it gained greater political independence. While this process is not detailed in this thesis, it was important for it gradually gave the colonists greater financial control of their affairs. Once it attained responsible government in 1872, the colony was better able to raise loans on the London money market and to attract investment from adventurers who were willing to risk their capital in the colonies. The Public Works Department engaged the Crown Agents from London to secure loan funding to finance bridge building, both for roads and railways. The discovery of diamonds in Kimberley in 1867 and of gold on the Witwatersrand in 1886 gave a further boost to this financial fillip. The colonists themselves provided internal pressure for development. The more entrepreneurial farmers and merchants recognised that easy access to markets was the key to economic development. Consequently, they put pressure on the government to invest in an infrastructure of roads and bridges. It was against this background that the roads and bridges and, eventually, the railways were constructed. The Public Works Department bridge building programme started with the most urgently required bridge constructions, using iron lattice girder bridge configurations almost exclusively, while timber trestle bridges were erected over lesser rivers where shorter spans were acceptable. In addition, nine stone masonry arch bridges were constructed during the period covered by the thesis.

While it is very expensive to design a bridge for all eventualities, another important consideration was the cost of lengthy disruptions to the flow of mercantile traffic and the transport of people. The devastating flood of December 1874 destroyed nine bridges throughout the region, when unprecedented flooding of the Great Fish, Little Fish, Kat,

Koonap, and Klaas Smits Rivers brought havoc to the region. This single act of wholesale destruction demonstrated the value of these bridges to the surrounding communities and brought the transport system across these rivers to a sudden halt. The transport operators had to revert to old drifts to cross these rivers, while it took months before the bridges could be repaired. This flood exposed the design and construction deficiencies of the destroyed bridges above all the inability of the design engineers to properly consider the hydrology of the region. The use of stone masonry piers and columns were phased out in preference to iron cylinder piers which could be more securely attached to the iron bridge girders. The amount of risk that the government was prepared to accept when having bridges designed and built was also revealed as being minimal.

Before the advent of the railways, all transport was carried out by ox wagons. Ox wagon transport's main disadvantage was its long delivery times and limited load carrying ability when compared with rail transport. There was constant rivalry between the two modes of transport along the railway routes, while the scourge of the dreaded cattle killing Rinderpest epidemic during 1896/97 was the ox wagon's final death knell. Elsewhere the construction of wagon bridges in the rural areas not served by the railways continued unabated, together with commercial expansion and the establishment of new towns.

The bridge building boom of the final quarter of the 19th century saw the construction of many iron lattice girder bridges, stone arch bridges and timber trestle bridges erected over the most important rivers of the Eastern Cape. The British engineers of the PWD such as Robinson, Fforde, Grier, Newey, Westhoven and clerks of works such as Jardine, Ferguson, Birnie, McLellan, Hyslop, and foremen bridge erectors such as Deason and Hiller, demonstrated their skill and ability in constructing bridges under trying African conditions.

This study has outlined the evolution of bridge construction, from the narrow rudimentary bridges comprising simple timber decks supported by rough stone abutments, to wider and braced timber bridge spans supported on several masonry stone piers, to the first properly designed and built stone arch culverts and bridges. The need to bridge wider rivers introduced iron lattice girder bridges, of which dozens were built. Finally the construction of the sophisticated steel cantilever bridge over the Gouritz River displayed the advanced progress that had been made by the bridge builders of the Cape Colony.

The surviving wrought iron, steel and stone arch bridges of the Eastern Cape are superb examples of historical engineering structures, each representing an outstanding illustration of British design and manufacturing innovation. The bridges illustrate the intricate pattern of technological transfer, theories of structural design, strength of materials, manufacturing technologies, and funding strategies, born out of the struggle between theoretical and practical know-how as all were dominated by 19th century construction methods and the demands for transportation.

The bridges described in this research all served the purposes for which they were constructed, and proved the thesis argument that their construction was indeed imperative for the free flow of transport to allow for the expansion of towns and the stimulation of free trade throughout the region.

The central argument of this thesis is that the construction of wagon bridges was crucial for the free and uninterrupted flow of trade and population expansion and the establishment of towns. In particular, it has attempted to tackle the lack of earlier writings about a specific aspect of colonial development, namely bridge design and construction. In producing a written record of historical structures such as bridges, the research undertaken has revealed the many circumstances that explain why these specific structures were necessary and significant. In attempting to address the lacuna in the history of civil engineering in South Africa, a challenge is made to others to follow suit.

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