

A HISTORY OF MINING IN BROKEN HILL (KABWE): 1902-1929

BY

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DECLARATION

I declare that the dissertation hereby submitted by me for the Master of Arts degree at the University of the Free State is my own independent work and has not previously been submitted by me at another university/faculty. I furthermore cede copyright of the dissertation in favour of the University of the Free State.

Buzandi Mufinda

DEDICATION

I dedicate this work to the memory of my late parents, Edward Mufinda, and Rosemary Mufinda, and to my niece Chipego Munene and hope one day she might follow in the footsteps of academia.

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ABSTRACT

This study has attempted to write a history of the Broken Hill mine in the period from 1902 to 1929. Despite the mine being the first large enterprise to be opened in Zambia, its history is largely unknown. Much of the information on which this dissertation is based was derived from archival research, primarily in the National Archives of Zambia in Lusaka; the Zambia Consolidated Copper Mines Archive in Ndola; and the Livingstone Museum in Livingstone.

Chapter one introduces the study. Chapter two examines the origin and development of the Broken Hill mine from 1902 to 1913. During this period, the productiveness and profitability of the Broken Hill mine was hampered by the problems of treatment of complex ores, expensive railway freights and the irregular supply of labour. In 1914 the First World War started and Chapter three traces the impact of the war on Broken Hill mine. The war was largely responsible for delays in the delivery of materials for the construction of a new treatment plant and furnaces. Because of the influenza epidemic, the mine closed towards the end of the year.

However, the war also provided opportunities for the mine to increase its production, sales and profits. In particular, the war led to a high demand for lead and zinc; an increase in the price of base metals; further reduction on railway rates by the Rhodesia Railways Company and the good prices of lead and zinc in London. This was a boost to increase the supply of the metals. Yet, the Rhodesia Broken Hill mine failed to make the most of such opportunities largely because of the recurring problem of treating complex ores. During the war, considerable effort was devoted to lead-zinc experiments, as the mine searched for better methods of treating the ores. In fact the mine was only once able to supply lead to Britain's Ministry of Munitions. Chapter four covers the position of the Broken Hill mine between 1919 and 1929. The period after the end of the war witnessed a tremendous increase in production, sales and profit margins. There was also greater infrastructure development at Broken Hill than ever before. Although between 1902 and 1929 production in terms of quantity and quality, sales and profits never reached hoped-for figures, they did roughly triple after the end of the war. This was made possible by the fact that Broken Hill mine was increasingly able to utilise cheap black labour, as well as cheap hydro-electric power. At the same time, the ores became richer even as the price of spelter increased. In the 1920s, Broken Hill mine benefited from a low cost of production per ton of lead and zinc and a selling price

per ton that was nearly double the cost of production. Indeed, Rhodesia Broken Hill mine enjoyed lower production costs than most of mines in the world.

KEY WORDS: capital, complex ores, kopje, labour, profit, production, revaluation, shareholders, taxes, treatment plant

OPSOMMING

Hierdie studie is daarop gemik om die geskiedenis van die Broken Hill myn in die tydperk 1902 tot 1929 te boek te stel. Ten spyte daarvan dat die myn die eerste groot onderneming is wat in Zambië geopen is, is sy geskiedenis tot 'n groot mate onbekend. Die inligting waarop hierdie verhandeling gebaseer is, is grotendeels afkomstig van argivale navorsing, vernaam die Nasionale Argief van Zambië in Lusaka, die Zambia Consolidated Copper Mines argief in Ndola en die Livingstone Museum in Livingstone.

Hoofstuk een is 'n inleiding tot die studie. Hoofstuk twee dek die tydperk 1902 tot 1913, en neem die oorsprong en ontwikkeling van die Broken Hill myn onder die loep. In hierdie tydperk is die myn se produktiwiteit en winsgewendheid belemmer deur probleme met die behandeling van komplekse erts, duur spoorwegtariewe en die onreëlmatige voorsiening van arbeid. In 1914 het die Eerste Wêreldoorlog uitgebreek en dus bestudeer hoofstuk drie die uitwerking die oorlog op die myn. Die oorlog het grotendeels bygedrae tot verdragings wat betref die aflewering van materiaal vir die oprigting van 'n nuwe aanleg en hoogoonde. As gevolg van die griep epidemie is die myn later daardie jaar gesluit.

Die oorlog het egter ook aan die myn die geleentheid verskaf om sy produksie, verkope en wins te verhoog. Die oorlog het veral gelei tot 'n hoë aanvraag vir lood en sink, 'n styging in die prys van basis metale, die Rhodesia Railways Company se verlaging van sy spoorwegtariewe en die gunstige prys van lood en sink op die Londense markte. Dit het 'n hupstoot gegee aan die verskaffing van metaal. Tog het die Broken Hill myn nie voldoende munt geslaan uit hierdie geleentheid nie, grotendeels as gevolg van die voortslepende probleme met die behandeling van komplekse erts. Tydens die oorlog is daar aansienbare kragte gewy aan lood-sink eksperimente as deel van die myn se soeke na beter metodes om die erts te behandel. Die myn kon slegs by 'n enkele geleentheid lood aan Brittanje se ministerie vir krygsvoorraad lewer. Hoofstuk vier dek die stand van die myn tussen 1919 en 1929. In die tydperk na die oorlog was daar 'n enorme opswaai in produksie, verkope en winste. Die infrastruktuur by Broken Hill het ook sy grootste uitbreiding tot nog toe beleef. Alhoewel die produksie met betrekking tot hoeveelheid en gehalte, sowel as verkope en

winste, nooit in die tydperk 1902 tot 1929 aan verwagtinge voldoen het nie, het die syfers kort na die oorlog verdriedubbel. Dit was grotendeels danksy Broken Hill se toenemende gebruik van goedkoop swart arbeid, sowel as goedkoop hidroëlektriese krag. Terseldertyd het die erts ryker geword, tesame met die toename in die prys van staafsink. In die 1920's het die Broken Hill myn voordeel getrek uit die lae produksiekoste per ton lood en sink, en verkoopsprys per ton wat byna dubbel dié van die produksiekoste was. Die Rhodesia Broken Hill myn het voordeel getrek uit van die laagste produksiekoste ter wêreld.

SLEUTELWOORDE: kapitaal, komplekse erts, koppie, arbeid, wins, produksie, herwaardering, aandeelhouers, belasting, ertsbehandeling.

CHAPTER ONE

INTRODUCTION

Few aspects of mining history at Broken Hill have been fully studied. The importance of Broken Hill mine in the history of mining in Northern Rhodesia (present day Zambia) has been neglected. The mine's importance has not been appropriately acknowledged in the early period up until the beginning of the Copperbelt mines in the 1920s. Apart from being the earliest large mine to open in Northern Rhodesia, its contribution to the regional history of mining is lacking. In the early 1920s, the mine exported its zinc to South Africa and Britain. It contributed to the economy of Southern Rhodesia as early as 1906 when it imported coal from Wankie Colliery. The railway system of modern-day Zambia was established when the discoveries of zinc and lead made it possible for the railway line to operate in the territory as early as 1906. This dissertation explores the history of the Broken Hill mine (later Kabwe) in the period from 1902 to 1929. It is based on archival research and published contemporary periodicals, mainly financial reports. Primarily from the National Archive of Zambia in Lusaka, Zambia Consolidated Copper Mines Archive in Ndola and the Livingstone Museum in Livingstone. The study comprises four chapters. Chapter one is the introduction. The introductory part of the study is divided into eight sub-themes namely: background and literature review, study area, sources and methodology, limitations of the study, structure of the study and conclusion.

Historical Background

The history of Broken Hill Mine is indirectly linked to the Industrial Revolution and the Mineral Revolution which started in the late 17th Century and second half of the 19th Century in Britain and South Africa respectively. For the Industrial Revolution to succeed there was a need for raw materials, and Africa, Asia and America answered to this need.

In the second half of the 18th Century, industrial development took a further leap forward. Steam power replaced wind and water power and copper became increasingly important for

the industrialists.¹ The need for this increased. Copper was used in the manufacturing of glass cylinders for pumps and engines; it was used for plumbing and sanitation in the new industrial towns; it was manufactured in a variety of different articles. Consequently, by the end of the 19th Century, as Britain, Germany, Belgium and France became more industrialised, Britain itself was the largest producer of copper in the world, with about 75% of world production.²

In the early 19th Century, the Industrial Revolution in Europe saw more and more countries investing in industrial development in order to compete in a world that was rapidly modernizing. This was especially true for Britain. She industrialised at such a fast pace that her natural resources could not meet the demand. This also became true for France, Germany and America. Though minerals like zinc, lead and copper were found in Britain, Germany, Belgium and the United States, demand outstripped supply. In Britain, lead and zinc occurred mainly in the central and northern part of England, where the lead-zinc fields appeared around Matlock in Derbyshire.³ Soon enough, production became expensive because of overseas competition and the poor quality of the veins, which faulted at depth.⁴ This forced Britain to look for cheaper sources of lead and zinc. During the mid-19th Century these minerals were in demand for use in roofing and zinc for galvanizing steel.⁵ As further stated by Arthur Downs,

The demand for Zinc was further advanced due to pollution and health dangers. The increase in pollution of air in large cities appeared to have been an important factor in stimulating the interest in this metal, for Zinc is resistant to the air borne chemicals found in smoke. Zinc paint was realised to have crucial health advantages over lead.⁶

The demand for copper also increased throughout the 19th Century. In many parts of the world, electricity was replacing gas lighting, horse-drawn trams were giving way to electric trams and soon all these new developments required copper. As a result of this demand,

¹ L. H. Gann, 'The Northern Rhodesia Copper Industry and the world of Copper: 1923-1952', *Rhodes-Livingstone Journal*, vol. 18 (1955), p. 4.

²Gann, 'Northern Rhodesia', p. 2.

³ G. Coyle, *the Riches Beneath our Feet: How Mining Shaped Britain* (Oxford: Oxford University Press, 2010), p. 5.

⁴ J.T. Koch, *Celtic Culture: A Historical Encyclopaedia*, vol.1 (California: ABC-CLIO, 2006), p. 690.

⁵ Coyle, *The Riches Beneath our Feet*, p.10.

⁶ A.C. Downs, 'Zinc for paint and Architectural Use in the 19th Century', *Association for Preservation Technology*, vol.8, no.4 (1976), p. 80.

British copper supplies became insufficient.⁷ Overseas resources became essential and from about 1820 Chile became a great producer of copper.⁸ Then the vast mineral resources of the United States of America were also exploited. The last two decades of the 19th century saw Western European powers, and especially Britain, engaging in a new wave of economic and political expansion in search of raw materials and new markets for their growing industries.⁹ Great Britain, with her highly developed banking system and trade connections with most parts of the world became the banker of the underdeveloped world. Therefore, the British investors were more willing to risk their capital overseas, hoping that in regions where capital was scarce and labour cheap they would secure high rates of interest than at home. British investors in particular became more interested in investing money outside Europe, as European countries like France and Germany which formerly had borrowed money from London, built up their own industries, repaid their debts and began to export capital.¹⁰ Their capital found fertile soil in Africa.

The discoveries of explorers such as Livingstone, Burton and Richard had shown that there were sources of copper in some parts of Central Africa, and by the 1890s, this knowledge became of great interest to investors.¹¹ Consequently, a number of discoveries of copper were made in the so-called “Hook of the Kafue”, between 1895 and 1899. In 1895 the British South Africa Company's notorious American scout, Frederick Russell Burnham first established for Westerners that copper deposits existed in Central Africa.¹² Along the Kafue River, Burnham saw many similarities to copper deposits he had worked with in the United States of America.

Lead and zinc were discovered at Broken Hill by T.G. Davey, an Australian geologist working for what became the Rhodesian Broken Hill Development Company. Using the mine at the Hook as a base, Davey went eastward at the start of 1902 to look for ‘certain old workings’ he had been told about by other prospectors. It was the height of the rains, and Davey’s guide became lost. In their wanderings, Davey noticed a steep hill which aroused his curiosity. He climbed up in dusk and quickly realised that it was heavily mineralised.¹³ He

⁷ Gann, ‘Northern Rhodesia,’ p. 2.

⁸ *Ibid.*

⁹ *Ibid.*

¹⁰ L. Gann, *The Birth of A Plural Society* (Manchester: Manchester University Press, 1958), p. 44.

¹¹ Gann, ‘Northern Rhodesia’, p. 4.

¹² R. Pugh, *Wingate Pasha: The Life of General Frances Reginald Wingate 1861- 1953* (London: Heinemann, 2011), p. 231.

¹³ R. Hall, *Zambia* (London: Pall Mall Press, 1965), p. 250.

stumbled across outcrops of lead, zinc and vanadium on a kopje or rocky hill which he named Broken Hill on account of its resemblance to a similar formation of that name in Australia. This fortunate occurrence was the result of Davey becoming lost in the bush. This was the discovery of the Broken Hill lead-zinc mine, which Davey named after a major property he had known in Australia. The Northern Copper Company secured land of about 35 square miles from the BSA Company.¹⁴ By 1906, Broken Hill started production and had become the railhead for the route from the south. It was the discovery of lead, zinc and vanadium that led to the railway line to be extended to Broken Hill. Thus it was lead and zinc and not gold that provided the justification for continuing the railway across the Zambezi River. But for Davey's discovery, the line would probably have been routed through the mines around the Hook of the Kafue near Mumbwa.¹⁵ The mining of lead and zinc commenced in 1904 and reached full-scale production in 1906.¹⁶

The Northern Rhodesia Copper Company, which was linked financially to the BSA Company began slowly to engage in developmental work.¹⁷ As in much of South Africa, mineral deposits determined the route followed by the railway construction. The BSA Company which had already linked Southern Rhodesia to the South African railway system extended the line north of the Zambezi River between 1904 and 1909.¹⁸ As a result, a railway was constructed through North-western Rhodesia to the Katanga mines in Congo. The railway avoided the small copper deposits in the "Hook of the Kafue" in favour of the lead and zinc deposits at Broken Hill, which were thought to be capable of immediate exploitation. The copper deposits were the first to be discovered but could only be exploited after the railway line was constructed for easy transportation of production equipment from South Africa via Southern Rhodesia.

Literature Review

There is a substantial body of literature on mining in Zambia. Scholars studying the economic history of the country have written extensively on mining on the Copperbelt and its effects on

¹⁴ A. J. Wills, *An Introduction to History of Central Africa* (London: Oxford University Press, 1965), p. 195.

¹⁵ Hall, *Zambia*, p. 251.

¹⁶ A. Turner, 'A Socio-Economic History of Kabwe 1902-1966,' unpub. PhD Thesis, University of California 1979, p. 6.

¹⁷ M. Chanock, *Unconsummated Union: Britain, Rhodesia and South Africa, 1900-45* (Manchester: Manchester University Press, 1977), p.16.

¹⁸ *Ibid.* p. 4.

socio-economic and political life. This historiography has neglected the history of Broken Hill mine. Most scholars have addressed the history of the Broken Hill mine only in relation to Copperbelt mines. The Broken Hill mine was the first to reach production in Northern Rhodesia and contributed significantly to its economic life, yet there is very little information on its operations from 1902 to 1994, when it was finally closed.

The history of the Broken Hill mine is mainly discussed in passing reference to the Copperbelt mines. For instance, Austen Bancroft's *Mining in Northern Rhodesia: A Chronicle of Mineral Exploration and Mining Development*, notes only that the Rhodesia Broken Hill Development Company eventually became a subsidiary of the Johannesburg based Anglo American Corporation.¹⁹ More important to this study, is Arthur Turner's dissertation which examines the socio-economic history of Kabwe from 1902 to 1966. His focus however, is on the formation of a European town and African urban society and the interplay of both structures in the town's development.²⁰ The mine itself is not his primary concern. Similarly, Andrew Roberts' general history of Zambia only offers a glimpse of the origin of the Broken Hill mine.²¹ Norman Pollock, too, briefly notes how the Broken Hill Company came into being.²² Nick Wincott's study notes only the technical difficulties experienced by the Broken Hill mine.²³ Maud Mutemba's work on the underdevelopment of the Kabwe Rural District simply attributes this to the impact of mining activities during the colonial era but without further elaboration.²⁴ Consequently, where the history of Broken Hill mine has been touched on by the above mentioned scholars, it is fragmented and falls well short of a much needed account of the mine's early history. As the only important mine contributing to the economy of the country before the late 1920s, the history of Broken Hill mine needs to be told.

¹⁹ A.J. Bancroft, *Mining in Northern Rhodesia: A Chronicle of Mineral Exploration and Mining Development* (Bedford Sidney Press, 1961); R. Hall, *Zambia* (London: Pall Mall Press, 1965); Pollock, *Nyasaland and Northern Rhodesia*; Roberts, *A History of Zambia*.

²⁰ Turner, 'A Socio-Economic History of Kabwe 1902-1966,' p. 1.

²¹ A. Roberts, *A History of Zambia* (London: Heinemann, 1976), p. 175.

²² N. Pollock, *Nyasaland and Northern Rhodesia: Corridor to the North* (Pittsburgh: Duquesne University Press, 1971), p. 337.

²³ N. Wincott, 'Education and Urban Development in Zambia,' In G.W. Smith, B.Pachai & R.K.Tangri (eds), *Malawi Past and Present* (Blantyre: Claim, 1971), p. 139.

²⁴ M. Mutemba, 'Expectations Unfulfilled: The Underdevelopment of Peasant Agriculture in Zambia: The Case of Kabwe Rural District 1964-1970, unpub. PhD Thesis, University of California, 1976, p. 10.

Authors such as Bancroft, Turner, Roberts, Baldwin, Pollock, Wincott, Mutemba and Gann have all commented in passing on the history of the mine. Issues of its origin, capital, labour, operations, production, the coming of the railway line, and the impact of First World War on Broken Hill mine receive passing mention. But the broad point is that they all discuss Broken Hill mine in relation to the Copperbelt from 1920s onwards, never in its own right.

In light of this study, the works of Bancroft, Hall, Pollock and Roberts offer a brief origin of the Broken Hill Mine both in history and context.²⁵ Their works note that the Broken Hill mine: was discovered in 1902 by T.G. Davey accidentally on his way to inspect old copper works in the Loangwa district; commenced operations in 1904; and reached full-scale production by 1906. Bancroft and Pollock in particular note that among the main prospecting companies such as the Bechuanaland Exploration Company, Northern Copper Company and Tanganyika Concessions, it was the Rhodesia Copper Company that formed the Rhodesia Broken Hill Company to run newly the discovered lead-zinc mine of Broken Hill.²⁶ These works do provide some useful background information on how the BSA Company encouraged mineral prospecting in the Broken Hill area.

In this context, Bancroft examines the Broken Hill mine's initial capitalisation and operations. He noted that the operations of the Broken Hill mine commenced in 1904 under the Rhodesian Broken Hill Development Company with a total area of 35 square miles of land. British capital was invested during the early development of the mine.²⁷ While his work is important in tracing the earliest developments of the mine, it falls well short of detailed information on investment. It is impossible to ascertain how much capital was invested in the first 28 years of its operation due to gaps in his work.

Turner's study focused on the development of African society under the pressures of the European power structures and the transition of rural people to urban life. These encompassed changing family relations, consumer patterns, and work habits in respect of the concurrent changes that took place in rural areas.²⁸ It was further observed that the Broken Hill mine regarded its social responsibility to help the town develop its water system, housing, health facilities and road construction as one of its lowest priorities. The mine's

²⁵ Bancroft, *Mining in Northern Rhodesia*

²⁶ Bancroft, *Mining in Northern Rhodesia*, p. 112. See also Pollock, *Nyasaland and Northern Rhodesia*, p. 338.

²⁷ Bancroft, *Mining in Northern Rhodesia*, p. 116.

²⁸ Turner, 'A Socio-Economic History of Kabwe', p. 3.

position regarding provision of infrastructure and social services turned on three factors namely: the mine's desire to make as much profit as possible; the municipality's desire to stay out of debt while creating a modern sanitary town; and the Colonial Government's desire to have the Mining Company and the Township Municipal Council fund the town's development on their own.²⁹ Accordingly, Turner concluded that, the Broken Hill Mine minimised its social obligations, initially because of the BSA Company's desire to keep administrative costs low and after 1924 because of colonial government parsimony. Until the 1940s only electricity and water were provided to town dwellers. Turner's work provided this study with the basis for finding out how the Broken Hill mine management reacted to such demands and what they did in situations such as 1918 when the influenza pandemic threatened to jeopardise their operations.

When discussing the impact of the First World War on Northern Rhodesia, scholars like Philip Daniel, Michael Coulson, Arthur Turner and Mwelwa Musambachime have all noted that the Broken Hill mine boomed during and after the First World War due to the high demand for minerals in Europe for their manufacturing industries.³⁰ Coulson, especially, discussed how the Germans in Tanganyika during the war attempted to disrupt activity by threatening the Broken Hill lead mine exports to Beira on the east coast.³¹ Musambachime, further postulates that the outbreak of the First World War led to a labour shortage due to the recruitment of thousands of men as porters. This adversely affected Broken Hill Mine.³² All of these studies, then, acted as vantage points from which the history of Broken Hill, can be glimpsed. Yet again, though, a detailed account of the mine is missing.

Studies undertaken by Ian Phimister, Charles van Onselen and Arthur Turner on labour are useful for addressing labour issues at the Broken Hill mine. Phimister and van Onselen studied black and white labour in the Southern Rhodesia mines during the colonial era. Their work shows how large and small mines made profits by reducing cost on labour. With regard to the status quo of black and white labour on Southern Rhodesia mines, they observed that

²⁹ *Ibid.* p.66.

³⁰ P. Daniel, *Africanisation, Nationalisation and Inequality: Mining Labour and the Copperbelt in Zambian Development* (Cambridge: Cambridge University Press, 1979); M. Coulson, *History of Mining: The events, technology and the people involved in the industry that forged the modern world* (Hampshire: Harriman House, 2012); Turner, 'A Socio-Economic History'; and M. Musambachime, 'Northern Rhodesia Tax Stamps as an Aid to Chronology.' *History in Africa*, 14 (1987).

³¹ Coulson, *History of Mining*, p. 258.

³² Musambachime, 'Northern Rhodesia', p. 366.

while mine owners were able to exercise a considerable degree of control over white workers, the harshest discipline and the greatest cost minimization was mostly reserved for black labour. As the Southern Rhodesian mining industry expanded, so African labour employed grew from 17,000 in 1906 to 36,000 by 1920.³³ This accords with Turner's observation for a slightly later period that labour recruitment for the Broken Hill mine during the post-war period of the First World War increased from 500 in 1920 to 3500 men by 1926. This was due to the following factors: the expansion of the mine after World War I, coupled with a rapid turn-over of labour; the falling-away of labour migration to Southern Rhodesia and South African mines; the localization of the mine's labour force; voluntary labour as opposed to forced labour; and the government's policy of giving five acres of land near the mine after 1924 to workers encouraged many to seek employment.³⁴ Equally, Lewis Gann's *General History of Northern Rhodesia* notes that Broken Hill mine employed black and white labour, but that they separated by a rigid colour bar, culture, skill and living standards.³⁵ Yet these passing remarks do not provide a detailed account of disparities in conditions of employment between whites and Africans in terms of payment of wages, job opportunities and housing conditions.

An important aspect of labour history is worker consciousness. Phimister and van Onselen critically examined worker consciousness and how it was linked to bad working conditions on the mines of Southern Africa. Their main arguments were against assumptions that the political consciousness of black workers should be assessed largely through the presence or absence of associations and organisations which manifestly articulate worker interest.³⁶ They observed that Africans had a well-developed and demonstrable self-awareness of their positions as exploited workers. Examples cited show Africans living in the area between the Limpopo and the Zambezi avoiding Rhodesian mines as far as possible. The Native Affairs Committee of 1910-11, for example noted that, in many instances African families would sell stock to meet tax obligations, rather than allow their kinsmen to seek employment on the mines.³⁷ Phimister and Van Onselen's findings were used to examine the extent workers on

³³ I.R. Phimister and C. van Onselen, *Studies in the History of African Mine Labour* (Gwelo: Mambo Press, 1978) p. 3.

³⁴ Turner, 'A Socio-Economic History', pp. 68-69.

³⁵ Gann, *A History of Northern Rhodesia*, p. 141.

³⁶ Phimister and Van Onselen, *African Mine Labour*, p. 1.

³⁷ *Ibid.* pp. 2, 5.

the Broken Hill mine responded to labour conditions in the manner they described, especially as this was the one mine that gave its workers substantial land to supplement their income.

When tracing the development of the electric-power industry in Northern Rhodesia, Richard Baldwin noted the significance of Broken Hill mine. The development of the electric-power industry, he argued, was closely linked to the expansion of mining, more so, even than was the construction of the railway system. He pointed out that electricity became vital for the metal mining industry. The lead and zinc mine at Broken Hill was the first big user of electricity, when in 1925 the Rhodesia Broken Hill Development Company installed the first hydroelectric plant in the sub-region.³⁸ But here, too, although Baldwin's work offered valuable insights in the introduction of hydro-electric power at Broken Hill mine, it failed to consider whether the introduction of electricity in extraction of lead and zinc increased production and what its impact was on labour.

Noting that the operations of the Broken Hill mine faced many setbacks, Pollock described the difficulties experienced in extracting lead from the mine's ore deposits. He also mentioned the large volume of water that flooded into the mine put to a stop to operations entirely because of the high cost of pumping.³⁹ Finally, Wincott emphasises that Broken Hill had a chequered history because the mine experienced considerable technical difficulties.⁴⁰ Although these works on production provide a picture of the mine, one cannot get a full view of the mine's production history because they do not provide a chronological account of the obstacles hindering operations and how the mine dealt with them.

Other works consulted for this study include general histories and comparative mining analyses. Phimister's work on Zimbabwe's Wankie Colliery argues that it occupied an extremely important position in the economic history of Central Africa.⁴¹ Coal for power and the smelting of minerals on the gold mines of Southern Rhodesia, as well as the copper and the lead-zinc mines in Northern Rhodesia was imported from Wankie. But despite being pivotal in supplying coal to the mines of Central Africa, the Wankie mine struggled to return

³⁸ R. E. Baldwin, *Economic Development and Export Growth: a Study Of Northern Rhodesia, 1920-1960* (Los Angeles: University of California Press, 1966), p. 177.

³⁹ Pollock, *Nyasaland and Northern Rhodesia*, p. 341.

⁴⁰ N. Wincott, 'Education and Urban Development in Zambia,' p. 139.

⁴¹ Phimister, *Wangi Kolia: Coal, Capital and Labour in Colonial Zimbabwe 1894-1954* (Johannesburg: Witwatersrand University Press, 1994), p. 1.

regular profits and dividends. So far as Broken Hill mine was concerned, however, this mattered less because both operations were controlled by Edmund Davis (see below, chapter two) and companies close to the BSA Company. This meant that while one mine might have made a loss, others in the group benefited from a complex system of cross-subsidisation.⁴²

Turning to railways themselves, also controlled by the BSA Company, Simon Katzenellenbogen highlights the complexities of a system extending from Bulawayo in 1897, Broken Hill by 1906, and to Elisabethville in 1910.⁴³ Like Katzenellenbogen, Peter Slinn also noted that the BSA Company investments in the Rhodesian railways, proved a great strain on the company's resources, as they were financed largely by debenture issues that is interest-bearing shares, guaranteed by the Chartered Company. Both Katzenellenbogen and Slinn have suggested that Rhodesia's gold deposits proved disappointing, and it was the coal fields of Wankie, the zinc and lead mines of Broken Hill and the copper fields of Katanga that drew the railway northwards and for nearly two decades provided the greater proportion of traffic and revenue.⁴⁴ It would seem that Broken Hill mine contributed to much needed traffic for the railway company, especially in its early years. The argument put forward in these studies was useful for identifying the mine's role in resolving, at least in part, the rail system's profitability north of the Zambezi.

Without African labour, Broken Hill mine could not operate, and, as elsewhere, the imposition taxes was crucial for driving Africans into wage labour. Slinn's work on taxation has demonstrated how the colonial government first requirement was that, the African population of Northern Rhodesia should pay the hut-tax which was the mainstay of the company's administrative revenue.⁴⁵ Macpherson, shares the same views on the use of tax. He observed that the relentless hunt for 'musonko' or tax, which the Company's agents began before thorough 'pacification' had been effected and which continued to the very end of their rule. Furthermore, Musambachime has explained how tax enriched the local chiefs through personalised levies. He cites the example of one chief, 'Kasakwa Kandundu', in his capacity as Chief 'Chipepo' of the Lenje, was apparently renowned for instituting his own levies and

⁴² *Ibid.* p. 16.

⁴³ S. Katzenellenbogen, 'Zambia and Rhodesia: Prisoners of the Past: A Note on the History of Railway Politics in Central Africa,' *African Affairs*, vol.73, (1974), p. 63.

⁴⁴ Katzenellenbogen, 'Zambia and Rhodesia,' p. 63.

⁴⁵ Slinn, 'Commercial Concessions and Politics during the Colonial Period: The Role of the British South African Company in Northern Rhodesia, 1890-1964,' *African Affairs*, vol.70, (1971), p. 368.

finer.⁴⁶ Additionally, Mutemba has concluded that, ‘the history of production in Broken Hill Rural District since its contact with capitalism has been largely one of conflict between African peasant producers and capitalists: Africans sought to organize their labour and apply other physical means of production aimed at increasing labour's productiveness; capitalists sought to draw off labour and to control resources to increase their own productivity; in the first 30 years of colonial rule, capitalist production was at a low level. To control this situation, tax was implemented and rural producers were turned into part workers and part peasants at the same time. Settler farmers took away from some African producers’ fertile land which they had previously occupied.’⁴⁷ This study draws on these observations about taxation when discussing the significance of taxation for the operations of Broken Hill mine in mobilizing much needed labour.

Sources and Methodology

This study is based on archival research. Three archives were consulted. These are the National Archives of Zambia in Lusaka, Zambia Consolidated Copper Mines Archive in Ndola and the Livingstone Museum Archive in Livingstone. Additionally, the University of Zambia Library proved extremely useful for this study.

The first archive consulted was the National Archives of Zambia. The British South African Company files from the period 1899 to 1924 were examined. Arranged chronologically, the collection included signed treaties with local chiefs for land and mineral rights, mineral prospecting, and mining concessions. It also contained Rhodesia Broken Hill Development Company files on the establishment of mine compounds, the allocation of five acre plots, statistics on the number of employees and exports of lead and zinc. Information from reports on the diseases within the territory, trade and commerce, histories of the tribes within Northern Rhodesia, tax and labour were also retrieved. Tour reports by District Commissioners were consulted. Documents relating to movements within the territory like the Watchtower Movement; the emergence of towns; and agriculture among both the black and whites were collected. However, there were very few financial reports on the operations of the BSA Company in the territory.

⁴⁶ M. Musambachime, ‘Colonialism and the environment in Zambia, 1890-1964’ in S.N. Chipungu, (ed) *Guardians in Their Time: Experiences of Zambians under Colonial Rule 1890-1994* (London: Macmillan Press, 1992), p. 21.

⁴⁷Mutemba, ‘Expectations Unfulfilled’, p.3.

The Livingstone Museum Archive was consulted primarily for the *Livingstone Mail* which was the earliest newspaper in the territory. It was first published in 1906 by a local Livingstone chemist Leopold Moore. First-hand accounts in documents and memoirs were examined, notably travellers' accounts like J.B. Moubray in South Central Africa and Barbra Mansfield experiences in Broken Hill town (see below).

The Zambia Consolidated Copper Mines became the custodians of all the records of Broken Hill mine after its closure in 1994. At their archive in Ndola, primary documents such as Annual Reports from the Rhodesia Broken Hill Company were sourced, as were Broken Hill district tour reports; reports on mine labour; annual financial reports of the Rhodesia Broken Hill Company; and financial reports on the sale of lead, zinc, vanadium and manganese. Other company documents provided information on the construction of the Hydro- Electric Power at villages near Broken Hill for the supply of power at the mine. Files on the Rhodesia Railways yielded useful information on tariff charges for mine equipment and exports. Unpublished photographs on Broken Hill mine were used to enrich the study.

Considerable research was done at the University of Zambia Library which proved useful for both published and unpublished data. Amongst official government reports consulted were the *Pim Report and Annual Reports on North-Western Rhodesia*. These sources yielded information concerning colonial taxation, labour migration from Broken Hill District and land usage.

So far as published primary sources are concerned, the use of financial and mining newspapers proved very useful. *The African Observer, The African World, The Critic, The Economist, The Financial News, The Livingstone Mail, Mining and Engineering World, The Mining Magazine and Pall Mall Gazette* among others enriched this study. These sources consisted of first-hand accounts, which came into existence within the period being investigated especially the engineer's reports by Mr. T. Davey on the discovery of the mine, quantity and quality of the zinc-lead ore. The company's reports through their Chairman Edmund Davis and his associates contained information on capital investment, shares invested, production output, profit and difficulties met with in operation and expenditure on machinery and labour. These were helpful in gaining a picture of mine owners reports, as well as reports from engineers and public investors' opinion of the mine.

Limitations of the Study

Challenges encountered during this research included the following. At the National Archives of Zambia the greatest problem experienced was missing files, especially commissions of enquiry on labour, health, accommodation and diseases. Some tour reports were also missing. Since the research covers the earliest period of both BSA Company administration and Crown rule, much information on the early years from 1902 to 1910 was very scarce. Some documents were in such a poor state that they were very difficult to read. Time was also wasted whenever it rained, as no document could be accessed for fear of them being soaked because the buildings where these documents were stored was yards away from the library building. Consequently, this study lacks statistical information on a number of issues. It was difficult to find figures for the first decade of BSA Company rule, partly because of inadequate storage, and possibly because the figures were simply not collected at the time. For this reason, there are gaps in the narrative.

At the Livingstone Museum, volumes of the *Livingstone Mail* were generally in good shape but not all editions were available for the period under study. However, issues for the period 1908-1912 were located. The documents in the archive were well catalogued, but unfortunately at the time of my research visit, many were being re-catalogued therefore difficult to locate. Apart from this, the Keeper of History, who was well acquainted with the history section, had left the Museum and there was no one who could assist in locating the files.

The Zambia Consolidated Copper Mine archive had a certain amount of information on statistical data for labour and the production of lead, zinc and vanadium. Unfortunately, though, annual reports and quarterly meetings were not arranged and catalogued. From the scattered documents, a number of company financial reports were retrieved but doubtless more information could have been collected if these files had been well arranged. The staff complained of understaffing and hence they could not find time to arrange them.

The University of Zambia special collection is well staffed and books are well catalogued. Most of the financial newspapers and engineering journals consulted for this study were written by company promoters. Company interests and speculation figure prominently,

African voices are entirely absent, and these biases and gaps in the coverage of these newspapers is obviously a problem for balance in this narrative. For example, *The African Observer* and *The African World* contained information on the settler political, social and economic life of the town important to my study, but rarely had anything to say about Africans except in the context of labour.

Structure of the Study

This study examines the history of Broken Hill mine from 1902 to 1929. The year 1902 marked the opening of the lead/ zinc mine in Northern Rhodesia by The Rhodesia Broken Hill Development Company. In addition, the period under study stops in 1929 because after the Great Economic Depression began, the mining context was transformed. This would require a quite different in-depth research of the situation at the mine

The dissertation is divided into four chapters. Chapter One, which is the introductory chapter, is followed by a chapter which discusses the role played by the BSA Company in acquiring mineral rights in Northern Rhodesia. It analyses the development of the mine and the Rhodesia Broken Hill Development Company management and finance of it, as well as the agreements entered into with the BSA Company. It also looks at the changes that took place at Broken Hill because of the complex ores encountered and the mine's response to this problem. Finally, the chapter examine the railway line and the mine. This chapter covers the period from 1902 to 1913.

Chapter Three covers the First World War period from 1914-1918. It examines the British Empire's attempts to solve the problem of the metal trade during the war through legislation to control markets. It also analyses the role of zinc and lead during war time. Other related issues include lead-zinc production output, financial constraints and the German monopoly of base metal trade before and the early stage of the war.

The fourth chapter examines the factors that led to many new developments in the period from 1919 to 1925 at the Broken Hill Mine, namely progress in the production of zinc and lead, the Mulungushi and Lunsemfya Hydro-electric Scheme, and the establishment of the Broken Hill town. Thereafter, the chapter also investigated black and white labour recruitment and the conditions of service on the mine between 1926 and 1929.

CHAPTER TWO

BROKEN HILL A DUBIOUS MINE 1902 – 1913

This chapter examines the origins and development of the Broken Hill mine from 1902 to 1913. Broken Hill mine, the first large mine in Northern Rhodesia, was established at a time when the country was subjected to extensive prospecting in a bid to find gold, copper and other valuable minerals. On the discovery of lead and zinc, there was a rush to open the mine, without sufficient assessment of its operational costs. It was soon realised that, like the neighbouring mines of the Wankie Colliery in Southern Rhodesia, and the Katanga mines in the Belgian Congo, the Broken Hill mine would need substantial capital to bring it to a productive stage. The Broken Hill mine also faced the challenges of a falling zinc price, insufficient labour, rising production costs, diseases and a lack of technical expertise. In its early years, the absence of a railway line made large-scale mining nearly impossible, while the challenge of separating its complex ores threatened the mine's viability. This led to frequent disruptions of mining operations.

The Southern African Mining Context

The story of capitalist mining took a new turn in Southern Africa when diamonds and gold were discovered in Kimberley and on the Witwatersrand between 1867 and 1886.⁴⁸ Prior to these discoveries, Britain, Germany and France looked to the African continent to invest capital.⁴⁹ They also wanted raw materials to feed their growing industries. Gradual steps were

⁴⁸ For detailed studies on Kimberley and Witwatersrand and their influence on mining in Southern Africa, see R. Turrell, *Capital and Labour on the Kimberley Diamond Fields, 1871-1890* (Cambridge: Cambridge University Press, 1987) and C. Van Onselen, *Studies in the Social and Economic History of the Witwatersrand, 1886-1914: Volume 1, New Babylon; Volume 2, New Nineveh* (London: Longman Press, 1982).

⁴⁹ South Africa was one of the regions to which British capital began to flow after the great diamond and gold discoveries between 1867 and 1886. The discovery of diamonds near Kimberly in 1867 sparked a Mineral Revolution in the region under the auspicious of the DeBeers Company. Meanwhile, the discovery of gold on the Witwatersrand (Transvaal) in 1886 attracted the attention of the rich Kimberly businessman, Cecil Rhodes, but when he failed to secure rich diamonds, he began to search for a Second Rand north of the Limpopo River

taken to establish contacts with Africa through missionaries and travellers. These discoveries led to a steady influx of investors from all over the world, wanting to get a share of the new found wealth. When foreign investors came to South Africa, mining was transformed from small scale mining run by indigenous people to large scale mining by companies. The latter used advanced methods of machinery as opposed to hand sorting and the use of primitive equipment. This led to a rush of prospectors to Southern Africa. International capital, especially British, was invested. In particular, Cecil John Rhodes, a Briton residing in South Africa, seized the opportunities presented by the new discoveries. Rhodes was able to secure both British and South African capital. With his keen eye for business, he made a fortune from diamond mining by swallowing up small companies and forming the De Beers Consolidated Mining Company. Small mining companies had sprung up to dig for diamonds, but after a while, many of them realised that digging out diamonds needed more capital and advanced machinery than they could afford.⁵⁰ Eventually they succumbed to the bigger companies. When gold was discovered in 1886, however, Rhodes missed the opportunity to secure some of the most prized gold-bearing land. According to Phimister,

The initial development of Witwatersrand gold after its discovery in 1886 was primarily undertaken by Kimberley capitalists. Of considerable significance for southern Africa was the fact that Rhodes, unlike magnates such as J. B. Robinson, hesitated. In February 1887, The Gold Fields of South Africa Ltd. was registered in London with over £ 100,000 of Gold Fields' capital sunk in mining properties and machinery. Rhodes and Rudd sought to escape from their faulty Witwatersrand investments by placing the rest of the company's capital in De Beers and Kimberley Central diamond shares. It was precisely because Rhodes had initially been unsuccessful on the Transvaal Rand that he sought a 'Second Rand' north of the Limpopo to recoup his losses.⁵¹

(into areas of modern-day Zambia and Zimbabwe). For further information see G. Arnold, 'Diamonds' in K. Shillington(ed), *Encyclopedia of African History*, 3 (New York: Taylor and Francis Group, 2005), p. 347.

⁵⁰ The diggers were mainly British or colonial subjects, but also included large numbers of Europeans and Americans. See S. Trapido, 'Imperialism, Settler Identities and Colonial Capitalism' in R. Ross, A. Mager and B. Nasson (eds), *The Cambridge History of South Africa*, 2 (Cambridge: Cambridge University Press, 2011), pp.73-76.

⁵¹ Phimister, 'Rhodes, Rhodesia and the Rand', *Journal of Southern African Studies*, 1974, v.1,p.76.

Rhodes' economic aspirations in the South were further complicated by his political ones.⁵² Disagreeing with the Transvaal government's mining policies, Rhodes felt he could use his money and his influence to overthrow the Boer government and install a government that was more amenable to the mine-owners' interests. Hence in December 1895 Rhodes sponsored an attack on the Transvaal, which became known as the Jameson Raid. This damaged his relationship with the Transvaal government beyond recall.⁵³ Phimister asserts that Rhodes 'was pursuing his own financial interests in the Rand at the expense of a united, British-oriented South Africa, and, presumably, at the expense of his untarnished immortality'.⁵⁴ The Raid was a failure and Rhodes had to resign as Prime Minister of the Cape.⁵⁵ But this all occurred in the aftermath of the fact that Rhodes' Gold Fields of South Africa had failed to secure the rich outcrop reefs of the Rand and it is in this context that Rhodes' earlier grasp for the 'northern goldfields' must be analysed.⁵⁶ Rhodes and his associates moved northwards, beyond the Limpopo River, in the hope of finding gold in the neighbouring territories of present day Zimbabwe and Zambia. Rhodes also wanted to use his wealth to pursue his dream of expanding Britain's empire in Africa. With matchless duplicity, his BSA Company colonised first Mashonaland and then Matebeleland in present-day Zimbabwe.⁵⁷ However, the local gold-fields proved unprofitable. As stated by Phimister, and noted above,

Examination of the growth of capitalist mining in Southern Rhodesia combined with a regional analysis, however, suggests that Rhodes and to that extent, the BSA Company realized the comparative poverty of Southern Rhodesia's mineral resources by 1894-5 and that certain of the so called 'political interruptions' were in a number of respects a

⁵² In fact, the Mineral Revolution had far-reaching political, economic and social consequences for Southern and Central Africa. The BSA Company, which through the person of Cecil Rhodes was closely linked to the diamond and gold industries in South Africa, secured a charter from the British government. This allowed it to bring first Southern and later Northern Rhodesia under its administration. The company acquired the mineral rights in these territories, hoping to recoup its expenditure on the administration of these territories by taking a share in the profits of new mining ventures. See E. A. Boateng, *A Political Geography of Africa* (London: Cambridge University Press, 1978), p. 179.

⁵³ For a concise understanding on the effect of the Jameson Raid on Rhodes' ambitions in South African and the gold industry, see Phimister, *An Economic and Social History of Zimbabwe 1880-1948* (London: Longman, 1988), pp. 18, 20, 29; and R. Davenport and C. Saunders, *South Africa: A Modern History* (London: Macmillan, 2000), pp. 98, 110.

⁵⁴ Phimister, 'Rhodes, Rhodesia and the Rand', p. 75.

⁵⁵ See Ross, *A Concise History of South Africa* (Cambridge: Cambridge University Press, 1999), pp. 69-70.

⁵⁶ Phimister, 'Rhodes, Rhodesia and the Rand,' p. 75.

⁵⁷ The Company conquered Matebeleland and Mashonaland, albeit only following the Shona and Ndebele Uprisings of 1896-7. As argued by S. Marks, 'Southern Africa', in J.D. Fage, R. Anthony, and R. Oliver (eds), *The Cambridge History of Africa: From 1870-1905*, 6 (Cambridge: Cambridge University Press, 1985), p. 451.

direct consequence of the failure of the 'Second Rand' to materialize between the Limpopo and the Zambezi.⁵⁸

Disappointed, Rhodes turned to what became Northern Rhodesia, but very little gold was found there. However, just on the border between Northern Rhodesia and the Belgian Congo, in the Katanga area, copper of high quality was discovered. This sparked interest on the Northern Rhodesian side.⁵⁹ Immediately, measures were put in place to secure the territory from other competitors. This was done through treaties and conquest.⁶⁰ From here on, prospecting in Northern Rhodesia intensified.

The British South Africa Company

To understand the origin of the Broken Hill mine, it is essential to appreciate the role of the BSA Company in mineral prospecting in Northern Rhodesia. As was the case in Southern Rhodesia, the BSA Company used a variety of methods to search for minerals in Northern Rhodesia. This involved signing treaties with African chiefs. The most important treaty signed by an African chief and the BSA Company was the Lochner Treaty of 1889. It was signed by Chief Lewanika of the Barotse people, with Frank Lochner acting on behalf of the BSA Company. It gave the latter exclusive mining and commercial rights. It included the buying of mineral concessions and gave rise to organised prospecting. The Lochner Treaty also gave statutory rights of administration to the BSA Company under the Barosteland North Western Rhodesia Order in Council.⁶¹ The BSA Company entered North Eastern Rhodesia as an extension of the occupation of Nyasaland. The British Consul of Nyasaland, Harry Johnston, was responsible for this process. By use of force, North Eastern Rhodesia was brought under BSA Company control by defeating recalcitrant local chiefs, such as chief Mpezeni of the Ngoni, Chitimukulu of the Bemba and Mwata-Kazembe of the Lunda. By

⁵⁸ Phimister, 'Rhodes, Rhodesia and the Rand,' p. 75.

⁵⁹ The Congo was brought under Leopold's administration, and rapacious economic exploitation proceeded apace. Northern Rhodesia and the Congo Free State were commonly thought to be of great potential value in copper production. See G. Everwyn, 'Which Way in Katanga', *African Affairs*, 1962, v.22, p.151.

⁶⁰ Northern Rhodesia was occupied in two ways. North-Western Rhodesia was occupied after the Lochner Treaty of 1890 with King Lewanika. North-Eastern Rhodesia was occupied upon conquering of the Ngoni of Mpezeni in 1891, Lunda of Mwatakazembe in 1893, and the Bemba of Chitimukulu in 1896. By 1900, the BSA Company had extended colonial rule over these territories, not least to secure in its labour supplies. It was successful in pacifying the region and this facilitated the secure of investment of capital. By imposing taxation, it forced Africans to work for wages. See D. Chanaiwa, 'African Initiatives and resistance in Southern Africa', in A. Boahen (ed), *General History of Africa: Africa under Colonial Domination 1880-1935*, 7 (California: California University press, 1990), p. 96; and G. Mwakikagile, *Zambia: The Land and its People*, (Dar es Salaam: Continental Press, 2010), p. 172.

⁶¹ A. Pim, *Report of the Commission Appointed to Enquire into the Economic and Financial Position of Northern Rhodesia* (London, 1938), [hereafter, Pim Report], p. 79.

1900, the occupation was complete.⁶² This gave the Chartered Company political security to continue with their business of mineral prospecting. Economic motives could not be separated from political ones.

The BSA Company was indirectly linked to the discovery of the Broken Hill mine. It should be noted that neither Joseph Thompson nor Alfred Sharpe (who were employees of the BSA Company) ever penetrated into the mineralised regions of the present day Copperbelt or Broken Hill, but even so, the authorities in London sanctioned the Company's mineral rights as extending to the Kafue.⁶³ This was done despite the fact that most of Northern Rhodesia east of the Kafue was outside Lewanika's effective sphere of influence and was therefore not actually covered by the Lochner Treaty.

Prospectors in Northern Rhodesia

Once the territory was secured, the BSA Company advertised and issued prospecting rights to interested companies. It had neither the capacity, nor the finances to prospect the vast land by itself. Most of the prospectors who came to Northern Rhodesia were not new to the game. These prospectors were usually employed by big companies. Many had gained experience in prospecting from Europe, South Africa and the wider Southern African region.⁶⁴ These new prospectors scoured Northern Rhodesia from as early as the 1890s. By 1895, organised prospecting had been carried out in the territory. During this same year time, the Northern Territories (BSA) Exploration Company sent F.C. Burnham and Pearl Ingram, who were prospectors from Southern Rhodesia, to prospect north of the Zambezi River. During the course of that year, the BSA Company issued a flurry of mining concessions. On 13 February, the Bechuanaland Exploration Company was allocated three areas of 100 square miles, which carried both land and mineral rights. On the same date, the Charterland Gold Fields was allocated 100 square miles of land and mineral rights; and on 21 May, J.W Dore was allocated one block of 30,000 morgen (about 100 square miles) with land and mineral rights.⁶⁵ On 22 March 1902, the above-mentioned rights, counting over 500 square miles, were amalgamated into the Big Concession which, when acquired by the Northern Copper

⁶² F. Macpherson, *Anatomy of a Conquest: The British Occupation of Zambia 1884-1924* (London: Longman, 1981) pp.76-80.

⁶³R. Hall, *Zambia: 1890-1964 The Colonial Period* (London: Longman, 1976), p. 31.

⁶⁴ Most of these prospectors came from Europe and had worked in South Africa, Belgian Congo, Southern Rhodesia. Their connections were discussed earlier in chapter one. See also A, Bancroft, *Mining in Northern Rhodesia*, (Bedford: Sidney Press, 1961), pp. 44-53.

⁶⁵ L. Gann, *A History of Northern Rhodesia; Early Days to 1953* (London: Chatto & Windus, 1964), p. 76. See also Bancroft, *Mining in Northern Rhodesia*, p. 57.

Company, was reserved for prospecting. On closer scrutiny, the area was found to cover 700 squares miles, but permission was granted to retain the excess land on the same terms as the original grant.⁶⁶

This whole area was subsequently acquired by the Rhodesia Copper Company. It was formed after the Northern Copper Company was merged with other small prospecting companies. In turn, the Rhodesia Copper Company was subdivided and the lease assigned follows: three areas of 10 square miles each, including the Sable Antelope, Silver King and Crystal Jacket mines, were transferred to the Kafue Copper Development Company by deed on 26 June 1905. Three areas of 10 square miles each, enclosing the Kafue Hot Springs and the Sugar Loaf and Nanga claims, were assigned to the Northern Copper Company by deed on 26 June 1905, which were later passed on to the Bechuanaland Exploration Company.⁶⁷ The Bechuanaland Exploration Company had numerous subsidiaries, which included the Northern Territories Exploring Company. It was established by Edmund Davis, an Australian who, like Rhodes, emigrated to South Africa for his health and became a prominent figure in mining finance. He had established the Bechuanaland Exploration Company in 1888, and later became a representative on the boards of more 40 companies.⁶⁸

Among the companies run by Edmund Davis was the Rhodesia Copper Company. This company employed Thomas Garfield Davey as one of its consulting engineers. Davey, the pioneer of systematic prospecting in Northern Rhodesia, had built up a substantial organisation by the turn of the century, with a large number of men in the field, with steam launches on the Kafue, and wagon-loads of material sent up from Bulawayo.⁶⁹ According to Bancroft, for some years “T.G. Davey must have had about thirty men in the field, including J.P. Allen, O. Baragwanath, W.C. Collier, Davison, J.J. Donohoe, Ingram, A.C. M. Kerr and Sheppard.”⁷⁰ Not much is known of Davey. He was born in Spain, where he gained his first mining experience. He became a consulting engineer and founder of a mining school in Australia, where he also conducted experiments in metallurgy. It was Davey who made what

⁶⁶ Bancroft, *Mining in Northern Rhodesia*, p. 57.

⁶⁷ *Ibid.*

⁶⁸ Phimister, ‘Edmund Davis’ in L. Goldman (ed), *Oxford Dictionary of National Biography: 2005-2008*, (London: 2013),

⁶⁹ *Zambia’s Mining Industry; The First 50 Years* (Ndola: Public Relations Department, 1978), p. 19.

⁷⁰ Bancroft, *Mining in Northern Rhodesia*, p. 60.

was, until the establishment of the Chibuluma deposits in 1939, the only discovery of a major mineral mine in Northern Rhodesia without the guidance of the local inhabitants.⁷¹

The Discovery of Lead and Zinc Deposits

The discovery of the Broken Hill mine in January 1902 was accidental in that Davey's prospectors were looking for copper outcrops. While reporting on a supposed copper outcrop, another outcrop composed almost entirely of pure lead and zinc minerals was found and investigated. The composition was recognised as being very similar to that of Broken Hill, Australia, hence the name given to the Rhodesia Broken Hill mine. Davey remained there for five days with his assistant Kerr. They discovered that the kopjes consisted of pure carbonate of zinc, which was of a high grade. Subsequently, the Rhodesia Broken Hill Extension was also discovered and Kerr found that it too had a similar formation to that of the Broken Hill mine. It appeared that this run of lead and zinc continued for a length of at least three miles.⁷² Once this discovery was made, Davey immediately secured the whole area by putting beacons around the two kopjes. He reported the discovery to his directors and advised them to apply to the Chartered Company for a concession of at least twenty five square miles surrounding the property. This was granted by the Chartered Company. Forty claims were taken up by the Rhodesia Copper Company directors, who extended the concession to thirty-five square miles. This ensured that the title-deed remained safe, without the danger of intruders in any way hampering their operations.⁷³

After the explorations were completed, further investigations were necessary. Therefore, between 1902 and 1903, the lead-zinc sample outcrops were excavated and examined. It was found that the lead and zinc deposits existed principally in the form of kopjes, of which there were several of varying dimensions situated throughout the neighbourhood. The formation occurred at intervals and, to a great extent, consisted of bog iron. The outcrops in the vicinity of the No.2 Kopje carried small deposits of gold, as much as 2 pennyweights per tonne. Six kopjes were identified and pegged. Among these, the most striking outcrops were those known as No. 1 and 2 Kopjes. These rose to a height of 65 ft. from east to west, and 330ft from north to south.⁷⁴ The two kopjes were devoid of vegetation, and stood out from their

⁷¹ *Zambia's Mining Industry*, p. 20.

⁷² *The Statist*, 16 July, 1904.

⁷³ *Ibid.* Later in the 1908, Mine management was fiercely opposed to the location of a township on its grant. An attempt was made to discredit the area as a site for a town. National Archives of Zambia. (hereafter NAZ), A3/8/1 R.B.H.D. Co. to the Administrator of N.W. Rhodesia , 7/28/1908.

⁷⁴ *The Statist*, 4 March, 1906.

surroundings. The first kopje consisted of a massive deposit of carbonate of lead, associated with carbonate of zinc. The other, much larger kopje, of about three-quarters of a mile distant, consisted almost solely of carbonate and silicate of zinc of high grade. In addition, four smaller kopjes, consisting principally of carbonate of zinc, associated with iron oxide were found.⁷⁵

The Establishment of the Mine

The identification of the two kopjes of lead and zinc led to the establishment of the mine in 1904. The Broken Hill mine was established by the Rhodesia Copper Company. It formed a subsidiary company, the Rhodesia Broken Hill Development Company (RBHD), which was registered in London in November 1904. By then, the newly formed RBHD Co. had a board of directors, which consisted of Edmund Davis (Chairman), Rt. Hon. Lord Gifford, V.C., Rt. Hon. Lord Teynham, C.H. Villiers, Sir Albert H. Markham, H.W. Fox and P. C. Tarbutt.⁷⁶

The company's initial capital was £550,000 in shares of £1 each. Of these, £350,000 shares were issued as fully paid on account of the purchase price of the property, £50,000 being the balance of the purchase price yet to be allotted. Another £100,000 was issued for cash in order to provide working capital, while 50,000 were held in reserve. Although the 35 square miles remained the property of the BSA Company, the land was in the hands of the RBHD. It acquired 1,690 claims from its mother company, the Rhodesia Copper Company, 1,690 claims, known as the Rhodesia Broken mine; from the Northern Rhodesia Syndicate ten square miles of land, and from the railway company twenty-five square miles. For these claims, the Company had to pay £300,000, £50,000 and £50,000 respectively; with £100,000 shares paid up in full, while £50,000 shares remained in reserve.⁷⁷

Once capital was secured and the appointment of a board of directors completed, the mine began small operations in 1904. The operations consisted of an open-cast system. A number of winzes were sunk down to the water level at about 25-30ft. These showed in every instance that the ore continued as far as the water level. Beyond this, they were unable to sink any further until pumping machinery had been installed. From time to time, small amounts of gold were found, but not of high grade.⁷⁸

⁷⁵ *The African world*, 10 December, 1904.

⁷⁶ Bancroft, *Mining in Northern Rhodesia*, p.112.

⁷⁷ *The Statist*, 4 March, 1905.

⁷⁸ *The African World*, 10 December, 1904.

These early operations at the Broken Hill mine initiated a number of developments. For one, it was estimated that the lead-zinc deposits were enormous, both in quantity and quality, with about 650,000 tonnes of high grade ore exposed at the surface. It was believed that the entire mine consisted of high grade lead and zinc ores. It was estimated that the average percentages of metal in the lead-zinc ore was 50% and 45% respectively.⁷⁹ These reports raised hopes that such a large quantity of lead-zinc ore would yield great profits. It was estimated that the 1,000,000 tonnes ore deposits above the water level would earn a minimum of £1,000,000, at a production cost of £1 per ton. Since these projected profits were only based on ore above the water level; what profits, then, could be earned if operations continued many thousands of feet below ground?⁸⁰ Such were the early hopes for the mine's prospects.

The Mining Environment: Early Challenges

Despite the earlier positive speculation around the mine's prospects, the mine faced unexpected challenges. The major challenges included climatic conditions, diseases, the lack of a processing plant, inadequate labour, transport problems and complex ores. These and other related issues are discussed in the subsequent sub-sections. As will be illustrated, some of these major challenges meant that mining activities were suspended for much of the period under study.

The Physical Environment

The geological formation of the country was limestone, with belts of sandstone and conglomerates with iron deposits in several places; as well as lead, zinc and vanadium.⁸¹ Although the belts of sandstone and conglomerates enhanced opportunities for the mine to exploit a variety of precious metals, which included copper, gold and silver; limestone, which attracted water and foul air, posed a great challenge to underground mining operations. Therefore, from the start, the Broken Hill mine suffered from water and foul air seeping through the limestone formation.⁸² Such a challenge necessitated the utilisation of advanced machinery. However, an equally significant challenge was that the lead-zinc Broken Hill mine lacked advanced equipment in the early years of its development. The early miners therefore relied on African workers for hard physical labour.⁸³

⁷⁹ *The Statist*, 16 July, 1904.

⁸⁰ *The Times*, 19 January, 1920

⁸¹ ZCCM, J. Moffat Thomson, *Human Geography Broken Hill District*, N.D. p.1.

⁸² *African World Annual*, December 1906,

⁸³ NAZ, KDA/2/1 Broken Hill Rural District, p.25.

The district was divided into three separate areas. The area to the South and East was generally swampy, with the Great Lukanga Swamps. The boundaries of the Lenje district were on the east of the Muchinga Escarpment, which was over 1,000 feet and along the Lusenfwa Valley. The west of the Kafue river, north of the Ndola district, was inhabited by the Balima and Balamba and, on the south, the Basala settled close to Lusaka. The approach to the Lukanga swamp from the north was over a vast plain studded with anthills or small kopjes of considerable height on which were large, wide-spreading trees. Far away in the distance there appeared to be a vast forest of timber, but as one travelled on, what appeared to be forest was only innumerable anthills covered with timber, and scattered some distance apart over the plains.⁸⁴ The forest provided timber and firewood to the mine and a large number of Africans were employed to collect these products. However, during the rainy season, the road to the forest was impassable. It became increasingly difficult to collect the timber, as sources were rapidly depleted and more labour was needed to move further inland. This proved costly in terms of wages.⁸⁵

During the dry season on the flats, surface water was unobtainable. The lives of the inhabitants who lived in the Lukanga swamp when the administration arrived in the country was controlled by the local environment, and the people in the neighbourhood of the swamp were also to a great extent dependent upon it for their livelihood. Food, material for house building, firewood, hut furnishing from the form of reed mats and baskets were all obtained in the swamps.⁸⁶ The timbered country is intersected with numerous grass savannahs. The savannah grasslands were more suitable for growing cereal crops. As such, the Lenje people were mainly subsistence farmers who grew millet, sorghum and maize as their staple food. Their diet consisted of fish, small game and tubers. Fish were caught from the Mulungushi and Lunsefwa rivers and their tributaries. In addition, they also traded fish for cloth, beads and other items with their neighbours, the Batwa and the Batema.⁸⁷

The east of the country was well watered by the Mulugushi and Mwomboshi Rivers and their tributaries. These rivers fall over the Lusenfwa Valley. After the First World War, it was estimated that the falls had a total drop of about 1,100 feet. The Mulungushi River would

⁸⁴ Human Geography Broken Hill District.p.3.

⁸⁵ NAZ,KDA/2/1, Broken Hill Rural District, p.2.

⁸⁶ Ibid,p.13.

⁸⁷ Ibid.

later facilitate the construction of a hydro-electric power station to supply electricity for domestic and industrial use at the Broken Hill mine.⁸⁸

The altitude of the Lenje country was about 3,700 feet above sea level and observers compared the climate to that of an English summer. The hot season began around the middle of September and ended towards the end of March. The wet season coincided with the hot months of the year. Spring arrived around 15 August and the cold season was from May to the end of July, or the middle of August.⁸⁹

The rainfall was fairly evenly distributed, although rain storms were usually localised. The average rainfall per annum was 33-38 inches. The heaviest rainy day would record rainfall of about 1-89 inches and the wet season extended from October to April, the wettest month being January.⁹⁰ Between October and April, mining excavations were frequently disrupted by rising water levels. The mine, especially in its early phase, lacked advanced pumping equipment to pump out the water.

Diseases

Some climatic conditions led to the outbreak of diseases. Travellers like F.C. Selous described the district as attracting mosquitoes. As he passed through Chitanda Village, he was harassed by mosquitoes. In the Lukanga swamps, mosquitoes affected the lives of the people. Many workers, from railway officials to local inhabitants, were affected by malaria due to a small swampy area near the Boma, which formed as a result of exceptionally heavy rains that provided an unexpected breeding place. While malaria could be treated with quinine,⁹¹ this drug was not readily available to the African workers. Consequently, black-water fever, a particularly virulent form of malaria affected those already debilitated by previous attacks. Dysentery occurred sporadically among Europeans, and became more prevalent in the winter months.⁹² Meanwhile, wet weather in the forest-grasslands attracted tsetse flies, which not only affected cattle, but people as well. A 1909 report by the Native Affairs Department stated that inhabitants from other parts of the territory had sleeping

⁸⁸ NAZ, A2/1/1/4, Native Affairs, p.2.

⁸⁹ Ibid.

⁹⁰ Ibid.

⁹¹ NAZ, A5/1/7 Medical Reports Medical on Sleeping Sickness, 1908-1909, p.18.

⁹² Ibid, p.19.

sickness, and the police was stationed to screen every African and European coming into Broken Hill.⁹³ Such occurrences badly affected labour, which was already scarce.

Early Labour

Apart from the financial challenges, as will be discussed in subsequent sections, the lack of railway transport meant that, neither coal from Southern Rhodesia nor machinery from Britain could be easily imported.⁹⁴ As such, in the early mining developments at Broken Hill, work was characterised by scant use of machinery and frequent stoppages. The mine relied on a great deal of cheap African labour for the cutting of wood for fuel, the digging of simple shafts, and the clearing of the bush and the carrying of materials. Initially, African labour was mobilised amongst the surrounding inexperienced Lenje people, who wished only to earn their money to buy a few basic needs such as blankets, plates and soap and then return to their villages.⁹⁵ Others wished to work on the mine because it was closer to home and they could easily return to their villages.⁹⁶ But many labourers had little incentive to stay in employment for long, and often worked for only a few months.⁹⁷ In addition, some local people were unwilling to work on the mine, because they could easily pay their tax by selling farm produce. This affected production.

Because of the unwillingness of local people to stay in wage employment, it was necessary to employ migrant labour. These were mainly Nyasas from colonial Malawi, who were already accustomed to working on the Rand and Southern Rhodesia. Most of them found work on the Broken Hill mine due to a break in their journey to the South. For some the journey became too long, and they ran out of money. Working on the mine gave them the opportunity to earn more money, which enabled them to continue their journey.⁹⁸

Generally, there were few local Africans working on the Broken Hill mine. Most of them had migrated to work in the better-paying Southern Rhodesian and South African mines. For instance, by 1903, an average of 125 Northern Rhodesians and 900 Nyasalanders were recruited annually to work on the Witwatersrand gold fields.⁹⁹ In these early years, the Broken Hill mine, like the Copperbelt mines, experienced critical shortages of African labour

⁹³ NAZ, A2/1/14. British South Africa Company; Review of North Western Rhodesia, p.24.

⁹⁴ R. Gray, *The Two Nations: Aspects of the Development of Race Relations in the Rhodesia and Nyasaland* (London: Oxford University Press, 1956), p.104.

⁹⁵ Gann, *Birth of a Plural Society*, p.121.

⁹⁶ Gann, *History of Northern Rhodesia*, p.121.

⁹⁷ *Ibid.*

⁹⁸ NAZ, ZP1/19/22/1. Rest Houses; Broken Hill. Kasama and Abercorn Route, 1 January, 1928. P. 3.

⁹⁹ Gray, *The Two Nations*, p.93.

due to the movement of labour from Northern Rhodesia to the south.¹⁰⁰ Broken Hill consequently found it difficult to attract sufficient labour from the surrounding Lenje people. Even though the Colonial Administration had implemented a hut tax of 5s in North Western Rhodesia, the Lenje preferred to sell grain and fish to raise tax money. To help the mine acquire much needed African labour, in 1909 taxation was raised from 5s to 10s.¹⁰¹

To some extent, the Broken Hill mine also relied on white foreign labour. The ratio of black to white employment in the early operations of the Mine was 60 to 1. In general, the whites were skilled workers and worked as foremen, telegraphists, postal sorters, typists and drivers.¹⁰² The mine's skilled cohort was multiracial, and hailed from a number of countries. They included Britons, Indians, Chinese, Indonesians, and Afrikaners. Most of its white workers had migrated from the diamond and gold mines of South Africa, as well as the coal mines of Southern Rhodesia.¹⁰³

Transport Problems: The Need for a Railway Line

Between July 1904 and July 1905, mining operations came to a standstill. This was because of lack of a railway line to transport ore concentrates to Livingstone to be smelted in electric furnaces. Apart from this, the railway line was needed for importing machinery, as well as to shorten the distance between Broken Hill mine and the Kansanshi mine and mines in the Hook of the Kafue. This would enable mines like Kansanshi to smelt copper ore at Broken Hill in order to prove its content, the latter being the only mine with furnaces. The BSA Company also needed the railway line for the easy transportation and movement of labour within Northern Rhodesia, as well as outside the territory, to the Belgian Congo, South Africa and Southern Rhodesia. Therefore, the railway was eagerly awaited.¹⁰⁴

One reporter working for the *African World* newspaper, spoke with scorn when referring to the mounds of lead-zinc ore heaped on the mine premises, awaiting the coming of rail:

What is the good of it to anybody? There it lies, waiting to be picked up and converted in golden shekels and there, presumably, it will continue to lie for years to come. Why? You can't do much unless you have a railway to help you, and as you know, the iron

¹⁰⁰ *The Livingstone Mail*, 22nd June, 1912.

¹⁰¹ B. Phiri, 'Zambia (Northern Rhodesia): Colonial Period: Administration, Economy'. In K. Shillington, (Ed.), *Encyclopedia of African History*, vol 1-3, (New York: Francis and Taylor, 2005), p.1679.

¹⁰² Gray, *The Two Nations*, p.104.

¹⁰³ NAZ, ZA/7/1/14/7. Broken Hill Annual Report, 1931, ZA/7/15/7 Luangwa District Annual Report 1932.

¹⁰⁴ A.M. Bentley, 'Broken Hill Mine,' *Northern Rhodesia Journal*, 6 (1953-55), pp.80-87.

horse hasn't reached the Victoria Falls yet. It must be pretty trying for the owners of these properties to see all this wealth in sight yet powerless to turn it to account.¹⁰⁵

It would be almost a year before the railway line arrived at Broken Hill. During this time, the mine shut operations. Some work still carried on, but most development devoted to outcrops, which were dug out. Trenching was done in close proximity to the outcrops, which were scattered over a distance of six miles from north-west to south-west. Its managers and directors did not doubt that, when it recommenced operations on a large scale, many other similar deposits would be discovered within the company's area. At that stage, the cost of working on the kopjes was very expensive.¹⁰⁶

The Coming of the Railway Line

As stated above, the management at Broken Hill mine was banking on the advantages of the extension of the railway line from Southern Rhodesia to Broken Hill. The railway from Kimberly only reached Bulawayo in 1897, eventually reached the Wankie coalfields in September 1903. By April 1904, it was at the Victoria Falls.¹⁰⁷ The Broken Hill mine progressively drew the railway into a vast wilderness. It appears to have been the innate optimism of the mining fraternity that convinced the Rhodesia Railway Company that the Broken Hill mine would justify a train a day by the time the railway reached it. Under this stimulus, the track moved forward 375 miles from Victoria Falls to Broken Hill, which it reached on 11 January 1906.¹⁰⁸ Its arrival was cheered by the small white mining community. However, the builders were disappointed with the state of the place, which consisted of small grass huts, the largest hut which accommodated the bar and Broken Hill's first hotel.¹⁰⁹ A. Varian, the Railway Manager, described his bitter disappointment at Broken Hill:

Apart from a few wattle and daub buildings belonging to the Mine, standing on the kopje overlooking the workings, there was only the grass building which served as a store for the African Trading Corporation, managed then by Robert Yule. Apart from

¹⁰⁵ *The African World*, 18 July, 1908.

¹⁰⁶ *The Financial Times*, February 2, 1905.

¹⁰⁷ The railway line was a fulfilment of Cecil Rhodes dream of connecting the Cape to Cairo. Through the railway line British ambitions could spread to whole of Africa. The B.S.A. Co. created the railway system and owned the railways until 1947.

¹⁰⁸ Bancroft, *Mining in Northern Rhodesia*, p. 115.

¹⁰⁹ *Ibid.*

this there was no human habitation. The Cape to Cairo railway came to an end in the middle of a burnt out vlei without even a buffer-stop at the rail terminus.¹¹⁰

To make matters very much worse, the railwaymen found there was nothing approximating the traffic that had been promised.¹¹¹ Nonetheless, with the coming of the railway line, the mine was reopened and operations on the mine soon resumed. The mining company began excavations to open up the No.1 kopje ore-body. It installed a dozen calcining furnaces with a capacity of 120 tons per day to calcine zinc ores for shipment. By the end of 1906, 8,965 tons of calcined ore, assaying 50 to 60 per cent zinc, was extracted and exported via Beira to Swansea for treatment.¹¹²

Freight Charges

The arrival of the railway line did not, however, immediately solve the transport problem. It was soon realised that the mine was not making a profit because of the costs involved in transportation. The railway freights were disproportionately high. For instance, the price of railway freight per ton from Broken Hill mine to Beira was estimated at £5,10s per ton, as opposed to the price of shipment from Beira to England, which was at 28s.9d per ton. The inland freight cost was much higher than on water. The railway freights had become so expensive that some of the tons sold could not be shipped. For example, by June 1906, about 1,539 tons of ore were still lying on the mine's premises, waiting to be exported. This was of great concern to the Rhodesia Railway Company, whose survival depended on freights. In response to this problem, T. Brodie, the Company Secretary wrote to Edmund Davis on the issue of railway freights. He explained that the sole purpose of constructing the railway was to serve the Broken Hill mine. It was therefore a serious matter that some of its ore was not being exported.¹¹³ Davis replied that the mine could not continue exporting ore via the railway at a loss to itself. To calm the situation, Davis promised to consider the interests of the railway, while at the same time safeguarding those of the mining company.¹¹⁴ It was clear that reasonably low railway freights were urgently required.

¹¹⁰ *The Financial Times*, April 24, 1907.

¹¹¹ Bancroft, *Mining in Northern Rhodesia*, p. 115.

¹¹² *Ibid.*

¹¹³ *The African World*, July 1907. See also ZCCM, Reports and Accounts for Rhodesia Broken Hill Development Company Limited (RBHD Co.) July 1925-December 1953. (no file number)

¹¹⁴ ZCCM 19.5.1F, Rhodesia Broken Hill Development Company Limited Confidential Letter Book; Correspondence Letters addressed to Mr. Moffat by the Mine Manager Mr. Macartney on 3 January, 1919.

Generally, the high cost of rail freights, coupled with other production costs, affected profits. By middle 1906, production costs on mining, calcining, shipping and rail freights amounted to £6,10s per ton. Meanwhile, the selling price per ton was at £8,5s. This means that the profit per ton was £2,4s.0d. But technical problems of recovery meant, the mine was not producing enough tons to make adequate profits for its shareholders. The profit made seemed good but it could not pay-off working expenses without reckoning anything for capital expenditure. As concluded in a report by R.J. Frechevilles, the mine engineer at Broken Hill mine, “the mine had only exposed 265,250 tons of lead and zinc ores, which were only a small proportion of what actually existed. Therefore, the exposed tons were not very definite grounds on which to have built two or three hundred miles of railways.”¹¹⁵

Coupled with the railway line’s failure to make a profit, the Rhodesia Railway Company was also faced with the problem of repaying loans. The railway could not meet the costs of the construction loans, and the railway company faced major financial problems. This was very serious because of the cost of widening the Beira railway. The only area which was likely to generate sufficient mineral traffic to relieve these debts was Katanga. Initially, the Congo Free State had concluded that Katanga's copper deposits were not rich enough to justify the capital cost of building a railway to the coast, but expeditions between 1899 and 1901 proved their value.¹¹⁶ As a result, the railway line was extended north of Broken Hill to Katanga. This relieved some of the pressure on the Rhodesia Railways Company. Such were the problems that the railway faced.

Complex Ores

By 1907, the mine might have reached a significant level of production owing to the unquestionably immense quantities of lead and zinc ores, but yet it yielded only a meagre output. This was entirely attributable to the metallurgical difficulties encountered in the treatment of the mixed ores occurring in the proposition. Both from the metallurgical and geological points of view Rhodesia Broken Hill was regarded as one of the most challenging and complex problems in the whole of the mining areas of Africa.¹¹⁷ Sulphides, carbonates and silicates of zinc and lead were mixed with various other elements, such as iron, vanadium, silver and gold, and on the whole presented a problem which taxed the minds of some of the cleverest metallurgists of that time. As such, in the period from 1907 to 1913, the

¹¹⁵ *Pall Mall Gazette*, 1 January, 1906.

¹¹⁶ Slinn, ‘Commercial Concessions and Politics during the Colonial Period’, pp. 372-3.

¹¹⁷ *The South African Mining Journal*, 17 September, 1910.

Broken Hill mine was faced with a much more serious recurring problem than that of expensive railway freights. The treatment of complex lead-zinc ores presented its greatest challenge. Attention now had to be devoted to the direct and indirect implications of complex lead-zinc ores for capital investment, expenditure, labour, mining operations, production, profits and marketing.

Before taking this discussion further, it is essential to understand the nature of the complex lead-zinc ores at the Broken Hill mine, as well as the problem of treating the ores. Complex ores existed in both Kopjes 1 and 2. The No. 1 Kopje covered a substantial area of about 62,000 feet at ground level, and an estimated 140,000 tons of ore in sight above water level.¹¹⁸ The No. 2 Kopje was less of a metallurgical problem than the No. 1, since it contained little lead, the deposit consisting mainly of zinc ore associated with hematite and limestone. It was estimated that this part of the company's property consisted of over 300,000 tons of ore.¹¹⁹ The future of the entire proposition depended on the discovery of an effective and economic method for treating its ores. In addition to this, the profitability of the proposition was influenced by problems concerning the cost of railway rates and the cost of procuring coal and coke, which at that stage could only be obtained from the Wankie Colliery mine in Southern Rhodesia.

The problem of complex lead-zinc ores at the Broken Hill mine was identified as early as 1903, but by the beginning of 1907 it became a serious managerial, operational and production issue. The problem of treating complex ores at the mine was first publically raised in 1907, when shareholders, at a meeting held on 24 April, insisted that the Company ought to have, by then, constructed a processing plant.. When asked why ore samples were not tested to determine ore compositions before erecting the plant, management argued that the Company lacked advanced testing equipment and that erecting such a plant required huge financial capital, which it lacked.¹²⁰ The blame for not sending samples for testing to England was laid upon the absence of a railway line to transport ore samples to the coast.

Management argued that a processing plant could only be erected after the type of lead-zinc mineral ore was determined, which could only be done by testing its samples abroad; a process requiring a considerable amount of time.¹²¹ As such, the mine operated without a

¹¹⁸ *Ibid.*

¹¹⁹ *Ibid.*

¹²⁰ *Financial Times*, 24 April, 1907.

¹²¹ *The Statist*, 27 July, 1907.

processing plant to separate the metals. Alternatively, the ore concentrates at Broken Hill had to be transported by rail to Livingstone, to be smelted in electric furnaces. This only became possible after 1906, following the construction of the railway line up to Broken Hill. Between July 1904 and July 1905, mining operations came to a standstill due to the lack of a railway line to transport the extracted ore for treatment.¹²²

Industrially and technically, the mine experienced great trouble in processing the lead-zinc ores. Lead has a lower smelting point than zinc, and the mine had difficulty in raising the temperature to 2000 degrees, which was needed to convert the lead into metallic vapours, and to pass it through a cooling chamber.¹²³ Manual processing was of poor quality, even when the ore was finally crushed.

Shareholders were sceptical about management's poor operational and financial reports. They probed the company's ability to make profits following delays in dispatching ore exports from the mine to the coast. When asked how much profit had been realised from the sale of 11,000 tons of zinc ore which, according to the report, had been sold at satisfactory prices, the then chairman failed to give exact figures.¹²⁴ It was clear that Broken Hill's management was reluctant to acknowledge the fact that the problem of complex ores contributed to low profits and delays in ore exports. At the same time, the absence of a processing plant, coupled with expensive rail rates, added to this problem. Consequently, by the end of 1907, ore production went down with irregular exports.¹²⁵

Pressure was mounting on the company to bring the mine into full-scale production through the utilisation of advanced machinery and the construction of a smelting plant. Between 1908 and 1910, the Rhodesia Broken Hill mine constantly sought to find a lasting solution to the ore treatment problem by sponsoring experimental and methodological metallurgical designs abroad, particularly in South Africa, England and Australia. Davis was very optimistic that a solution would soon be found, since ore could be separated mechanically owing to the lead and zinc ores not being chemically combined.¹²⁶ By the end of 1909, trials had been carried

¹²² *The Financial Times*, 17 February, 1905.

¹²³ *Livingstone Mail*, 28 August, 1909.

¹²⁴ *Ibid.*

¹²⁵ *Financial Times*, 24 April, 1907.

¹²⁶ *The African World*, 18 July, 1908.

out on a large scale. One of the most fruitful trials revealed that 33% of the ore could be separated and that the 33% contained 79% of lead and 4% of zinc.¹²⁷

By the beginning of 1910, however, most of the interested parties in the mine's operations were disappointed at the failure to find a lasting solution. Shareholders were disappointed to learn that the quality of lead and zinc remained below the required market standard of above 90% on the London Stock Exchange.¹²⁸ Some of the shareholders complained that many theories had been put forward as to the reason for the refractory nature of the ore, "They had a chemical theory which was exploded; they had a mechanical theory which was now in full blast and now he had heard of another theory – not physical but psychological one."¹²⁹ A similar concern was expressed by the special correspondent of the *Cape Times* newspaper, who was commissioned to attend the celebrations at the opening of the Rhodesia-Congo railway,

I have already given particulars as to the state of affairs at Broken Hill, where work has been entirely suspended pending the results of the experiments now in progress in England for reducing the lead-zinc ore, and separating its two constituents. One of the Broken Hill kopjes, where zinc alone was found, has already been extensively worked, but all efforts to separate the ore when it is found under its usual conditions in the remaining kopjes have hitherto proved unsuccessful. The ore has been reduced to a pin-head, and afterwards to a pin-point – as nearly as possible, in fact, to the original atom and still the resulting metal has been the commercially useless zinc-lead combination.¹³⁰

These sentiments embodied the view that experimental trials or methods gave excellent results. However, when the process was tested on a large scale, it was found that not only the zinc came into the solution, but also the salts of other metals. These salts affected the deposition of the zinc, which made the process a complete failure.¹³¹ Such unreliable methods of ore processing were not only expensive to run, but also contributed to indefinite closures of mining operations, thereby indirectly reducing the chance of erecting a permanent processing plant on the property, as well as the mine's production output, ore exports, profit margins, and labour, due to repeated lay-offs. Generally, between 1907 and early August 1910, visitors to the Broken Hill mine would have encountered little activity, because the

¹²⁷ *Ibid.*

¹²⁸ *The Economist*, 18 July, 1908.

¹²⁹ *The Critic*, 18 July, 1908.

¹³⁰ *The South African Mining Journal*, 31 December, 1909.

¹³¹ *Ibid.* 6 August, 1910.

complementary negative effects of the treatment of the ores, rail rates and the blurred future financing of the venture threatened the company's fortunes.¹³² Mining operations at the Broken Hill mine were in a complete shamble. More capital was desperately needed. As a result, the company was reconstructed on 20 August 1910, in order to raise capital to expand operations and to buy new equipment. Most of its working capital had been exhausted due to the huge expenditures on equipment and on freight for sending trial ores to Europe.

The Reconstruction of the Company

The reconstruction of the company brought new developments. A new company was formed under the same name, with a capital of £350,000 divided into 1,400,000 shares of 5s each, of which 525,000 were held in reserve.¹³³ At the same time, the Bradley Williams Ore Treatment Company was formed with the sole purpose of treating the complex ores. The capital of the new subsidiary processing company was £61,000, divided into 60,000 shares of £1 and 20,000 deferred shares of 1s each.¹³⁴ Arrangements were to be entered into between the processing company and the Rhodesia Broken Hill board of directors to agree on the price of treating the ore, as well as with the Rhodesia Railways for the carriage of fuel, ore and metals. As its name implied, the new company employed the Bradley Williams process of ore treatment. This process was mechanical, utilising electricity, sulphuric acid and an oxide solution. In practice, the essential principles involved subjecting a solution of zinc sulphate to electrolysis and then dissolving the zinc out of the ore with this electrolysed solution.¹³⁵ This process offered more promise for the treatment of the lead-zinc, more than any other known method at that time, as it resulted in the extraction of 66.65% of the zinc in the ore.¹³⁶

However, between 1911 and 1913, even the Bradley Williams process was frustrated by leaching problems in the ore process, which yielded average results. It was also challenged by the lack of a hydro-electric power supply, which was needed to support electrolysis in the processing of large quantities of ore. Another supporting process was also identified. As gravity or floatation would be useful only for materials unsuitable for direct smelting, a small

¹³²*Ibid.* 3 September, 1910.

¹³³ *The Mining Magazine*, 10 September, 1910.

¹³⁴ *Ibid.*

¹³⁵ *The South African Mining Journal*, 27 January, 1912.

¹³⁶ J. Taylor, *The Lead-Zinc- Vanadium Deposits at Broken Hill, Northern Rhodesia* (London: HMSO, 1955), p. 9.

lead blast furnace was ordered from Germany in 1913, which reached the Broken Hill mine in June 1914 and was started up in June 1915.¹³⁷



**Figure 1: A SIDE VIEW OF THE FIRST FURNACE TO BE CONSTRUCTED AT
BROKEN HILL**

¹³⁷ZCCM, 19.4.3A. Zambian Broken Hill Development Company Limited. Mining at Broken Hill: Metallurgical Operations, 12 September, 1969. p. 1.

CHAPTER THREE

FROM ZINC TO LEAD: BROKEN HILL MINE IN THE FIRST WORLD WAR

The previous chapter described a range of challenges experienced at the Broken Hill mine in its early development. In the period from 1904 to 1913, the mine battled insufficient labour, rising production costs and diseases. The absence of a railway line, expensive railway freights, coupled with the problem of separating complex lead-zinc ores, all contributed to frequent disruptions of large-scale mining operations. When the First World War broke out in 1914, the Rhodesia Broken Hill Company was still seeking a lasting solution to expensive railway freights and separating complex ores. At the same time, the mine had begun to initiate the installation of a new lead smelter, but the war delayed the transportation of equipment from Britain and Australia. Yet Britain and her allies needed more lead and zinc from the colonies than ever before, in order to sustain the war effort.

In light of the aforementioned challenges, this chapter examines the impact of the First World War on Broken Hill mine. It will consider the context of the war and its socio-economic implications; the position of the Broken Hill mine prior to the outbreak of the war; the impact of the war on Broken Hill mine; and the future of the lead-zinc industry after the war.

Context of the War

The First World War involved all the major European Powers, as well as Japan and, eventually, the United States of America and China.¹³⁸ As stated by Barnwell, “The external shock of the war and the exigencies of having to fight it placed enormous and unanticipated

¹³⁸ R.F. Hamilton and H.H. Herwig, ‘World Wars: Definition and Causes’ in R.F. Hamilton and H.H. Herwig (eds), *The Origins of World War I* (Cambridge: Cambridge University Press, 2003), p. 4.

strains upon the institutions of government".¹³⁹ Such external shocks did not spare Africa, and certainly not Northern Rhodesia and the Broken Hill Mine. It had an effect on the mine which was unforeseen. When war broke out, Northern Rhodesia was in a position to help with the war effort. The railway line passed fairly close to the frontier and so both Broken Hill and Ndola were of importance in the transport of both men and war materials.¹⁴⁰ Although inland communications were poor and the use of animals in the movement of men and supplies had to be limited on account of tsetse fly, the Administration had sufficient control of the country to be able to organise enough carriers to take supplies to the front. Had this not been the case the campaign in East Africa might have taken an entirely different course.

Northern Rhodesia was brought more directly than Southern Rhodesia into the war with Germany because with Nyasaland, she shared the long frontier between these two countries and the German territory of Tanganyika.¹⁴¹ Thus all her valuable resources were placed virtually in the hands of the military authorities and the Government helped as much as possible with men, money and food. The contribution by the people and country of Northern Rhodesia towards the successful conclusion of the war with Germany was significant, although most mining development had to be postponed for a few years.

Lead-Zinc and the War

The First World War had wide-ranging economic consequences, which did not spare any economic related ventures, including mining. Mining activities were negatively affected during the war, especially in 1916. By the end of 1914, many important industries in Great Britain were very adversely affected by the difficulty of obtaining supplies. Of particular note for Broken Hill, the war pushed the price of spelter, a commercial alloy containing proportions of zinc, lead and other metals such as iron.¹⁴² Higher and higher the price for spelter ranged from as low as £21.10 to as high as £100 per ton. Consequently, the trade in brass, muntz-metal and galvanised sheet was affected in a manner never before experienced.¹⁴³

¹³⁹ N. Barnwell, 'Australia and the First World War: A re-evaluation of its long term economic Impact' (2008), paper presented at the University of Technology, Sydney.

¹⁴⁰ M. Gelfand, *Northern Rhodesia: In the Days of the Charter* (Oxford: Basil Blackwell Limited, 1961), p.254.

¹⁴¹ Gelfand, *Northern Rhodesia*, p.254.

¹⁴² Smith, *The Zinc Industry*. (London: Longman, 1918), p. 6.

¹⁴³ *South African Mining Journal*, 31 July, 1915.

Before the war, Germany was the largest producer of spelter in Europe, although it was also produced in Austria and Belgium. From the set two latter countries, Britain imported about 150,000 tons per annum, either as spelter itself or as brass and zinc goods.¹⁴⁴ Spelter was also produced in the United States of America, which was estimated to have had a capacity of 500,000 tons per annum.¹⁴⁵ In Britain, a relatively small number of companies dealt with lead-zinc processing. Some of the foremost processors included the Central Zinc Company at Seaton Carew in Durham. The most extensive works were located at Swansea, which numbered five, namely, Vivian and Sons, the English Crown Spelter Company, Williams-Foster and Company Limited, Dillwyn and Company Limited, as well as the Swansea Vale Spelter Company Limited.¹⁴⁶ Of these companies, Swansea Vale Spelter Company Limited was owned by Aron Hirsch and Sohn of Germany before the outbreak of war.¹⁴⁷ By and large, the main concern was that the high price at which spelter was selling raised the question of the British government's control over the industry's profits.¹⁴⁸

By December, 1914, the position of the base metal industry, owing to the outbreak of the war, was a matter that called for immediate attention. The processing of copper, lead and zinc, the former used largely in electrical work and the latter two essential to certain mining operations, had been almost entirely a German monopoly.¹⁴⁹ At the outbreak of war, Germany was in a dominant position, buying copper lead and zinc from most of the ore producing countries and supplying the world with the pure metals. In the past, there was no reason why large smelting plants could not be established in England, and for that country to become a leading supplier for the world market. The enterprise was already projected; the necessary large capital was available, but only one thing stood in the way. The obstacle was exemplified by the position of the Broken Hill companies, both in Australia and Northern Rhodesia. Most, if not all, were under contract to sell all their lead-zinc ore to German firms up until 1919.¹⁵⁰ However, during the war, they could not sell to Germany and, if held to the strict letter of their contracts, they could sell to no one else. When peace was eventually restored, the owners of the German smelting works would presumably resume their lucrative trade as if no obstacle to the smooth trade had been created by the war. Obviously, unless the

¹⁴⁴ *Ibid.* 6 February, 1915.

¹⁴⁵ *Ibid.* 4 May, 1916.

¹⁴⁶ *Ibid.*

¹⁴⁷ Smith, *The Zinc Industry*, p. 7.

¹⁴⁸ *Ibid.*

¹⁴⁹ *Ibid.*, p. 10.

¹⁵⁰ *Ibid.* p.2.

lead-zinc industry was to be paralysed during the war and to revert to the German monopolists at the close of it, there was only one course to pursue. Accordingly, towards the end of 1915, the British Government declared all such contracts entered into within her Empire to be absolutely void, not merely suspended during the continuance of the war, and closed the British Courts to any application that might subsequently be made for their enforcement.¹⁵¹

In addition, there were also other practical issues to be considered. In order to sell their product at a reasonable price, and at a profit, smelting works would have had to run constantly, treating large quantities of ore.¹⁵² This would demand the investment of considerable sums of capital. There was another possibility: If the electoral precipitation of zinc from its ores could prove as successful on a large scale as it did in its laboratory tests, there would be a great future for it. British capitalists, before investing enormous sums of money in erecting lead-zinc smelters, needed to satisfy themselves regarding the ore separation process in question. Already, there was relative technological advancement in lead-zinc smelting. For instance, electric furnaces were successfully utilised in the zinc industry in Norway, Sweden and Finland, while much experimenting had been done in America and Australia.¹⁵³ In 1913, furnaces with 4,000 horse-powers were being used in producing zinc in Scandinavia, and 7,000 horse-powers were added since then.¹⁵⁴ The firms were very discreet about their methods; in fact, there was no reliable published data about the type of furnace they used.

Demand for Base Metals: Copper, Zinc and Lead

During the war, base metals including copper, lead and zinc were in high demand for the production of ammunition. Although zinc had been extracted on a commercial scale in Europe from as early as the mid-eighteenth century, it did not take an important place in large-scale industrial production until the middle of the nineteenth century. From an industrial point of view, zinc was regarded as a comparatively modern metal when compared to metals such as lead and copper, which had been in common use for centuries. Zinc possessed physical and chemical properties that rendered it extremely useful, and when these properties were fully recognised the metal rose rapidly, to a position of considerable importance, occupying the third place on the list of non-ferrous base metals of value in the

¹⁵¹ *The Times*, 15 August, 1916

¹⁵² *The Financial Times*, 10 November, 1919.

¹⁵³ *Ibid.*

¹⁵⁴ *The Times*, 12 May, 1920.

metal industries. It was only surpassed in this respect by lead and copper.¹⁵⁵ Zinc was used for galvanising iron, its conversion into sheets and for alloying. Lead and zinc were used in the manufacture of spelter.¹⁵⁶ Lead and copper were also used extensively in the manufacture of bullets.

The large amount of zinc required for war purposes, and the resulting increased demand for the metal, focussed attention on the utilization of zinc ores. Up until that point, the majority of zinc ores had been mined in the United Kingdom and its colonies.¹⁵⁷ Zinc ores were mined in many parts of the United Kingdom, notably in Cumberland, Northumberland, Durham, Derbyshire, Shropshire, and the Isle of Man, but a large proportion of the production had, for several years, been shipped to mainland Europe for smelting.¹⁵⁸ The most important zinc deposits in the British Empire were those of Broken Hill mine of New South Wales. Its output alone was sufficient to supply Britain's entire demand for metallic zinc.¹⁵⁹ But before the war, Broken Hill ore was mainly sent to Germany for smelting. Zinc was also found in Queensland, Tasmania, New Zealand and in Newfoundland.¹⁶⁰ Canada contained a number of workable zinc deposits, particularly in British Columbia, and there was every prospect of Burma becoming an important producer. In Africa, apart from Northern Rhodesia, zinc deposits were found in Egypt, Nigeria and the Transvaal.¹⁶¹

Before the war, the world's markets for the majority of the non-ferrous metals were largely controlled by a group of German metal companies, engaged primarily in buying metals and acting as selling agents.¹⁶² Their market connections were exceedingly complicated and difficult to control because they involved direct financial transactions and some form of penalty trade agreements.¹⁶³ There was no doubt about the Germans' pre-eminent position. The most important of the companies was the Metallgesellschaft of Frankfurt-on-the-Main.¹⁶⁴ Frankfurt was, by then, the centre of German financial interests, which had combined to establish the Metal Bank and the Metallurgische Gesellschaft. Financially, this organisation

¹⁵⁵ Smith, *The Zinc Industry*, p. 4

¹⁵⁶ *Ibid.*

¹⁵⁷ *Mining Magazine*, 23 October, 1914.

¹⁵⁸ *South African Mining Journal*, 8 April, 1916,

¹⁵⁹ *Ibid.*

¹⁶⁰ *Ibid.*

¹⁶¹ *Financial Times*, 12 December, 1917.

¹⁶² Smith, *The Zinc Industry*, pp. 1-2.

¹⁶³ *Ibid.*

¹⁶⁴ NAZ, B 1/2/1/22. Confirmation of telegrams between the Secretary Administration and Rhodesia Broken Hill Development Company, 4/18 to 4/23/1914.

surpassed its counterparts in London, as it established financial interests in metal undertakings, not only in Germany and Austria, but also in the United States of America, the United Kingdom, and various parts of the British Empire.¹⁶⁵

In no case was the German-metal control more absolute than in that of zinc. Before the war the Germans, by means of the so-called Zinc Convention which they organised, were placed very largely in control of the zinc trade of the world, and were also able to enter into long-date contracts from the supply of large quantities of ore mined within the British Empire.¹⁶⁶ This move by the Germans, therefore, had placed British consumers of zinc in an extremely difficult position, impossible to maintain in wartime.

This control was a source of great embarrassment to the British government at the outbreak of the war, and for two years afterwards Britain's war effort, as well as that of its Allies was severely handicapped, because they were without the necessary metal supplies.¹⁶⁷ With a view to preventing German control of the metal trade in the future, the British Government passed the Non-ferrous Metals Act, which was a measure designed to keep control over the supply of essential metals in British hands.¹⁶⁸ Yet, for some years after the bill was passed, the United Kingdom still depended on imported metal, including more than 70%, of her zinc requirements.¹⁶⁹ This was because, even though wartime Britain commanded the seas, and had an immense supply of zinc ore within the Empire, her smelting plants were inadequate to convert this ore into spelter. The serious shortage of spelter was temporarily met by exports from the United States, at the time the world's largest producer of zinc. However, since production in Britain was lower than consumption, the result was a rapid rise in the price of the metal, the selling price appreciating by more than five times from its pre-war figure.¹⁷⁰ Ultimately, it was considered more advantageous and cheaper to smelt the metal concentrates within the Empire. There was little doubt that at some point the valuable mineral resources of the Empire would have to be fully developed and utilised. However, the localisation of the

¹⁶⁵ NAZ, B1/112/1. The War Effort in Northern Rhodesia, 1914.

¹⁶⁶ Smith, *The Zinc Industry*, p. 2.

¹⁶⁷ *Ibid.*

¹⁶⁸ NAZ, B1/2/1/22. Confirmation of telegrams between the Secretary Administration and Rhodesia Broken Hill Development Company.

¹⁶⁹ *Ibid.*

¹⁷⁰ *Ibid.* p.3.

smelting processes largely depended on a number of factors, including the availability of cheap fuel, suitable smelting plants, and skilled labour.¹⁷¹

The War and British Trade Policy

In July 1916, the Council of the London Chamber of Commerce adopted the report of a special committee appointed to consider problems connected with trade during and after the war. The committee devoted its attention mainly to fiscal proposals, with the object of securing preferential reciprocal trading between all parts of the British Empire and between the Empire and its Allies, with favourable treatment for neutrals, and for regulating trade relations with enemy countries.¹⁷² The committee thought this could be done by tariffs, which would be more effective than the prohibition of imports from any country, which could have proved unworkable in practice.¹⁷³ The committee recommended a tentative tariff for consideration. It also believed tariffs would prove a useful basis for negotiations by the Government. The rates suggested were as follows: wholly manufactured goods, maximum 80% and general 20%; semi-manufactured goods and articles solely used as raw materials in industries, 15%, 10% and 5%; existing war rates or modifications thereof during period of suggested tentative tariff, 50% for enemy countries and these proposals applied to the British Empire, Allies, friendly neutrals, other neutral countries and enemy countries.¹⁷⁴ The duties, other than raw materials and the then dutiable articles were allocated as follows: British Empire countries, minimum rates and free, less any percentage of duty these countries would accord as a preference to the Mother Country; the then Allies, minimum rates and free; friendly neutrals especially those that gave Britain most favourable treatment, general rates; other neutral countries namely those giving preference to other foreign nations, general rates plus surtax equal to preference given to other countries; and enemy countries, maximum rates.¹⁷⁵ These tariffs against the Central Powers, especially Germany, improved Britain's supply of spelter to a considerable amount. However, the demand for spelter both by its home industries and by its Allies far exceeded supply. For Britain to win the war it had to find other means of obtaining lead and zinc, apart from Australian sources. A tentative plan was therefore put in place to encourage its production within the British Empire. This will be discussed later in the chapter.

¹⁷¹ NAZ, KDA1/1/2. Luangwa Annual Reports 1911-1915, p. 24.

¹⁷² *South African Mining Journal*, 29 July, 1916.

¹⁷³ *Ibid.*

¹⁷⁴ *Ibid.*

¹⁷⁵ *Mining Magazine*, 28 June, 1916.

Position of the Broken Hill Mine

In January 1914, the Broken Hill mine property consisted of an area of 35 square miles of land, with mineral and surface rights located in one block, which enclosed mineralised kopjes or outcrops, and which was subject to the mineral rights of the British South Africa Company.¹⁷⁶ Mining operations were conducted amid serious challenges on the property, as indicated earlier on in this chapter. Therefore, there was a need to examine and review the operations at the mine to determine its future. As such, in September 1913 Broken Hill's mine management contracted the consulting engineers, Hooper, Speak and Company from England, for the purpose of studying progress at the mine and giving advice as to future operations.¹⁷⁷ The consulting engineers eventually submitted a report embodying recommendations on a range of issues. The importance of their report is that it illustrates the position of the Broken Hill mine prior to the start of the war on a number of mining related issues elaborated below.

As regards capital, the report of the Rhodesia Broken Hill Development Company for the year ended August 31, 1914 disclosed that the company's working capital was at £160,270 in 641,083 shares of 5s each, leaving 758,917 shares in reserve should operations and profits warrant further issues.¹⁷⁸ Considering the many challenges faced by the mine, the working capital was small, and the Rhodesia Broken Hill Development Company did not consider it advisable to incur any expenditure on the mine during the year, except that which was necessary to keep the principal workings in repair.¹⁷⁹

Although none of the mine's deposits ore had been as thoroughly developed as professional engineering required for estimates of ore blocked out, the consulting engineers came up with a better estimate. They estimated that there was available, above water level, in the No. 1 Kopje approximately 55,000 tons of ore averaging 38% lead and 18% zinc.¹⁸⁰ The advantage was that the ore was relatively close to the surface, and could be extracted without great expense. For many years it had been known that some portions of No. 1 kopje were richer than others, but it was thought that there was no regularity of distribution and that the ore could be regarded as a whole averaging 26% lead and 22% zinc. Careful examination of the Kopje by the consulting engineers indicated that this was a mistaken idea. Instead of mining

¹⁷⁶ *South African Mining Journal*, 2 January, 1915.

¹⁷⁷ ZCCM, NCCM/BHD/HO151/2. Rhodesia Broken Hill Annual General Meeting of 31 December, 1915. p. 9.

¹⁷⁸ *South African Mining Journal*, 16 January 1915.

¹⁷⁹ *Ibid*, 24 January, 1914.

¹⁸⁰ ZCCM, NCCM/BHD/HO151/2. Rhodesia Broken Hill Annual General Meeting, 1917. p. 18.

140,000 tons of the ore above average metal contents it would be quite feasible to mine separately 55,000 tons averaging about 38% lead and 18% zinc.¹⁸¹ This would leave a remaining 85,000 tons averaging about 18% lead and 25% zinc.¹⁸² This discovery changed the metallurgical problem. The best way of dealing with these 55,000 tons of higher grade lead ore was to smelt it direct; this could not be successfully done, however in the only small furnace then available. Consequently, the problem of treating poorer quality ore was not completely solved. The old official estimate of the ore in No.2 kopje above water level was 300,000 to 320,000 tons averaging 32% of zinc.¹⁸³

Such plant as the mine had at the outbreak of war was as follows. It consisted of a "murex" unit capable of treating about 24 tons of ore per day; three "wifley" tables with classifiers; sintering hearths for ore and concentrates; a blast furnace 4 feet in diameter; a reverberator furnace with a bag house for the collection of zinc fumes; a power plant; as well as crushers, elevators, fans and blowers.¹⁸⁴ The original object of this equipment was to ascertain the relative merits of the complex process of concentration in the separation of the lead and zinc minerals contained in the ore. The small blast furnace was erected to treat lead concentrates.

Perhaps one most important issue to consider is the extent to which the processing plant was utilized. It is worth noting that much of the work at the mine was devoted to experimenting with the best ways of treating lead-zinc ores. The murex plant was of great importance in this category. This portion of the plant commenced running experimentally at the end of November, 1914. Because the results were considered unsatisfactory, it was stopped early in March, 1915, and the Harding Mill was replaced with rolls. Trials were restarted towards the end of April, and during May the average recovery of concentrate was only 64% of that contained in the ores. But during the first week of June the extraction improved to 72.5%.¹⁸⁵ Just at that time the staff of this particular plant was needed to assist at the commencement of lead smelting operations, and little more was done until the arrival of an expert technician, when more trials were commenced. However, the mill engine then broke down, and the trails could not be completed.

¹⁸¹Ibid.

¹⁸²ZCCM, NCCM/BHD/HO155/1. Annual Report, 31 December, 1917, p.15.

¹⁸³ ZCCM, Directors' Annual Report, December, 1915. p.11. (no file number)

¹⁸⁴ See Special Report: Rhodesia Broken Hill Development Company limited; submitted to the shareholders. February, 1927. pp. 19-21. ZCCM, NCCM/BHD/HO155/1. Annual Report, December, 1915. P .5.

¹⁸⁵ ZCCM, 19.4.3A. Metallurgical Operations, 1915.

Serious attention, however, continued to be given to the question of ore treatment. As such, the services of the consulting engineers, Hooper, Speak and Company, were also employed for the purpose of superintending the tests and advising the company board of directors on the results. The engineers advised that the results with regards to the lead values of the ore were satisfactory, and that the company would be justified in erecting a small plant at the mine to treat 50 tons of ore per day.¹⁸⁶ At that stage, the mine was only dealing with the lead values of the ore. Its zinc residues were left for treatment at a later date. Meanwhile, the cost of erecting the concentration plant was estimated at either £14,000 - £15,000.¹⁸⁷

The parts for the small treatment plant began to arrive in June, 1914, and its erection thereof commenced immediately. Unfortunately, some parts of the smelter were on board a ship which was interned at a neutral port for an indefinite time because it was filled with war equipment.¹⁸⁸ These parts were, however, replaced at a relatively small cost, and it was expected that they would be delivered to the mine by the end of February 1915, where after the smelter could be completed in a matter of days.¹⁸⁹ While the mine waited for the arrival of the smelter parts, a test lot of 1,000 tons of ore was put through the concentration plant. The test was to be completed by January 1915 and the concentrate obtained would be smelted upon the completion of the smelter plant.¹⁹⁰ This initial experiment was to test for the treatment of lead values of the ore, while the treatment of the zinc values would commence as soon as the results of the former had been obtained. Overall, it was anticipated that the lead-smelting process which was adopted would drive off a large amount of zinc in the form of fumes containing about 70% of zinc. Such a prediction impressed the shareholders of the Broken Hill mine, to the extent that the British South Africa Company agreed that lead could be smelted and sold up to 31 December 1917, free of royalty, instead of up to 31 December 1916.¹⁹¹ The management at the mine was the most optimistic of all, and promised to

¹⁸⁶ *South African Mining Journal*, 24 January, 1914.

¹⁸⁷ *Ibid.*

¹⁸⁸ *Ibid.*

¹⁸⁹ *Ibid.*, 2 January, 1915.

¹⁹⁰ *Ibid.*, 17 June, 1917.

¹⁹¹ Commercial production of lead was started on the property in 1916, when a small experimental blast furnace with an output of approximately 100 tons of ingots per month was in operation. See for example, NAZ, KD1/10/1. Mining in Northern Rhodesia East Luangwa, 1914-1933. p. 34. See also Special Report: Rhodesia Broken Hill Development Company limited, February, 1927. P. 18.

increase the smelter plant to a capacity beyond 100 tons per day if the new experiments proved successful.¹⁹²

Although the plant, owing to its smallness, did not possess all of the sophistications current in the industry, the few trials made had proved interesting and instructive. On a test with ore assaying 27.8% lead and 26.5% zinc it gave concentrates assaying 56.7% lead with a recovery of 60% of the lead in the ore.¹⁹³ On ore containing less lead than the preceding test the extraction was, however, not nearly so good. Tests on tailings from the "Murex" process had demonstrated that the Wilfley tables could save a certain amount of the lead minerals which escaped in the "murex" treatment. The tables were also used as an endeavor to produce a concentrate rich in zinc, but the results obtained were not expected ones. The failure of the Murex process to yield good percentages of Zinc was aggravated by a lack of a proper blast furnace. From its inception, the mine had used a small experimental blast furnace. This was due to lack of funds to build a bigger one as well as the constant problem of complex ores which made it difficult to decide on the suitable type of blast furnace to use. Therefore, the mine experienced constant problems of the blast furnace breaking down. This situation worsened at the beginning of the First World War. By middle of June 1914, the furnace had broken down, and was thereafter run with frequent stoppages. The process of smelting adopted differed from ordinary lead smelting in that an iron slag containing up to 20% of zinc oxide was used.¹⁹⁴ The original intention was that the furnace should operate only on sintered concentrate, but when it was found that the presence of zinc was not as troublesome as anticipated; some selected ore from the mine was smelted directly. During November and December, 1915 the blast furnace operated entirely on raw ore from the mine, and the results were satisfactory with the exception that the quantity of lead produced was not so great as it had been worked entirely on rich concentrate. Nonetheless, it seemed from actual experience indicated that the direct smelting of high grade lead ore could be done without serious difficulty.¹⁹⁵ Various experiments, then, had revealed that smelting methods promised an almost complete separation of lead and zinc and a good recovery of each, while concentration methods at the best gave an unfinished separation, and in no case high grade zinc

¹⁹² Ibid p. 37.

¹⁹³ZCCM, Directors' Annual Report, December, 1915.

¹⁹⁴ ZCCM, Directors' Annual Report, 1915

¹⁹⁵ NAZ, MH1/2/1. General: Broken Hill Mine, p. 45.

concentrate.¹⁹⁶ In other words, the concentration methods did not promise to be much of assistance towards turning the zinc to profitable account and their main usefulness must be as an adjunct to the blast furnace by concentrating classes of ore not suitable for direct smelting.¹⁹⁷

The implications of these experiments were huge. They pointed the way to the possibility of greatly expanded production of lead with zinc as a by-product. But how best could large tonnages of zinc be recovered? In the No. 2 Kopje 300,000 tons of ore containing about 32% of zinc and a small percentage of lead was already partially developed.¹⁹⁸ Meanwhile, the low-grade ores already developed in No. 1 Kopje together with the tailings from the operation of the concentration plants, provided another 50,000 tons of material containing 30 to 35% zinc and 10 to 15% lead. Ore containing zinc had also been disclosed in other outcrops and kopjes.¹⁹⁹ Such quantities of the lead-zinc ore raised hope for a bright future full of huge investment, mass production and larger profit margins at the Broken Hill mine. However, none of these surface ores could be properly extracted by either water or oil concentration, as management was looking in other directions for a process of turning them to profitable account, as they were too low-grade for profitable shipment.²⁰⁰

Otherwise, management considered it feasible to produce a rich zinc-fume by the treatment of the slags from the lead smelter, but even so the quantity expected was small in comparison to other sources of zinc. At greater depths the ores became sulphurous, and there was little doubt that it was possible to concentrate such ore to give a high grade zinc concentrate, but the great problem, by then, was to turn a vast amount of oxidized ore containing about 30% zinc to profitable account. The chief difficulty of this lay in the remoteness of the property from cheap power and the metal market. The cash price of spelter in England for the eight years preceding World War One varied between £18 and £28 per ton, but zinc ore itself did not command anything like such prices owing to the high cost of zinc smelting.²⁰¹

¹⁹⁶ NAZ B1/94/3. The Mine management was in dire need of a treatment process that would separate the lead – zinc ores at least to a purity content of 97%. Up to this point the shareholders had never reaped any dividends from this venture.

¹⁹⁷ NAZ, B1/94/3, Broken Hill, p. 78.

¹⁹⁸ Ibid.

¹⁹⁹ ZCCM, NCCM/HO155/1. Annual Report of 1915, copy of Report by Messrs. Hooper, Speak and Company Consulting Engineers on their tour on Rhodesia Broken Hill Mine. p. 7.

²⁰⁰ ZCCM, NCCM/HO155/1 Annual Report of 1916, p. 10.

²⁰¹ NAZ, ZA7/1/9/7. Broken Hill sub-district, for the year 1918.

The best solution appeared to be the production of metallic zinc by solvents and then deposition of zinc from the solutions by electrolysis. For this cheap power was essential. Smelting the ore in closed vessels permitted the distilling of the zinc. Cheap fuel, good fire clay and skilled labour were also necessary for this. The cost of plant, though, was high. Nonetheless, equipment of this nature would afford the greatest possible stimulus towards the establishment of a large zinc industry.

Even so, the consultanting engineers emphasized the importance of constructing a larger lead smelter, considering the large amounts of lead held in reserve and the booming market for base metals required war for the effort. For the first time in the history of the Rhodesia Broken Hill mine, there was a paradigm shift from zinc to lead production. Assuming that there were 55,000 tons of lead ore available for smelting, this amount, if treated at the rate of 50 tons per day, would last nearly three and half years, or less if treated at the rate of 100 tons per day.²⁰² The larger scale of operations would obviously cost more in plant, but could be conducted more cheaply; further it would return the profits more quickly. If the cost of a 100 ton smelting plant did not exceed that of a 50 ton smelting plant by more than £18,000, it would be more profitable to erect the 100 tons smelter.²⁰³ From a purely financial standpoint, the figures were greatly in favour of smelting operations on a scale of not less than 100 tons per day.²⁰⁴ However, for technical reasons such as the bigger the plant the greater the loss if any breakdown or bungling occurred; and rising water level during the rain season, the engineers recommended taking matters slowly.

The small furnace was only capable of smelting about 350 tons of ore per month. But it produced metallic lead at the rate of 110 to 120 tons per month, and with high lead prices it retained an appreciable profit.²⁰⁵ The advantages of increased ore production were sufficiently obvious, and although in the first instance management proposed only a fourfold increase, it was expected after the new furnace was in successful operation steps would be taken to double the capacity. The total expenditure of enlarging the new plant ranged from £15,000 to £25,000.²⁰⁶ Overall, the engineers thought that it would be profitable to smelt lead on a larger scale. By contrast, there was little hope of any profit from zinc without a large and

²⁰² NAZ, ZA7/1/2/9. Chilanga sub-district for the year 1914-1915. P. 23.

²⁰³ Ibid p. 34.

²⁰⁴ ZCCM, NCCM/BHD/HO155/1. Annual Report of 1915, p. 10

²⁰⁵ Ibid.

²⁰⁶ Ibid.

expensive plant from the word go. But to warrant such an outlay, it was imperative to obtain unassailable proof of the existence of enormous quantities of zinc ore on the property, never mind demonstrating conclusively the feasibility of a process of treatment. It was also necessary to get down to the sulphide ores in order to make quite sure that they could be satisfactorily treated. At the same time, the extent of the deposits at depth needed to be established. However, it should be mentioned that the profitability of the lead production, like that of the smelting process, was subject to several risks as the business was at the mercy of railroad and shipping combined while the fluctuating market price of metal always introduced a gambling element into the business.

Impact of the War on Broken Hill Mine: 1915-1917

By August 1915, the impact of the First World War was being felt at the Rhodesia Broken Hill mine. During that year, work at the mine had been chiefly directed to mining ore from No. 1 kopje. As noted above, the consulting engineer reported that there were 55,000 tons of ore available, assaying approximately 38% lead and 18% zinc suitable for direct smelting. Considerable deposits of ironstone and limestone of a suitable character for fluxes had also been discovered.²⁰⁷ However, war conditions meant a delay in construction work, in particular the erection of a concentration plant and a smaller smelter. As stated earlier, essential parts of the smelter had to be replaced due to non-delivery. A significant challenge posed by the war was the difficulty of obtaining freight for oil and other materials. This prevented the commencement of the concentration tests on the due date. Even so, all construction work, with the exception of the erection of the bag-house for the recovery of zinc fume, was finally completed in September 1915.²⁰⁸ The smelter was fired on 14 June 1915, but it ran erratically, with mechanical difficulties of such magnitude that Broken Hill's board of directors requested Mr S. J. Speak of Hooper, Speak and Company Consulting Engineers to visit and investigate the problem. Notwithstanding the mechanical difficulties, the output of lead by the end of November that same year amounted to 354 tons. The metal produced was of a good quality, and sold for a top price.²⁰⁹

Although the Broken Hill mine's working capital totalled £160,270 in 1914, as a result of the various delays and disappointments, the funds provided for maintaining operations were

²⁰⁷ *South African Mining Journal*, 22 January, 1916.

²⁰⁸ *Ibid*, 10 May, 1916.

²⁰⁹ *Ibid*.

found to be insufficient.²¹⁰ For the sake of efficient operations, a loan of £10,000 was obtained.²¹¹ However, with an eye on the views of the consulting engineers, Hooper, Speak and Co., on the probable success and size of the smelter process, the loan obtained was increased to £26,000.²¹² This had a multiplier effect on some of the operations at the mine, as a number of issues came under scrutiny. In particular, the London expenses were further reduced. At the same time, the directors' fees were waived. It was anticipated that when operations continued, the cost of production would be lowered. The company also received help from the Rhodesia Railways in the form of a substantial reduction of railway rates on the carriage of lead.²¹³ Overall, the possibility of continuing operations depended to a great extent upon the support of the country's administration and the railway management.

Production Output and Enlargement of the Smelter Plant

From June 1915 to the end of May 1916, the smelter at Broken Hill produced 1,000 tons of lead.²¹⁴ As a result of this large output, Broken Hill's board of directors believed that the knowledge now acquired of the methods necessary to successfully handle the processing equipment, would justify the enlargement of the plant, as advocated by the consulting engineers. Accordingly, orders were placed for the construction of the two blast furnaces and another plant. It was hoped that the whole plant would be delivered from England by the end of August 1916, with the first unit up and running towards the end of the year.²¹⁵ The second unit was expected to be commissioned about a month or two later. The total capacity of the new furnaces was estimated at 900 tons of lead per month.²¹⁶ Initially, though, these forecasts proved wildly optimistic. In a letter dated 5th April, 1917 to his counterpart at Broken Hill mine in Australia, the then Rhodesia Broken Hill mine Manager lamented that one furnace produced only about 120 tons of lead a month, far below the projected output of 900 tons per month.²¹⁷

²¹⁰ *Ibid.*

²¹¹ ZCCM NCCM/BHD/HO155/1 T18.6A The Rhodesia Broken Hill Development Limited Annual Reports of 1919- 1936: Report for 31 December, 1924, p. 4.

²¹² *South African Mining Journal*, 22 January, 1916.

²¹³ NAZ RC/1035 Railway Rates on Mining Materials and Products, p. 12.

²¹⁴ *Ibid.* p. 398.

²¹⁵ ZCCM, NCCM/HO151/2. Broken Hill General Meeting, 20 July, 1917. p. 4.

²¹⁶ *Ibid.*

²¹⁷ ZCCM, 19.5.1F. Rhodesia Broken Hill Development Company Limited Confidential Correspondence Letters. Correspondence between D. Meredith of Broken Hill North mine of Australia and R. Macartney, Rhodesia Broken Hill Mine Manager, 5th April, 1917.

Challenges

The mine continued to experience a number of challenges despite such improvements towards the end of the war. Some of the recurring problems included complexity of the ores, a problem of course which pre-dated the war years now it began to affect lead more than zinc. The ore, which was mostly carbonate of lead, was always difficult to treat on account of its high zinc content. New experiments, though, demonstrated that even a slag containing 20% zinc oxide could be purified.²¹⁸ A small experimental blast furnace of only 48" diameter and produced over 100 tons of lead, of exceptional purity per month. But needed constant watching, and required a skilled and experienced foreman.²¹⁹

In the early months of 1917, lead production again fell away. Delays in the running of the furnace were a source of worry to the mine management.²²⁰ In addition, efforts to erect a third furnace as an immediate solution were hampered by uncertain deliveries times owing to the war disrupting transport and lack of skilled labour due to long distances from labour markets. In any event, most of the best men were at the war front.²²¹ Coupled with water-boiler and water pump defects, lead production decreased between January and March, 1917.²²² However, a new water pump was purchased at £100 and the old one replaced.²²³

But by July 1917, the problems had been solved and the Rhodesia Broken Hill Company was putting up a larger plant.²²⁴ Revised calculations suggested that upon the completion of the construction work, monthly lead production would top 1,000 tons at a maximum cost of £11 per ton.²²⁵ This, with an average lead price of £18 per ton, would give an annual gross profit of £84,000 or 50% on the £160,270 capital in 5s. shares, then quoted at 2s. 6d., with a variation of £12,000 a year in profit for every £1 per ton in the price of lead.²²⁶

Other positive news soon followed. Although about half-a-mile to the south of No. 1 kopje another enormous zinc deposit, estimated down to water level alone at 300,000 to 320,000 tons, averaging about 32% was discovered of the ore and there were other promising outcrops

²¹⁸ ZCCM, 19.5.1F. Correspondence between t G. Klug and R. Macartney, 19 October, 1916.

²¹⁹ *Ibid.*

²²⁰ ZCCM, 19.5.1F. Correspondence between H. Moffat and R. Macartney, 16 February, 1917.

²²¹ ZCCM, 19.5.1F. Correspondence between Mr Hockley and R. Macartney, 1 March, 1917. Mr Hockley was a major shareholder in the Broken Hill Mine and a personal friend of Edmund Davis.

²²² ZCCM, 19.5.1F. Correspondence between H. Moffat and R. Macartney, 8 March, 1917.

²²³ *Ibid.*, Correspondence between H. Moffat and R. Macartney, 29 March, 1917.

²²⁴ *South African Mining Journal*, 29 July, 1916.

²²⁵ *Ibid.*

²²⁶ ZCCM, NCCM/BHD/HO155/1, RBHD Co, Annual Report for year 1917, p. 5.

in the vicinity.²²⁷ Yet, despite such enormous additional quantities of zinc, the company confined its attention to increasing its lead output in order to repay its £60,000 new capital, and to build up a strong financial position.²²⁸ However, when the treatment of zinc ore was taken in hand, it proved very profitable, especially when the market for the metal product was supported by government demand.²²⁹

After being held up for reasons such as the late delivery of some materials for the erection of the smelting plant, progress now moved on rapidly. The two blast furnaces suggested by Messrs Hooper, Speak and Company were at last put into order. The first furnace started its work on 25 June 1917 and was running successfully, but it was decided not to blow in the second furnace until the workers and their supervisors had attained satisfactory efficiency.²³⁰ For this reason, the second furnace was blown in on 18 October 1917.²³¹

There was also progress in terms of new equipment and contracts to supply lead and timber. The new plant commenced operations on 15th June 1917, with parts such as fluxes for the consumption of the new furnace, boiler and hoist all installed.²³² Combined with the two water-jacketed furnaces erected earlier in October 1916, this equipment led to an improvement in the production of ironstone and lead despite a continuing lack of skilled labour.²³³ In July, 1917, for example the No. 1 furnace produced 412 tons of lead; in August 478 tons, and in September 520 tons.²³⁴ By the end of the war, the mine had produced a total of 14,000 tons of lead.²³⁵

The produce from the first furnace, coupled with the reduction of railway rates by the Rhodesia Railways until the end of 1917, caused the board of directors to exercise their option for the purchase of shares in the Rhodesian Land and Zinc Syndicate. Thereupon, the mine and plant were leased for five years back from April 1, 1916, on certain terms.²³⁶ The lease would be cancelled once the syndicate repaid its debentures of £60,000 and all interest

²²⁷ *South African Mining Journal*, 29 July, 1916.

²²⁸ *Ibid.*

²²⁹ NAZ RC/848. Rhodesia Broken Hill, p. 23.

²³⁰ *South African Mining Journal*, 15 December, 1917, p. 351

²³¹ *Ibid.*

²³² ZCCM, 19.5.1F. Correspondence between H. Moffat general manager of the Bechuanaland Exploration Company and R. Macartney, 5 April, 1917.

²³³ ZCCM, 19.5.1F. Correspondence between Collin Frazer and R. Macartney, 19th October, 1916.

²³⁴ *South African Mining Journal*, 15 December, 1917.

²³⁵ Zambia Broken Hill Development Company Ltd, Mining at Broken Hill: Metallurgical Operations, 12 September, 1969. P. 96.

²³⁶ *South African Mining Journal*, 24 July, 1917.

and £30,000.²³⁷ The Rhodesia Broken Hill Development Company, however, had an option to acquire the total share capital of the syndicate at any time.

Such was the good progress at the mine that it won contracts to supply lead to Britain. In January 1917, the mine secured a large contract to supply lead to the Ministry of Munitions. Besides this, the Ministry of Munitions allowed the mine to dispose small tonnages in Africa and also to Australia.²³⁸ Although costed at the English market price, surviving records do not indicate how much the actual price was. What was clear though is that the high demand for base metals in Britain obliged the Ministry of Munitions to press the mine for larger and larger supplies of lead.²³⁹

Increased production had knock-on effects. These included the preparation and extension of other areas of development-related activities, such as township extension, agricultural and manufacturing industries, housing, clinics and roads. These projects were not new, having been anticipated as early as 1914. At that time, the management at the Broken Hill mine believed that, once the problem of separating the ore was solved, it could envisage a better future, with massive developments. Management promised the shareholders that the time would come when the mine would attract a much larger capital investment and hence larger profits; there would also be a larger white population, townships would spring up and agricultural and manufacturing industries would be developed.²⁴⁰ Railway communication and cheaper transport would do more to hasten that development than anything else.

The Government, too, had planned optimistically. In June 1914, it surveyed and laid out stands over an area of 2,000 acres, reserved within the company's concession for township purposes.²⁴¹ The stands were held by the BSA Co. and the Rhodesia Broken Hill Development Company on half shares. By the end of 1914, a few stands had been sold and others leased at satisfactory rentals. Such projects, however, were halted by the challenges posed by the First World War and the lack of sufficient capital.

After the war, the Rhodesia Broken Hill Company felt it necessary to take up such developmental activities on the mine, especially as mining plant was to be expanded. To this end, the company realised in 1918 that the future of the whole mine undertaking depended on

²³⁷ *Ibid.*

²³⁸ ZCCM, 19.5.1F. Correspondence between Mr. Klug of Australia and R. Macartney, 30 January, 1917.

²³⁹ ZCCM, 19.5.1F. Correspondence between Mr Klug and R. Macartney, 5 April, 1917.

²⁴⁰ *South African Mining Journal*, 24 January, 1914.

²⁴¹ *Ibid.*, 2 January, 1915.

the immediate development of the township to support the needs of the labour force – which in turn was solely needed for the expected expansion of the mine’s operations.²⁴² The Broken Hill mine had initially erected, on its own property outside the small township, some half-dozen brick residences for its staff, but the increased size of the mine required additional housing. More than ever before, additional staff was required, especially qualified managers, their assistants, and skilled artisans for whom comfortable residences were essential in a tropical climate.²⁴³ It was believed that the building of the houses within the township area would increase the value of stands and naturally assist in its general development.

Poisonous lead fumes were a major continuing challenge at the Rhodesia Broken Hill mine. At the time, the mine lacked the technology and skilled man-power to deal with this problem. While assistance was sought from Australia, where the New South Wales Institution of Mining and Metallurgy had successfully dealt with lead poisoning, at Broken Hill in Northern Rhodesia the environmental consequences were devastating.²⁴⁴

Labour Issues at Broken Hill Mine

Another recurrent problem during the war was the difficulty of obtaining labour both white and African. Mining activities required adequate supplies of labour, not only cheap but also skilled labour needed in many departments. Certainly installing smelting works required skilled-labour which was hard to find. Practically, it took years to train workers, whose skill and knowledge could be said to result from their work environment.²⁴⁵ The main strength of the great centres of lead-zinc production could be said to have been located in their force of skilled labour. This applied to the Broken Hill mine as well. It is, therefore, essential at this stage to consider the labour situation at the Rhodesia Broken Hill mine during the war.

In 1906, most of the Europeans residing in Northern Rhodesia were in the Government service, railways and on the mines, but there were also a few traders and farmers. The high cost of building was a great handicap to European settlement, yet even so was twenty-seven white residents in Broken Hill protested against the employment of lowly-paid African artisans in the construction of the Broken Hill camp, under the supervision of white

²⁴²ZCCM, 19.5.1F. Correspondence between Bechuanaland Exploration Company Limited and D.O. Malcolm, 9 December, 1918.

²⁴³ Ibid.

²⁴⁴ ZCCM, 19.5.1F. Correspondence between F.R. Godfrey (Inspector of Mines, New South Wales) and R.Macartney, 19 October, 1916.

²⁴⁵ H.L. Sulman, Presidential Address. *Transactions of the Institute of Mining and Metallurgy, 1910-1911*, vol. xx.

foremen.²⁴⁶ There already were in North-Western Rhodesia, a number of semi-skilled African artisans coming to the towns from a government training scheme at Fort Jameson, as well as from the industrial missions in Nyasaland. The Administrator pointed out that in his opinion, skilled white workmen should supervise the labour of the unskilled African artisans.²⁴⁷ He believed that the climate was not suitable for the performance of hard manual labour by the Europeans, but that whites could be used in a supervisory capacity. He added that in more advanced trades requiring skills and judgment the European had no need to fear the competition of the African.

The demand for skilled labour meant better wages than before, although these were confined to whites as shown in Table 1 below.

Table 1: Broken Hill mine workers in 1917 - 1918

Job Category	Income per Month	Origin
Mining		
Underground Manager	£50	Swaziland
Foreman Smelter	£45	Australia
Storekeeper	£30	Southern Rhodesia
Typist	£15	Southern Rhodesia
Cook (African)	£2.10	Northern Rhodesia

Source: Rhodesian Broken Hill Mine Confidential letters for the 1916-1939.

It should be noted that there were other conditions of scrutiny in addition to professional qualifications considered when employing workers at the mine. A skilled person such as an underground manager, foreman, typist, or storekeeper, to mention but a few, was expected to be of sober habits. This condition was rigorously monitored.²⁴⁸ Beer drinking was not entertained at work and those that were known to be heavy beer drinkers were not employed by the mine. They were deemed unreliable and untrustworthy.²⁴⁹ Beer licenses were banned.

²⁴⁶M. Gelfand, *Northern Rhodesia: In the Days of the Charter* (Oxford: Basil Blackwell Limited, 1961), p.131.

²⁴⁷Gelfand, *Northern Rhodesia*, pp. 131-132.

²⁴⁸ NAZ, MH1/2/1. General: Broken Hill Mine Township, p. 12.

²⁴⁹ NAZ, B1/2/211. Broken Hill Native Compounds, R. Macartney report, Mine Manager: In Central Australia trouble from drink occurs, but the men are not as bad as they only go on a bust and do not drink for ever and a

For instance, Duess and Company were given a liquor license which was later withdrawn, as the Administration did not wish to grant one in the mining camp.²⁵⁰ Women, white and black, were generally not employed at the mine where hard, manual labour was involved. But even white women were not employed to do shorthand and typing. To take one example, when the mine was looking for shorthand-typist in 1917, one Mrs Hemming proved very good at it. However, management ruled her out because the job also entailed dealing with black worker, which white women were not allowed to undertake.²⁵¹ Unlike the diamond and gold mines of South Africa, from the start, the Rhodesia Broken Hill mine allowed African women to stay with their men folk in the mine compounds.²⁵²

During the war, a significant number of white miners left to join up; others lost their jobs when mines laid off workers because of wartime inflation. If management is to be believed, however, the real problem was not so much a shortage of labour, but its poor quality. The mine manager claimed in 1918 that he was obliged to fire men for drunkenness or laziness.²⁵³ The problem was different in Australia, he confided. There, trouble from beer drinking, certainly occurred, 'but the men were not as bad as they only went on a bust and did not drink for ever and a day'.²⁵⁴ They simply asked for a holiday, 'which was an intimation that they simply asked to go on a drinking spree and then return once it was over. At Rhodesia Broken Hill mine though, they drunk until they were useless!'²⁵⁵

Influenza Pandemic: 1918

The influenza pandemic of 1918 affected not only the Rhodesia Broken Hill mine but also most mining areas around of the world. In March 1918 an influenza epidemic broke out among army recruits in Kansas.²⁵⁶ Subsequently called Spanish flu, it spread, within a year,

day. They simply ask for a holiday, which is an intimation that they are going to have a big spree and return after it's over. Here they drink until they are useless; p. 5.

²⁵⁰Gelfand, *Northern Rhodesia*, p.131.

²⁵¹ZCCM, 19.5.1F. Correspondence between Mr O'Connor and Mr Teagle (Broken Hill Mine Secretary) 11December, 1916.

²⁵² ZCCM, 19.5.1F. Correspondence between Mr Klug and R. Macartney, 5 April, 1917.

²⁵³ NAZ, A5/1/7. Report for the Principal Medical Officer for the year 1 march,1919 .p. 26.

²⁵⁴ ZCCM, 19.5.1F. Correspondence between H. Moffat and Macartney, 28 December, 1918.

²⁵⁵ Ibid.

²⁵⁶ R.F. Hamilton and H.H. Herwig, 'World Wars: Definition and Causes' in R.F. Hamilton and H.H. Herwig (eds), *The Origins of World War 1* (Cambridge: Cambridge University Press, 2003), pp. 3-4.

to all continents. Estimates of total deaths ranged from 25 to 39 million, more than twice the number killed during the First World War.²⁵⁷

Spanish influenza spread rapidly not only from one continent to another or from nation to another but also within nations from one town to another as soldiers migrated to and from one battle front to another. By early October, 1918 it had reached Northern Rhodesia.²⁵⁸ Broken Hill did not escape. So many Africans labourers died that they had to be buried in one long trench and there were not enough coffins for the Europeans, many of whom were buried in blankets. Such coffins as there were reserved for Europeans.²⁵⁹ A.P. Marriott arrived in Broken Hill to take up his job as the first official mine compound manager when the influenza epidemic was at its height. His first task was to pay hundreds of black mine workers who wanted to flee from the flu but who were anxious to collect their dues before they did so. The manager of the one-man bank, the National Bank, was in bed near death's door at Boon's Hotel and Marriott had to take the bank keys from under the sick man's pillow and help himself to cash from the safe, leaving a receipt in its stead.²⁶⁰ The pandemic and the ensuing disruption caused the mine's lead output to drop by half. Many times the train would leave without any lead.²⁶¹ The influenza pandemic was followed, a month later by another flu outbreak.²⁶² One way or another, the pandemic shut down the Broken Hill mine for three months.²⁶³

The Way Forward

It is worthwhile at this stage to note how contemporaries envisaged the post-war future of the lead-zinc industry. As already discussed, before the war the British Empire produced large quantities of the lead-zinc ore, but nearly all was exported to Germany and Belgium to be smelted.²⁶⁴ Thus in 1913, although the Empire produced 20% of the world's output of zinc ores, its production of the metal (spelter) was only 6.4% of the world's total.²⁶⁵ Germany and Belgium, on the other hand, together produced about 48% of the world's annual supply of spelter, though they themselves contributed only 23% of the world's output of zinc ore. The

²⁵⁷ *Ibid.*

²⁵⁸ Gelfand, *Northern Rhodesia*, p. 194.

²⁵⁹ Turner, 'A Socio Economic History of Kabwe,' p. 24.

²⁶⁰ H, Ross, 'Broken Hill: some reminiscences,' *Northern Rhodesia Journal*, Vol, 6 (1962-64) pp. 590-92.

²⁶¹ ZCCM, 19.5.1F. Correspondence between T. Donald Of London and Macartney, 26 December, 1918.

²⁶² *Ibid.*

²⁶³ Ross, 'Broken Hill' p. 91.

²⁶⁴ *South African Mining Journal*, 27 April, 1918.

²⁶⁵ *Ibid.*

balance of their supplies came from Australia. But during the war, Britain abandoned trade with Germany, opting instead to trade within its Empire and with its Allies. To this effect, Britain stepped up the production of mineral ores in her colonies by localising mineral ore processing; and like other British owned mines such as those in Tasmania, Australia and Canada, the Rhodesia Broken Hill mine was part of this changed policy.

Between 1914 and 1918, much work at the Rhodesia Broken Hill mine had been devoted to the mining of lead ore deposits. There was now need to explore the zinc deposits on the same scale. With this in mind, in July, 1918, the Rhodesia Broken Hill Development Company Limited cabled the first results from the a second borehole drilled in one of the big lead-zinc bearing kopjes, to get deep samples for treatment experiment, and also to ascertain whether the sulphides justified the erection of a sulphuric acid works (plant), the product of which was to find ready market in South Africa for the manufacture of artificial fertilisers and explosives.²⁶⁶ The boring scheme had been laid out under the advice of the Central Mining and Investment Corporation Limited, a major Witwatersrand Corporation which was contemplating taking a large financial interest in the Rhodesia Broken Hill Company.²⁶⁷ The Central Mining and Investment Corporation, having undertaken to carry out certain prospecting work at No. 1 Kopje, sank a series of boreholes. The results estimated the ore contents at No. 1 Kopje at 100,000 tons of metallic lead and 25,000 tons of metallic zinc.²⁶⁸ At No. 2 Kopje, although no new development work was carried out, estimates put reserves at about 300,000 tons of 32% zinc ore.²⁶⁹ Such tonnages of lead-zinc ores in reserve laid a very good foundation for future investments after the war. Table 2 gives the monthly statistics of the output of lead during the war. As such, suffice to mention that the importance to the Rhodesia Broken Hill mine of production of lead and zinc within the British Empire had been clearly demonstrated during the war and the Central Mining and Investment Corporation, Limited and others were considering their options for future investment in the Rhodesia Broken Hill Company Limited.²⁷⁰

²⁶⁶ *Ibid.*

²⁶⁷ *Ibid.*, 27 July, 1918.

²⁶⁸ British South Africa Company (BSACo.), *Report of the 22nd Ordinary General Meeting* (1918), pp. 4-8.

²⁶⁹ *Ibid.*

²⁷⁰ ZCCM, Directors' Annual Report to Shareholders, 27 March 1919. (no file number)

Table 2: Lead Output from 1915 – 1919

Year	1915	1916	1917	1918	1919
Month	Tons	Tons	Tons	Tons	Tons
January	-	72	80	949	587
February	-	137	100	812	846
March	-	77	108	666	1085
April	-	139	141	1044	1202
May	-	122	104	1085	1221
June	31	121	117	1078	1346
July	80	57	412	1035	1219
August	81	80	478	801	1089
September	37	110	520	962	1028
October	34	132	588	729	-
November	106	108	648	-	-
December	109	89	525	-	-

Source: Mining Magazine, October 1919.



Figure 2: African Porters on the way to the war front.

Source: C. Mansfield, *Via Rhodesia: A Journey through Southern Africa* (London: Stanley Paul & Co. 1919)

CHAPTER FOUR

FULL-PRODUCTION OF MINERALS AND ECONOMIC FLUCTUATIONS: 1919-1929

Two factors should be noted from the previous chapter. First, the First World War stimulated the production of the lead base metal with production output reaching 15,383 tons, the highest record since the Rhodesia Broken Hill mine was opened.²⁷¹ Second, the expanded supply of lead to the Ministry of Munitions established the mine's significance on the international market and attracted investment. Consequently in the aftermath of the First World War, further developments occurred on the mine, notably: the construction of the Mulungushi Hydro-electric power station and a new zinc smelter; the expansion of zinc production; a boom in lead production; infrastructural and commercial development in Broken Hill town; fresh taxation; and the emergence of small mines. The purpose of this chapter is two-fold. It examines how mining developments after the war contributed to the full-scale production of the lead-zinc ores at the Broken Hill mine. It further discusses the extent to which mining developments had already run their course by the time of Wall Street's collapse in October 1929.

Progress at Broken Hill mine was unsteady for several years after 1918. Fresh difficulties were experienced in extracting lead from the ore, and in addition to this problem, a large volume of water flooded into the mine, threatening to put a stop to operations entirely because of the high cost of pumping.²⁷² Yet overall, the post war period found Broken Hill mine, like Bwana Mkubwa, ready to embark on a programme of improvement and expansion. Expansion was fueled by rising prices and the increasing demand for metals brought-about by the war and its aftermath.

By February 1919, the Rhodesia Lead and Zinc Syndicate Limited had redeemed its debenture issue of £60,000 and was placed in voluntary liquidation.²⁷³ As mentioned in Chapter Three, on 28th February, 1919 the lease of the 35 square mile mineral area, which included the Rhodesia Broken Hill mine to syndicate, reverted to the Rhodesia Broken Hill

²⁷¹ *South African Mining and Engineering Journal*, 31 May, 1919. p.389.

²⁷² 'Mineral Resources of Northern Rhodesia, *Bull. of the Imperial Institute*', No. 20, 1922, p.341-342.

²⁷³ NAZ, NCCM/BHD/HO155/1 Broken Hill Annual Report on the work done by the Messrs Hooper, Speak and Company Consulting Engineers, 1915. See also *South African Mining and Engineering Journal*, 31 May, 1919.

Development Company, together with the equipment, including the two lead smelting furnaces erected by the syndicate, all machinery, plant, buildings, stores and future profits.²⁷⁴ Since, the Company acquired the whole of the share capital of the syndicate; a development policy was adopted with a view of increasing the production of lead and zinc beyond the war-time peaks. But this could only be additional investment in equipment. Once the installation of a new blast furnace took effect, lead production expanded markedly with each passing year reaching 14,714 tons in 1919; and 16,354 tons in 1920.²⁷⁵ A new plant was imported in 1923 capable of treating sulphide ores which were encountered with greater frequency.²⁷⁶ At the same time, a pilot zinc electrical deposition plant was also installed. With this new equipment not only was the output of lead increased considerably, but the production of zinc and vanadium also began on a commercial scale.

Financial Arrangements

With regard to financial arrangements, the RBD Co. requested help from its partner, the Central Mining and Investment Corporation Limited, (hereafter CMIC) a London based company. The CMIC Ltd and others were keen to exercise options they held on unissued shares of the company, but subject to the consent of H.M Treasury.²⁷⁷ The Treasury withheld its permission for the issue of reserve shares to the Central Mining Corporation, as it feared that they would be sold to finance the expansion of the South African base metal industry and not the lead-zinc Broken Hill mine. In the event, the £40,000 secured from the acquisition of the syndicate sufficed to purchase further mining equipment.²⁷⁸

Lead Smelter and Zinc Industry

In May 1919, the RBHD Co. ordered a third lead smelter in order to increase output to 1,500 tons per month; and it was hoped to start working by the end of the same year.²⁷⁹ Meanwhile, the output of metallic lead from the two smelters was 1,202 tons per month,²⁸⁰ whereas during the war both together could only produce a total about 900 tons per month.²⁸¹ The increased output was due to a combination of factors. The major factor was the fact that the ore was richer as its body or root went deeper down. The other factor related to the

²⁷⁴ *Ibid.*

²⁷⁵ 'Mineral Resources of Northern Rhodesia, pp. 341-342.

²⁷⁶ Pollock, *Nyasaland and Northern Rhodesia*, p.342.

²⁷⁷ *South African Mining and Engineering Journal*, 12 July, 1918.

²⁷⁸ *Ibid.*, 28 August, 1919.

²⁷⁹ *Ibid.*, 31 May, 1919.

²⁸⁰ *Ibid.*

²⁸¹ *South African Mining Journal*, 29 July, 1916.

installation of additional pumping equipment coupled with the adoption of the Francois cementation process that contained flooding and ever enabled deeper excavations of the ore body. Another factor was the abandonment of the Murex magnetic process in 1917, owing to the high war price of oil, and the subsequent adoption of the two smaller furnaces, made lead ore treatment cheaper and more efficient.²⁸² Besides ordering the smelter, the company undertook considerable expenditure in order to lay the foundations for an expanded zinc industry.²⁸³ However, a zinc plant could not be erected until 1926 as the mine was still waiting for a successful process to treat the ore. Otherwise, lead production continued to dominate mining activities.

Profits

Within a year of these investments, the Broken Hill mine entered a new era. On 31st December, 1919 a profit and loss account presented before shareholders opened the first period in the company's operations when it was possible to pay a dividend of 10%.²⁸⁴ How had this become possible? It was due to a massive increase in production, improved sales and profit margins widened by the demand for base metals to rebuild industrial infrastructure after the war. The price of lead increased from £31 per ton during the First World War to £54 per ton after the war on the London Metal Exchange to whom the mine supplied this metal.²⁸⁵ Between December 1918 and December 1919, the Broken Hill mine sold approximately 6793.5 tons of metallic lead; the profit earned, after providing for royalty and depreciation, amounted to £100,889; and after paying dividend, there was still a cash balance of £65,889.²⁸⁶

The balance sheet now showed an exceptionally strong position and this had a multiplier effect on the company's assets. For instance, the total assets at December 31, 1918, figured at £210,701, but by December 31, 1919, it increased to £546,853.²⁸⁷ As stated earlier on, the company had invested £40,000 in Treasury bills, debtors amounted to £211,958, and creditors and bills payable amounted to £77,315.²⁸⁸ Considering the price of shares in August 1920, the whole undertaking was valued in the market at £770,000. Shareholders were also pleased to

²⁸² *Mining Magazine*, 15 October, 1919.

²⁸³ *South African Mining and Engineering Journal*, 3 May, 1919.

²⁸⁴ *Ibid.*, 20 August, 1920.

²⁸⁵ *South African Mining Journal*, 29 July, 1916.

²⁸⁶ *South African Mining and Engineering Journal*, 10 August, 1921.

²⁸⁷ *Ibid.*

²⁸⁸ *Ibid.*

hear that the body of rich lead ore had reached a depth of 150 feet with favourable prospects of continuance.²⁸⁹

The prospects for continued profits seemed remarkably good. Neither the onset of the post-world war economic depression nor the absence of expanded zinc production could apparently, stop economic development at the Broken Hill mine. Indeed, the period 1920-1926 witnessed considerable progress in terms of increased production of lead-zinc ores; emergence of small-mines; increase in capital and shares; a more favourable tax regime; hydro-electric power construction; and greater labour efficiency including employment of women. These are all discussed in the subsequent sub-headings.

Boom in Lead Production and the Emergence of Small Mines: 1920-1923

The last few months of 1920 witnessed the onset of a post-war economic depression. At a time of depression in international metal markets, it was remarkable that a lead-zinc mine in the centre of Africa was making profits and paying dividends. But this was what, in spite of so many disadvantageous circumstances, the Rhodesia Broken Hill Development Company was doing. This was made possible by not only the increase in lead production and sales but also by the production of other minerals such as vanadium, silver and ironstone. Manganese was also mined. The manganese ore deposit was within reasonable distance, that is 16 miles from a point on the railway, 30 miles north of Broken Hill. The manganese ore was pegged and registered under one Mr. J.H. Burnett, actually one of the Broken Hill mine contractors.²⁹⁰ The samples submitted by him were of high grade, and consistently showed 90% manganese dioxide.²⁹¹ Mr. Burnett negotiated for the sale of the property to one of the Union Steel Works, but promised not to sell until the Rhodesia Broken Hill Company had an opportunity to match the offer.

Lead production increased from 14,806 tons to 18,122 tons to 22,961 tons in 1920, 1921 and 1922 respectively.²⁹² The net profits after production costs and depreciation on machinery and plant was £54,949 in 1920; reduced to £32, 860 in 1921; and increased to £76,982 in 1922.²⁹³ The net profit of £76,982 shows an increase of as much as £44,122 with a total

²⁸⁹ *The Times*, 13 October, 1920.

²⁹⁰ ZCCM, 17. 4.2A Confidential Correspondence General Manager for R.B.H.D. Co. May 1922-January 1924. Correspondence between Mr H.U. Moffat, General Superintendent R.B.H.D. and Co. R. Macartney Broken Hill Mine Manager. 15 November, 1922.

²⁹¹ ZCCM, 17.4.2A. Correspondence between H. Moffat and Teagle, 18 November, 1922.

²⁹² *Mining Magazine*, 20 August, 1922.

²⁹³ *Ibid*, 29 September, 1922. See also *South African Mining and Engineering Journal*, 11 August, 1923.

balance forward of £104,700 as against £60,578 brought in.²⁹⁴ Of the three other minerals, vanadium was the most important. Vanadium even contributed more to the overall output than zinc.²⁹⁵ This is evidenced from the sales of vanadium in the preceding years under discussion, increasing from £4,431 to £7,995, albeit then declining to £2,959.²⁹⁶

On the whole, 1923 was a highly satisfactory one for the mine and its shareholders.²⁹⁷ Despite European disorder, international demand for base metals had continued to grow. Lead production was one of the most profitable of mining activities, owing to high demand and an unusually high price for the metal.²⁹⁸ The high demand for lead outstripped the price of copper and zinc. For instance, before to the war, one pound of copper could generally be exchanged for three to four pounds of lead, but by 1923, one pound of copper was equivalent in value only to about one and half pounds of lead.²⁹⁹ By then it had already outstripped the price of zinc. It needs to be emphasised that, underlying these shifts was the extraordinary demand for lead and the inability of production to keep pace with consumption.

This indeed was a period when the Broken Hill mine operated to full capacity, at least as far as lead production was concerned. But, operational developments at the mine did not keep pace with increased world-wide consumption of the metal. Broken Hill's capacity was hampered by financial and technical constraints as well as unforeseen circumstances such as mine accidents and flooding. For instance, the 10,000 tons amount of rock which fell across the mine in August 1922 left nine African workers dead and twenty others injured.³⁰⁰ As no whites were working in the open cut, no European suffered. Although management claimed that the black miners were kept well away from loose ground, the fact that they were killed and injured suggest that they were forced to work despite lack of safety in the open-cut.³⁰¹

As always Broken Hill mine faced recurrent technical problems in treating its lead-zinc ores. This repeatedly affected output. This mine was still not effectively treating oxidised ores.

²⁹⁴ *The Economist*, 28 July, 1923.

²⁹⁵ *South African Mining and Engineering Journal*, 10 February, 1922.

²⁹⁶ *Livingstone Mail*, 1 May, 1924; NAZ, SEC/3/556, Broken Hill Mine Minutes of Proceedings at a meeting held at Broken Hill, 12/9/22.

²⁹⁷ *Mining Magazine*, 11th January, 1923. And 23th January, 1924.

²⁹⁸ *South African Mining and Engineering Journal*, 10 May, 1924. The Position of Lead at Broken Hill Mine.

²⁹⁹ *Ibid*, 12 November, 1923.

³⁰⁰ *Ibid*, 23 September, 1923.

³⁰¹ *Ibid*.

Consequently, there was a considerable falling off in production in 1923 once oxidised ores were encountered at depth.³⁰²

Something needed to be done to restore the fortunes of Rhodesia Broken Hill mine. To this end, new management policies were implemented which increased capital investment and shares; negotiated for reduction of rail, royalty and mining rights taxes; embarked on massive hydro-electric power construction; constructed a zinc electrolytic plant; promoted labour efficiency. It was hoped that a combination of these policies would restore, if not hugely increase, the production of base metals.

Capital and Shares: 1924

In order to provide funds for the construction of the mooted hydro-electric power station and the zinc plant, the capital of the company was increased by £1,000,000 by the creation of 4,000,000 new shares of 5s each.³⁰³ Of these shares, 1,500,000 were immediately placed and another 1,500,000 shares, which was offered to shareholders, was underwritten.³⁰⁴

Even with such increased investments, it was absolutely necessary for the RBHD Co. to keep capital expenditure within tight limits. One way of reducing expenditure was a reduction in transport and royalty rates and taxes. In 1923 the company began negotiations to reduce rail, sea, royalty and coal taxes. Owing to the great distance of about 1,330 miles from Broken Hill to the coast, the settlement of railway rates on plant up and production out was one of the most difficult and important matters to be settled.³⁰⁵ However, the RBHD Co.'s negotiations with the Rhodesian railways was fruitful as the latter reduced railway rates on lead from 1923 to 1928.³⁰⁶ The issue of expensive rates on coal to the Broken Hill mine from the Wankie Colliery Company was settled and the former was granted a rebate of £5 per short ton on machinery, sulphide, zinc and power plants through the Beira route.³⁰⁷ Doubtless, all these negotiations were greatly facilitated by Edmund Davis, whose interests encompassed the railways, coal, lead and zinc.³⁰⁸

³⁰² NAZ, ZP/2/1/80, Rhodesia Railways, Annual Reports (1922), p.10; NAZ, SEC/3/350, Interim Report of the Commission of Inquiry into the Cost of Living, p. 120.

³⁰³ *Mining Magazine*, August 1925, p.70.

³⁰⁴ NAZ, KDA/4/1/1/, Broken Hill District Notebook, 1919-1924, p. 56.

³⁰⁵ *South African Mining and Engineering Journal*, 12 May, 1923, pp. 235-236.

³⁰⁶ ZCCM, RC/CSD/ WMA/85 Railway Rates, 1923-1952, p. 43.

³⁰⁷ ZCCM, RCM/CSD/WMA/86 Revision of Railway Rates 1924, p. 12-25.

³⁰⁸ Phimister, *Economic and Social History of Zimbabwe*, pp. 118-119.

Apart from its successful negotiations for railway rate reductions, the Company dealt with the British South Africa Company on the subject of royalties, a water power site, the right of transmission of power and additional land rights. The BSA Co. agreed to reduce royalties on lead³⁰⁹ and granted a fifty years' lease not only for the water-power development on the Molungushi Falls, situated about twenty-eight miles from the mine site, but also for 5,000 acres of land near the mine.³¹⁰ The land and the water-power were held subject to a rental at the 10s. per h.p. per annum for the first 2,500 h.p., with a minimum of £1,250 per annum, and 15s. per h.p. per annum for anything in excess, and £37.10 per annum for the land.³¹¹ As regards mineral rights, the RBH Company not only maintained its 35 square mile lease but also embarked on prospecting for other metals, including the ones discussed earlier in this chapter, to add to the value of the property.

Construction of the Mulungushi Hydro-Electric Scheme

Reasons for the Construction of the Mulungushi Hydro-Power Station

Plans to construct a hydro-electric power station on the Mulungushi River dated back to early 1923.³¹² The company was basically motivated by two major reasons for erecting the power station. The first factor was the high demand for lead and zinc. This caused the company to consider hydro-electric power as the best way of increase production of these two metals.³¹³ Additionally, the Company realised it was a key step towards recovering an improved quality of the yield of the full metal contents of the company's large reserves of ore containing lead, zinc and vanadium.³¹⁴ By then, the oxidised lead ore reserves in No. 1 kopje were 69,000 tons; the sulphide ores 104,000 tons of 30% lead and 30% of zinc; the lead and zinc ores 680,000 tons of 27% zinc.³¹⁵ The chemical process of treating the ores (through the furnaces) produced low yields in terms of quantity and poor yields in terms of quality of lead and zinc. Therefore, there was need for a mechanical process utilising electric current. This could be

³⁰⁹ A flat royalty rate on the zinc and vanadium ores was charged on the value of silver. Satisfactory reductions were obtained in sea freight and returning charges on lead.

³¹⁰ *South African Mining and Engineering Journal*, 12 May, 1923, p. 236.

³¹¹ ZCCM, NCCM/BHD/67/. Mulungushi Dam and Plant, RBHD Co. notes on the operations of the Mulugushi Plant, p. 37.

³¹² ZCCM, NCCM/BHD/HO156/. Building the Mulungushi Hydro- electric power, p.45.

³¹³ *Ibid.*

³¹⁴ *South African Mining and Engineering Journal*, 10 May, 1924, p. 945.

³¹⁵ *Special Report: Rhodesia Broken Hill Development Company Limited*, February, 1927.

achieved economically by the adoption of water power instead of steam, and installation of a hydro-electric plant (Zinc Electrolyte Plant).³¹⁶

The Mulungushi River rises north of Broken Hill, and below the power site is joined by the Mwomboshi River. Both Rivers flow into the Lunsemfwa, which, in turn, flows into the Luangwa River, and the Luangwa flows into the Zambezi River at Luangwa, formally known as Feira.³¹⁷ At a point 32 miles east of Broken Hill, a large camp was established close to where the Mulungushi River flowed through sheer-gorge-walls 250 feet high.³¹⁸ In any hydro-electric scheme it is essential that there should be sufficient water to run the generating plant during the dry seasons, so for this reason, a huge catchment area of approximately 1,110,000 acres was planned for, and the maximum flow of the Mulungushi River being estimated at 2,400 cusecs. The Mulungushi Falls themselves were three times the height of the Victoria Falls.³¹⁹

COMPLETION, CAPACITY AND COST OF THE HYDRO ELECTRIC PLANT

The scheme would never have materialised but for a natural gap in the hills, where a dam was built. In order to build the dam, a tunnel some 700 feet long was driven through the rock, to divert the stream which joined the old bed some distance away.³²⁰ This tunnel which was 15 by 12 feet served to control the flow of water.³²¹ The water, after leaving the controls of the main dam, ran for about 1.5 miles along the old river bed until it met the diversion weir, where it was directed to a canal 2.5 miles long to the head box of the pipe line leading the turbine at the generating station.³²²

The machinery and equipment for the hydro-power station was ordered from England and arrived at the mine shortly before the start of the dry season of 1924. Equipment weighing about 3,000 tons was transported to the construction site during the dry season and construction work begun during the rainy season in the same year and was completed twelve months later. The Mulungushi Hydro-Electric Power Station was officially opened at a ceremony held on 15th July, 1925, by the Prince of Wales.³²³

³¹⁶ *Ibid.*

³¹⁷ *Ibid.*

³¹⁸ *Ibid.*

³¹⁹ *South African Mining and Engineering Journal*, 11 October, 1924, p. 127.

³²⁰ *Ibid.*

³²¹ *Ibid.*

³²² *Ibid.*, 12 May, 1923, p. 236.

³²³ *Ibid.*, 25 July, 1925. p.598.

The turbine had a capacity of 3,150 horse power running at 750 R.P.M. It was connected with 2,000 kilowatts, 3-phase, and 2,000 volts generator.³²⁴ The current was stepped up to 44,000 volts for transmission to the mine, where it was reduced to the original voltage. The cost of the scheme was approximately £150,000 and it was estimated that there would be a saving of about £15,000 by hydro-generation over the steam driven plant.³²⁵

New Treatment Plants: 1926 – 1927

With a guaranteed supply of electricity following the construction of the Mulungushi power station, the RBHD Co. hastened to build a new treatment plant capable of producing volumes of high quality lead, zinc and vanadium. This was to increase the supply of lead, zinc and vanadium on the local South African and international United Kingdom markets.

There were two new plants, namely the concentrating and de-sulphuring plant and the electrolytic zinc-producing plant. The new plants expressly dealt with sulphide ores. Meanwhile, the Lead Smelter was enlarged to increase on the yield of the metal. Plans to erect the two plants and enlargement of the lead smelter were drawn up late in 1924, construction work begun in 1925 after the official opening of the hydro-electric power, and they were completed by December 1927; all commissioned in January 1928.³²⁶

The concentrating and de-sulphuring plant had been designed on the basis of the results of the experimental plant, which during nine months of operations in 1924 produced an average 200 tons of concentrates per month, assaying 65% lead.³²⁷ The capacity of the new concentrating plant was claimed to be 300 tons of ore per day, capable of producing 110 tons of zinc and 60 tons of lead concentrates.³²⁸ If the new concentrating plant produced the same amount of concentrates as the experimental plant, the output would be in the order of 10,200 tons of lead at 85% extraction per year.³²⁹

Similarly, the electrolytic zinc-producing plant, the experimental unit having come up to expectations, was thought likely to produce 25 tons of zinc per day.³³⁰ The recovery of the metal from the ore by the electrolytic zinc plant was expected to be 95%, while the probable

³²⁴ *South African Mining and Engineering Journal*, 11 October, 1924. p. 127.

³²⁵ *Ibid.*

³²⁶ *Rhodesian Mining Journal*, February 1928.

³²⁷ *South African Mining and Engineering Journal*, 11 October, 1924. p. 127.

³²⁸ NAZ, 63/1/30, Broken Hill, Annual Report 29 April, 1929.

³²⁹ NAZ, 7/1/8/61, Annual Report, Loangwa District, 1924-25

³³⁰ KDA/4/1/1, Moffat Thomson, Luangwa District Annual Report, 1927.

cost of £18 per ton to realisation was the same as for lead.³³¹ Overall, the plants were expected to produce about 15,000 tons of zinc, 3,400 tons of lead, 35,000 ounces of silver, and 600 tons of vanadium per annum.³³² The total cost of constructing two plants and the transmission lines and other electrical plant on the mine was £350,000.³³³

At this stage, the major question to ask is; were the two plants effective in terms of quantity and quality production of lead, zinc and vanadium? Perhaps, a critical illustration would help with the answer to this question.

Table 3: Production of Zinc and Lead, 1927-1929

Zinc	
Year	Production in Tons
1927	-
1928	9,579
1929	12,121
Lead	
Year	Production in Tons
1927	5,857
1928	4,676
1929	1,635

Source: Mining Magazine, RBHD Co. Ltd., December 1929.

Table 2 illustrates the production of zinc and lead after the construction of the new plants. During 1927 the mine produced 5,857 tons of lead but as the zinc plant only begin operations at the end of the year, no zinc was produced before then. A number of factors can be deduced from the table.

The first point relates to the fact that zinc production surpassed lead production. The major reasons attributed to this scenario were that zinc was cheaper to produce; the mechanical method of electrolysis produced a huge leap in production of zinc of excellent quality of about 99.95%.³³⁴ The availability of markets in Europe at £32 per ton encouraged mass production for export.³³⁵ The reason why zinc was produced at the lowest cost then known

³³¹ *Ibid.*

³³² *South African Mining and Engineering Journal*, 13 August, 1927.

³³³ *Ibid.*, 11 October, 1924.

³³⁴ *Ibid.*, 18 August, 1928.

³³⁵ *ibid.*

in the world was due to cheap electric power, cheap black labour, and the richness of the zinc ore reserves. As far as power was concerned, the mines on the Rand paid the Victoria Falls Power Company for their power generated on a huge scale, at £0.44 per unit.³³⁶ By contrast, power at Broken Hill cost £0.01 per unit, and that included maintenance, transmission and all other possible charges and it was one of the lowest power costs in the world at the time.³³⁷ As regards the richness of the ores, the main deposits of zinc ores in the various kopjes amounted to 1,000,000 tons assaying 30% zinc, 9% vanadium and 8% lead; while slag amounting to 200,000 tons contained assays 18% zinc, 4.2% lead and 1.2% vanadium oxide.³³⁸

This leads to another important point. Because of the availability of cheap electric power, cheap African labour and rich ore, the cost of production of a ton of electrolytic zinc in the new plant did not exceed £18; a cost far lower than that incurred by zinc producing companies in Europe, America and Australia.³³⁹ An expert correspondent, writing for *Industries and Handels Zeit*, nonetheless, maintained that zinc production was still profitable at prevailing prices even for high-cost European producers.³⁴⁰ This was questioned by a leading firm, Metallwistschaft. This latter company insisted, unlike Broken Hill in Central Africa, most European production costs were very near to and sometimes greater than the selling price of the metal.³⁴¹ Certainly, Broken Hill mine had benefited largely from hydro-electric power, cheapest technical and mechanical means of ensuring quantity and quality zinc production.

Table 2 also discloses that, the production figures show that production for zinc was becoming more important than the production of lead after 1927. Obviously, this was related to the reasons dealt with above. But figures for both lead and zinc increased in 1928. Sales of 9,579 tons of zinc and 4,676 tons of lead amounted to £327,416, compared to a total of £152,184 the previous year; and this was a very satisfactory increase of £175,232 over the sales during 1927.³⁴²

However, what Table 2 also reveals is that the electrolytic treatment adopted after lengthy experiments and confirmation by the pilot plant, had failed to realise the anticipated output of

³³⁶ *The Times*, 24 July, 1928.

³³⁷ *Ibid.*

³³⁸ *South African Mining and Engineering Journal*, 18 August, 1928.

³³⁹ *Ibid.*, 10 November, 1928.

³⁴⁰ *Ibid.*

³⁴¹ *Ibid.*

³⁴² *Rhodesian Mining Journal*, July 1929.

15,000 tons of zinc per year. Although, the lead output of 4,676 tons in 1928 was way over the expectations of 3,400 tons per annum, it too dropped dramatically in 1929. The principal explanation advanced was an inadequate supply of sulphuric acid.³⁴³ In the original plan of treatment it was estimated that the necessary supply of sulphuric acid would be derived from the sulphide ores of the mine, but it was soon realised that other sources would have to be sought. In this regard, 2,000 tons of pure sulphur were ordered from Texas in the United States of America, the company guaranteeing that the imported mineral could be delivered at Broken Hill at a considerable saving over the South African product.³⁴⁴

Overall, 1929 was a troubled year for the mine. The inadequate supply of sulphuric acid coupled with flooding in the mine during the rainy season, caused lead production to fall sharply.³⁴⁵ But ill-considered vanadium experiments conducted on the zinc plant during the latter half of the year also adversely affected zinc production.³⁴⁶ More than this, it became apparent that lead production would be affected in future owing to the exhaustion of sulphate lead-zinc ore reserves above 225 feet level. This would call for a new pumping programme to lower the water level in the mine to permit deeper mining. The lead smelting plant also needed updating in order to permit modern metallurgical processes which would result in improved recoveries of lead.³⁴⁷

Labour Efficiency

The mine generally and the new zinc plant in particular, required not only skilled white labour which in 1928 consisted of 288 employees, but also a large complement of workers, totalling 2,719.³⁴⁸ The supply of white labour was at all-time on high, additional construction men having been easily obtained and the operating crews remaining stable.³⁴⁹ The total number of natives engaged and taken on the payroll in 1929 was 1,691.³⁵⁰ It should be noted that black labour was procured from various parts of Central Africa (see Table 3 below). Very few local people were employed at the mine despite the provision of five-acre plots see below).

³⁴³ NAZ, ZA/7/1/8/6, Broken Hill Annual Report 1924-25.

³⁴⁴ Ibid.

³⁴⁵ NAZ, ZA/7/1/5/7, C.F. Molyneux, Broken Hill Annual Report 1920-1921.

³⁴⁶ ZCCM Rhodesian Broken Hill Development Company Limited, General Manager's Report, p.14

³⁴⁷ Ibid, p.15.

³⁴⁸ *The African World*, 28 July, 1928. P.12.

³⁴⁹ General Manager's Report on Rhodesia Broken Hill Development Company Limited, 31 December, 1930.

³⁵⁰ Ibid.

Table 4: Procurement of Black Labour in Central Africa

Area	Labour Supplies
North Eastern Rhodesia	1, 231
North Western Rhodesia	333
Nyasaland	99
Broken Hill	28

Source: Zambia Consolidated Copper Mines Archives: *General Manager's Report on Rhodesia Broken Hill Development Company Limited, 31 December, 1930.*

With regard to bettering the lives of white labour, the company established a clinic equipped with up to date equipment and made charges for the services lower than anywhere in South Africa.³⁵¹ From the perspective of Broken Hill's mine management, the African labour situation was complicated by the allegedly poor physique and general health of the neighbouring Lenje people.³⁵² As late as the 1920s, management claimed that it would take another generation for Lenje men to become effective workers.

In the meantime, though, the mine's needs for increasing number of African workers caused the mine management to make the best of what they thought was a bad job.³⁵³ Every effort was made to promote mine "boy" efficiency, and black workers were schooled in the elementary principles of their work such as shovelling, hammer, saw and axe work, in the shaping of timber supports and in the manipulation of drills and steels.³⁵⁴ The company claimed that even these simple instruments were not handled properly. Over the course of several shifts involving 2,719 Africans employed by the mine, these mistakes assumed a very large dimension in the shape of wastage and breakages. The correction of mistakes became a matter of greatest importance.³⁵⁵ But there was a possibility if not probability that these breakages were deliberate, reflecting 'worker consciousness' in the 'nooks and nannies' of the workplace. In line with this argument van Onselen states that, 'the analysts who seeks for an index of worker consciousness or an outright demonstration of African resistance should therefore not look for dramatic responses.'³⁵⁶

³⁵¹ Ibid.

³⁵² *The South African Mining and Engineering Journal*, 14 September, 1929.

³⁵³ *The Rhodesian Mining Journal*, 19 May 1928.

³⁵⁴ Ibid.

³⁵⁵ Ibid.

³⁵⁶ G. Williams, review of C. van Onselen, 'African Mine Labour in Southern Rhodesia, 1900-1933', *Journal of African Studies*, vol. 11 (1977), p. 533.

Broken Hill's white miners came mostly from South Africa, and soon after the end of the war, union representatives of mechanical technicians, carpenters, engine drivers, smelters and miners demanded a £155 cost-of-living bonus on wages earned between 1st March 1919 and 29th February 1920 inclusive.³⁵⁷ Their demand turned on the high cost of living brought about by wartime shortages, and the fact that unlike mines in Southern Rhodesia, no special war bonus had been received by the men.³⁵⁸ Married men especially were unable to live on the wages received. They considered wages were inadequate in view of high prices ruling for food stuffs and other necessities. The miners also asked for the payment of compensation to men who were unable to work because of sickness brought about by the lead fumes.³⁵⁹ Lead poisoning was often contracted by the smelter men, and was testified by the doctors' certificates. All that management would concede was the mine climate allowance of £5 per month in addition to the then Southern Rhodesia rates of pay, as agreed to by the Miners Association. On the other hand, white workers would pay Southern Rhodesian charges for medical attendance and house rent.³⁶⁰ Insisting that this was their final offer, management refused to consider any further claims unless there was a considerable increase in the cost of living.

Although medical compensation was refused because 'newcomers placed the blame of the slightest indisposition on lead fumes', continued inflation did persuade management to agree to a cost of living bonus on condition that only half was paid immediately, the other half after six months and that no further demands were made for a period of one year from the receipt of the bonus.³⁶¹

No sooner had this been agreed to, however, than there was a strike by white workers on the railways for increased wages. This was closely followed by Broken Hill mine management who feared that any wage settlement on the railways would unsettle their own workers.³⁶² Management saw that it was certainly in their interest "to reasonably meet the white men, but if they were to put forward impossible demands the mine was to consider a bad policy to accede to them without a show of fight as long as a strike can be avoided."³⁶³

³⁵⁷ZCCM, 19.5.1F, Correspondence between H. Moffat and R. Macartney, 29 March, 1920.

³⁵⁸ NAZ, SEC/NAT/311/36, Management Board Broken Hill, 24 July, 1936.

³⁵⁹ Ibid.

³⁶⁰ ZCCM, 19.5.1F, Correspondence on Miners' Union, Wage Increment and Bonus, 5 April, 1920.

³⁶¹ NAZ, SEC/NAT/264/1, Native Industrial Labour advisory Board, Ndola, November, 1935.

³⁶² Ibid.

³⁶³ NAZ, SEC/NAT/34, September, 1933.

The local branch of the miners' union, not surprisingly, informed mine management they wanted an immediate payment of a general bonus and a substantial increase in wages. The figure the union settled on was a 25% increase in wages.³⁶⁴ This was directly influenced by the highly favourable railway strike settlement. The mine management, anxious to avoid a strike just as the mine was beginning to come right, insisted that the bonus would only be given if the men accepted the condition that no further demands would be put forward for at least a period of 12 months.³⁶⁵ Following further negotiations, a bonus of 15% on one year wages was agreed to, half paid immediately and half after six months.³⁶⁶ Privately, the Company felt there was no just ground on which to make a demand for a bonus. White workers had been well paid in the past, compared to Southern Rhodesian mines and railways. Wages at Broken Hill compared favourably with Shamva and Falcon mines in Southern Rhodesia.³⁶⁷ Publicly, though, Broken Hill's management merely pointed out to the union stewards that in the past the wages were higher than at comparable mines in the region, and that the bonus should be considered as a reward for good service and not seen in any way as an obligation. As it turned out, the union's final demands were remarkably modest. Union branch members wanted wages to be paid at the same rates as at Wankie Colliery.³⁶⁸ As Broken Hill mine management privately acknowledged, it would be a small matter to meet this request, as the only rises in wages required to come into line with Wankie would be about 6d per eight hours for carpenters and a similar amount for engine drivers.³⁶⁹ That, however, was the limit of the Company's concessions. When salaried staff employees also requested increases, they were turned down.³⁷⁰ By then the price of lead was falling, from £54 to £28 per ton, and the Company dug in its heels.

The situation amongst Broken Hill's black workforce was different. After the First World War, the spread of anti-colonial ideas among Africans widened. In Southern Rhodesia, Nyasaland, and Northern Rhodesia, some Africans expressed their opposition to colonial rule through religious or millenarian movements. In Northern Rhodesia, religious separatism erupted into violence for the first time immediately after the end of First World War in

³⁶⁴ ZCCM, 19.5.1F, Correspondence between H.Moffat and R. Macartney, 1926.

³⁶⁵ NAZ, KDA/4/1/2, Annual Report, 1926.

³⁶⁶ NAZ, ZA/7/1/10/7, Administration of Native Labour, 1937. p. 22.

³⁶⁷ Ibid.

³⁶⁸ Ibid.

³⁶⁹ NAZ, ZA9/1/9/3, J. Moffat Thomson, Annual Report from Luangwa District. 1925-1926.

³⁷⁰ ZCCM, 19.5.1F, Correspondence between Bentley and Macartney on Salary Increment, 15 August, 1920.

1918.³⁷¹ Late in the previous year, the government of Southern Rhodesia had deported six adherents of the African Watch Tower or Kitawala (from the sound of the English name) movement to their homes in Northern Rhodesia.³⁷² On their return journey from Salisbury they passed through the Mkushi and Serenje districts, where they preached a millenarian message. In Broken Hill, Joseph Sibakwesa, a Namwanga from Chipata, told an audience that the Colonial Government of Northern Rhodesia was no good and that during the year 1926, a new one was coming from America, and would be made up of Black people only and that in 1927 all the trains were to be stopped and all the Europeans were to leave the country to the Africans who were then to be able to live their own life.³⁷³ This movement encouraged black workers at the Broken Hill mine to strike against meager wages, but in the event nothing happened.³⁷⁴ .

As was the case in most mines in Southern Africa, African labour at Broken Hill mine endured poor conditions of service, not least where safety and health were concerned. Figures prepared by R.H. Stevens, Broken Hill Mine General Manager, revealed that in 1929 2,134 black workers suffered from diseases such as silicosis, lead poisoning and malaria; another 26 died from accidents; and 351 deserted due to a combination of health, safety, and wage-related issues.³⁷⁵ Yet as black labour was a matter of very great importance to the mine's low production costs, the Company did make some effort to secure so-called 'voluntary' migrants. Workers' food rations included a variety of vegetables in addition to the usual mealie-meal and meat.³⁷⁶

Perhaps the most important reason why the Broken Hill mine was able to attract voluntary labour was the fact that the Company made available five acres plots to workers, where they were allowed to build huts and live with their families. Although, the plot system was first instituted at Bwana Mkubwa mine near Ndola and in Luanshya by the mining companies there, Broken Hill provides a unique case study because it is the only place where the system

³⁷¹R.I. Rotberg, *The Rise of Nationalism in Central Africa: The making of Malawi and Zambia 1873-1964* (Harvard University Press: Cambridge, 1966), p. 136

³⁷² NAZ ,IN2/1/10,Letter to the High Commissioner in South Africa from Livingstone Administrative Office, Northern Rhodesia, 6 February 1919.

³⁷³ Rotberg, *The Rise of Nationalism in Central Africa*, p. 141.

³⁷⁴ Hall, *Zambia*, pp.60-62.

³⁷⁵ *Ibid.*

³⁷⁶ *Ibid.*

was successfully adopted.³⁷⁷ When mining started at Broken Hill, African workers were seen as temporary migrants oscillating between the mine and their villages. In this way, the mine avoided the expense of permanent settlement as well as permanent workers. African labourers were usually contracted for a period of three months after which they returned home to the rural areas.³⁷⁸ This way the mine benefited in terms of wage payments as temporary workers were cheaper to maintain than permanent ones. The mine, preferred to employ single workers who shared living quarters. This cheap labour policy was beneficial especially in the early years of the mine which were characterised by frequent closures due to unforeseen technical and geological problems. But as the mine became more stable with improved recovery plants, and especially after the First World War when labour became scarce, there was a growing need for a stabilized labour force if the mine was to operate smoothly. From the early 1920s onwards, the mine began to employ more married men because they were deemed more likely to stay for longer periods than if they were unmarried. With a family to look after, work became important and among married men the "evil vice" of beer drinking, as termed by the Mine Manager, R. Macartney, became less prevalent.³⁷⁹ The plot system then, was meant to entice workers to stay longer and become more productive.

Accordingly, the small plots of land called the five acre plots were surveyed and mapped-out in Broken Hill by the Northern Rhodesia Government in 1926 and came into being in 1927.³⁸⁰ The main purpose of these plots was to provide land to the Africans who wanted to have a piece of land of their own where their women and children could grow food crops.³⁸¹ Initially, the plots were established purely as residential areas. The Mine management wanted the conditions on the plots to be similar to the conditions that were found in the villages from where migrants came. It was hoped that this would give workers a sense of belonging and hence they would stay longer on the mine. Contracted labour was expensive as each labourer bought from the Rhodesia Native labour Bureau cost about £10.³⁸² 'Voluntary' labour, by

³⁷⁷ F.E. Mulenga, 'The Plot System within the Colonial Political Economy: A Case of Broken Hill,' p. 1. For further elaboration, see J. L. Parpart, *Labor and Capital on the African Copperbelt* (Philadelphia: Temple University Press, 1983), p. 32.

³⁷⁸ Mulenga, 'The Plot System within the Colonial Political Economy': A Case of Broken Hill, p.1.

³⁷⁹ NAZ, KDA 4/1/1 District Commissioner's Report, 1927. P192

³⁸⁰ NAZ, ZA1/9/15/M Five Acre Plots, Broken Hill. From the Secretary for Native Affairs, to the Honourable, the Chief Secretary, and Livingstone: "Plots Leased to Natives in the Vicinity of Townships in the Luangwa Province, August, 1933.

³⁸¹ NAZ, ZA1/9/19/M Five Acre Plots, Broken Hill, 1928 August to 1934 October. From District Commissioner, Broken Hill, 16 January, 1931, to, Provincial Commissioner, Ndola, "Native Five Acre Plots at Broken Hill.

³⁸² Ibid.

contrast, cost nothing up front.³⁸³ But no commercial farming was allowed on the plots as the workers were only allowed to grow for subsistence purposes and a small surplus. Some miners' wives grew vegetables which then sold to white workers. In this manner, women took up the role of tending vegetables and contributing to home income.³⁸⁴ Some of these vegetables were sold to the mine. Even so, this income rarely exceeded the rental paid for the land. Africans plot-holders were required to pay £2.10s per year for a five acre plot.³⁸⁵ But as Mulenga puts it, both the Northern Rhodesian Government and the Africans knew that the money or rent could not be expected to be raised from the sale of crops.³⁸⁶ Crop yields at times were unreliable hence wage employment remained the main source of income, precisely as the mining company intended.³⁸⁷

Developments in Broken Hill Town

A proposal to purchase a total of 38 stands in the Broken Hill Township and build suitable residences for white mine employers was discussed early in 1919.³⁸⁸ It was proposed to erect houses at a cost of £420 each.³⁸⁹ However, provision would also be made for even better housing for staff officials, separate from artisans. The former would occupy houses of better construction and in a different suburb from the latter. As far as white artisans were concerned, many of them were still housed in pole and dagga huts, and it would be healthier altogether for them to be properly accommodated. At the same time, the Company would materially benefit, as a better stamp of workman would be attracted to the mine. Quite a number of the employees were married men with large families and their residence in the township, it was hoped, would bring them into closer touch with the government schools, church and shops, and generally enhance good sanitation.³⁹⁰ Since the township area was situated on a Kopje, it benefited from the wind and was cooler than the low-lying veld.

For all that its greatest imperative was the making of profit, the Company found it necessary to construct roads, bridges, and erect power lines and tramways. But by incurring expenditure now, it benefited later on as the properties were developed and the town

³⁸³Mulenga, *The Plot System within the Colonial Political Economy*, p.1.

³⁸⁴ For discussion of 'penny capitalism' in other mining communities, see V. Hall, *Women at Work, 1860-1939* (Woodbridge:Berghan,2003)

³⁸⁵Mulenga, *The plot System within Colonial Political Economy*,p.1

³⁸⁶ Ibid.

³⁸⁷ NAZ, KDA 4/1/1, District Commissioner's Report, Luangwa District,1927, op.cit. p. 24.

³⁸⁸ZCCM,19.5.1F Letter to the Rhodesian Lead and Zinc Syndicate Limited by Teagle, Mine Secretary, 23 January 1919.

³⁸⁹ZCCM, 19.5.1F Letter to the Rhodesian Lead and Zinc Syndicate Limited, 23 January 1919.

³⁹⁰ Ibid.

gradually populated.³⁹¹ In the immediate post-war period, the town site was laid out and great deal of construction went rapidly ahead. The development of the township held on joint account of the RBHD Co., and the British South Africa Company.³⁹² A large number of buildings were erected; schools established; and tennis courts and other playgrounds provided. A popular cinema, shareholders were informed, added to the gaiety of the place, it being company's desire to see the (white) population happy and contented.³⁹³ As the township consisted principally of the mine's own employees, the RBHD Co. benefited from the large expenditure which had been incurred in making the place fit to live in. The mine employed, directly and indirectly, 500 whites and 3,000 to 4,000 Africans.³⁹⁴

By 1927, the township had expanded rapidly, with a white population of 1,500.³⁹⁵ One year later, Broken Hill had approximately 2,000 white inhabitants. It was the largest town in Northern Rhodesia, beating Livingstone the capital by a substantial margin.³⁹⁶ Broken Hill attained to this position not only because of its great zinc, lead and vanadium deposits, but also by reason of the fact that it was the headquarters of the Anglo-American Corporation's organisation in Northern Rhodesia. Anglo American by this time had bought a controlling interest in the RBH Company. In addition to its big interests, Broken Hill was also the centre of a large number of small mines, that is, of properties which did not come under the sway of any of the large groups. In the first place, there was Mr. Marriott's Base Minerals of Northern Rhodesia property, where vanadium ores were successfully mined; the Star Zinc Mine near Ngwerere about 22 miles from Broken Hill; and Maughan's Copper mine situated about 10 miles from the main camp of Kasempa Concessions along the Luano Valley.³⁹⁷

Of all the resident companies in the Broken Hill town, the Anglo American Corporation was by far the most important. By the end of 1927 it had erected some notable buildings to be used as its principal offices in Northern Rhodesia. Its staff at Broken Hill included mining engineers, mechanical engineers, and geologists.³⁹⁸ In addition to the office buildings, suitable residences were erected for the various members of staff.

³⁹¹ *The African World*, 30 July, 1927.

³⁹² ZCCM, NCCM/BHD/HO155/1 Annual Report of Directors, 7 July, 1922.

³⁹³ *Ibid*

³⁹⁴ ZCCM, NCCM/BHD/HO155/2 General Manager's Report on Rhodesia Broken Hill Development Company Limited, 31 December, 1930.

³⁹⁵ *The African World*, 30 July, 1927.

³⁹⁶ *The Rhodesian Mining Journal*, 10 June, 1928.

³⁹⁷ *Ibid*.

³⁹⁸ *The Times*, , 29 July 1927.

Revaluation of Property and Postponement of Dividends

When accounts for 1926 indicated that the company had made a trading loss, the board of directors was quick to point out that the loss of £75,586 included depreciation on plant of £56,442, making the actual loss on the year's operations only £18,644.³⁹⁹ Management felt in an undertaking such as theirs, during the construction stage, this was purely a nominal amount and in no way represented the indirect benefit to the whole derived from continuous working.⁴⁰⁰ Yet, much as the Company might argue that working on an expanded scale would soon return the mine to a profit, the loss had negative implications for the company's reputation. It also affected its ability to pay dividends, a status that Broken Hill mine had enjoyed since 1919. In these circumstances, revaluation of the mine's assets seemed to offer the best market solution.

Accordingly, the company's assets were re-valued in 1927 with the help of Mr C.B. Kingston, a leading consulting engineer. The mine's property was re-valued at £1,000,000 and after deducting £192,148 (expenditure on electricity installation and zinc plant construction), there remained a surplus of £807,852 which was transferred to reserve account.⁴⁰¹ With this amount in reserve, management hoped any loss in the future should be amply covered, thereby guaranteeing profits for distribution. But not all shareholders were persuaded by this accounting sleight-of-hand. This was not the first time the mine had been revalued. One shareholder thought the revaluation was ill-timed and unrealistic. He insisted that he had never been in a company that re-valued its assets upwards, only in some that had written down their assets.⁴⁰² The Company, however, maintained that companies which revalued in this manner did so in the interests of the shareholders.

But the Company soon found that its room for financial manoeuvre was increasingly limited as lead and zinc prices, normally 'flat', entered a period of masked volatility. The cash 'created' by imaginative book entries soon drained away. Re-valuation was also necessary to clear the decks (to get rid of many items on the debit side of the balance) with a view of distributing profits. A total of £170,000 was paid for underwritten shares and commission charges on other options.⁴⁰³ In addition to such expenses, the cost incurred in the construction

³⁹⁹ *The Mining Magazine*, 31 December, 1927.

⁴⁰⁰ *Ibid.*

⁴⁰¹ *The Times*, 24 July, 1928.

⁴⁰² *The African World*, 28 July, 1928.

⁴⁰³ *Ibid.*

of the new plant and orders from British manufacturers amounted to £15,000 per month for almost two years.⁴⁰⁴ All this left the company drained in terms of capital. Once again, dividends were postponed.⁴⁰⁵ Between 1926 and 1929, Broken Hill's shareholders had hoped that dividends would become an annual feature receive following the increase in production of lead, zinc and vanadium. Yet all the Company did was to keep promising better dividends which never materialized.

In 1928, for instance, the board of directors blandly stated that profits for distribution would gradually increase once the mine had been enlarged to increase both production and sales. Shareholders were assured that the property still held outstanding prospects of developing a tonnage of ore both lead and zinc, far in excess of amounts so far disclosed.⁴⁰⁶ The ore, they were assured, could readily be treated by the electrolytic process. They were fortunate as this was first case on a large scale in metallurgy where a zinc silicate ore was treated by this process. All the indications for producing zinc on this scale would be realised as soon as full production was reached.⁴⁰⁷ When shareholders objected to what they saw as huge expenses and general charges, the Company was quick to point out that shareholders overlooked the fact the expenses and general charges not only applied to the mine operations but also to the whole administration of Broken Hill, which had between 250 and 300 white employees and between 2500 and 3000 black workers.⁴⁰⁸ Bearing this in mind, shareholders were again quick to focus on, 'the salient feature in the figures put before you is the enormous strength of your ore reserves, which, in my opinion, warrants the rushing on with the increase of the plant so that the shareholders shall at the earliest possible moment take advantage of that position.'⁴⁰⁹

Acceleration of Economic Uncertainty and its Impact on the Broken Hill Mine

Notwithstanding logistic, technical and mechanical advancement at the Rhodesia Broken Hill mine, economic uncertainty undermined investment opportunities. Certainly, the recession delayed the delivery of the plant from Britain thereby delaying construction work at Broken Hill. But the delay in sending of plant by British manufacturers was attributed to the effect of

⁴⁰⁴ *The Times*, 24 July, 1928.

⁴⁰⁵ *The African World*, 28 July, 1928.

⁴⁰⁶ *The Times*, 24 July, 1928.

⁴⁰⁷ *Ibid.*

⁴⁰⁸ ZCCM, NCCM/BHD/HO155/1, R.B.H.D Co. Annual Report of 1927.

⁴⁰⁹ *Ibid.*

the general strike.⁴¹⁰ Workers demanding better wages went on strike hence the zinc plant could not be manufactured as scheduled. The RBHD Co. regarded the excuse as lame and felt the British manufacturers could still have sent the plant without delaying for almost a year after it was ordered. The other concern for the company was payment of penalty fees on railage due to lack of production.⁴¹¹ However, the company was forced to replace some plant which had a faulty casting to sustain production.

The base metals' market had always been noted for the comparative gentleness of their price fluctuations. It was unusual to see the price of lead and zinc move violently up and down as it did during the recession, due to unstable economic environment. In 1926, for instance, before the acceleration of the economic depression, the price of zinc was at £30 per ton plus premium of £2, vanadium at £0.12, lead at £27.10 per ton, and bar silver at 2s.6d per ounce.⁴¹² However, zinc in 1927 costed about £5.9, of lead £7.10, of aluminium £7.12, of copper £14.6, and of tin £59.⁴¹³ The low cost of zinc and lead was particularly noticeable. The decline in prices of lead and zinc was held mainly accountable for the fall in Rhodesian share prices.⁴¹⁴

In light of the fall in prices of lead and zinc, it was not a surprise to the shareholders that the account records reviewed in August, 1929, showed a loss of £26,100, irrespective of £26,600 depreciation and £13,700 commission on shares.⁴¹⁵ The total deducted from the balance sheet left to reserve £61,800 as the outcome of the revaluations and writing off effected in 1928.⁴¹⁶ But the balance sheet reflected further (new) expenditure on plant and other items. Therefore, depreciation reserve figured at £336,800; while cash and metals on hand totalled £75,000, against creditors for £114,900.⁴¹⁷

⁴¹⁰ *Ibid*

⁴¹¹ *The African World*, 30 July 1927.

⁴¹² *The Mining Magazine*, 31 December, 1926.

⁴¹³ *The African World*, 30 July, 1927.

⁴¹⁴ *The Rhodesian Mining Journal*, 20 November, 1927.

⁴¹⁵ *The Economist*, 17 August, 1929.

⁴¹⁶ *Ibid*.

⁴¹⁷ *Ibid*.

CONCLUSION

The history of the Broken Hill mine between 1902 and 1929 was decisively influenced by problems of processing ores of great complexity, as well as by the impact of financial difficulties pre-dating the First World War and the Great Depression. This study has also highlighted important aspects to the history of Broken Hill mine since its discovery. Though discovered by Thomas Davey employed by the Rhodesia Copper Company, it was the Industrial Revolution of the 18th Century in Britain that saw the opening of European interest in Africa. A revolution of technology led to the development of steam engines, better roofing materials for building and later on the invention of motor cars. Most of these developments led to the demand of base metals like copper, lead, iron, vanadium and zinc. Local supplies could not meet this demand and other sources of such metals in Africa, and elsewhere became important.

The British South Africa Company, chartered by the British Government secured these raw materials in Central African territories through conquest and the signing of deceitful treaties. This led to the discovery of minerals including lead and zinc at Broken Hill in Northern Rhodesia. The mine operated for c.90 years in total. During its early operation, Broken Hill mine became the first viable economic venture in Northern Rhodesia. However, the history of this mine has received little attention from scholars writing the economic history of the territory.

The literature reviewed shows that very few studies were undertaken on Broken Hill mine. Scholars that have examined the history of Northern Rhodesia have looked at Broken Hill in light of the Copperbelt. A few authors including Bancroft, Gann, Turner, Pollock and Roberts tried to bring to light issues of origin, production and operation. Although their works give a glimpse of the history of Broken Hill mine, they lack depth and chronology. Certain aspects or themes of the mine such as the importance of the railway line for zinc and lead markets within Africa and Europe, treatment of complex ores, labour, capital and the effects of electricity need to be told. This is precisely what this study has tried to do.

Chapter two of this study suggested that the productivity and profitability of the Broken Hill mine were not realised in its early operations up until 1913 because of the unexpected high cost complexity of ore treatment, and the cost of transport. The latter in particular was vital for the importation of coal and export of lead-zinc ores. Far from the coastal ports, the mine

suffered from the absence of a railway line until the BSA Co. extended it up to Broken Hill in 1906. Yet even after the arrival of the railway line, Broken Hill mine languished because of high freight charges. Consequently, between 1902 and 1913, expensive high rail freights of about £5.10 per ton meant that machinery and other equipment often lay on Beira port premises for many months. On the other hand, Rhodesia Railways' expectations that there would be at least a train per day transporting ore for export did not materialise because of the mine's irregular production.

Irregular production before the outbreak of the First World War was hugely exacerbated by the problem of treating complex ores. Once the railway line was completed and coupled with the large quantities of ore reserves claimed for the mine. In practice, output was meagre because of the nature of its complex ores. From both metallurgical and geological points of view, Rhodesia Broken Hill was regarded as one of the most challenging and complex problems ever encountered anywhere in Africa.⁴¹⁸ Much of the capital invested in the mine was spent on experiments in a bid to find effective solutions to treating these complex ores. Even the then famous Bradley William process only yielded results of about 66% which were well below the internationally accepted standard of 97% purity.⁴¹⁹ There was still a need to perfect this process. Experiments were carried out both locally and internationally, but proved fruitless. Other factors, which were crucial for the operation of mine, such as a constant supply of local labour and a railway line, also proved to be challenging.

The expectations of the mine's management, its shareholders and the Rhodesia Railway Line management with regards to the productivity and profitability of the Broken Hill mine were not realised in the period 1902 to 1913. The invested capital was slowly swallowed by growing expenditure. According to shareholders, management was often refusing to acknowledge that complex ores were more responsible for poor yields, sales and profits than any other reason. Management persisted in its belief that expensive railway freights and low prices. To their credit, shareholders were quick to realise complex ores were more problematic than solving the freight charges. Indeed, the Company's efforts to find a lasting solution proved fruitless for several years before and after the First World War.

Nonetheless the war's impact on Broken Hill mine was mixed. Like in most mines in Africa, and as discussed in Chapter Three, the war did have a negative impact on Rhodesia Broken Hill mine. The war was responsible for delays in the delivery of materials for the construction

⁴¹⁸*The South African Mining Journal*, September 17, 1910.

⁴¹⁹ *The Times*, 30 August, 1909.

of a new treatment plant and furnaces. Transport and communication networks were paralysed, and of course the latter stages of the war saw the closure of the mine twice due to the influenza pandemic.

But at the same time, the war provided significant opportunities which paved the way for tremendous developments at Broken Hill mine. Notably, the war led to a high demand for lead and zinc; an increase in the price of base metals; and a further reduction in railway rates by the Rhodesia Railways Company and in London expenses, all of which boosted the supply of lead and zinc. Had it not been for the recurring problem of treating complex ores, the Rhodesia Broken Hill mine could have utilised such an opportunity in terms of increasing its production, sales and profits. In fact, during the war much work was devoted to lead-zinc experiments as the mine continued to search for better methods of treating the ores. Even so, the Broken Hill mine was able to supply lead to Britain's Ministry of Munitions, something that enhanced the former's reputation.

Because of the demand for the base metals, prospecting also improved at Rhodesia Broken Hill mine. For the first time the mine employed a consulting company from England to assess the property's holdings in terms of reserve ores and the quality of zinc and lead. The results reassured the holders of the company that the mine had the potential to be a profitable property. It was discovered that the initial estimates of the reserved ore was wrong and that mine had only 55,000 tons, of lead which were feasible to mine as compared to mining 140,000 tons of ore above average metal contents. The remainder of 85,000 tons could be further classified during mining. This discovery had quite changed the metallurgical problem. The proper way of dealing with these 55,000 tons of higher grade lead ore was to smelt it direct.⁴²⁰ Therefore, the Company concentrated on lead smelting as it was easier to smelt than zinc.

The demand for lead during the war caused the Broken Hill mine management to embark on a number of developmental projects to equip the mine with suitable machinery for greater production. However, their efforts were hindered by the war. As the war intensified, it resulted in shipments being delayed for many months at a time. Even so, the operation of the blast furnace improved with re-ordered parts. More than 300 tons were produced at £10 per

⁴²⁰ NAZ, NCCM/BHD/HO155/1 Broken Hill Annual Report on the work done by the Messrs Hooper, Speak and Company Consulting Engineers, 1915.

ton by the end of 1915.⁴²¹ To improve production, in 1916, the Rhodesia Lead and Zinc Syndicate acquired a lease for five years, producing over 2000 tons of lead.

As discussed in Chapter Four, the period after the war witnessed a tremendous increase in production, sales, profit margins and infrastructural development at Broken Hill. Between 1919 and 1929, the Broken Hill witnessed massive mining related developments, much more than before and during the First World War. The lead-zinc industry progressed significantly in terms of investment, infrastructural development, production, sales and profit margins. Behind such progress were a constellation of factors. In the first place, the increase in shares of 1,500,000 meant more capital investment for smooth operations and production at the mine. But more importantly, a reduction in royalty and railway rates coupled with cheap hydro-electric power, cheap African labour and the richness of the zinc ores reduced production costs which in turn increased profit. Equally important, a combination of hydro-electric power and new lead-zinc treatment plants contributed to high quantity and quality yields. As a result, these factors maximised profits, enabling the company to pay dividends at a high rate of 10% per share despite the onset of economic uncertainty.

On the negative side, such progress was undermined by financial deficits brought about by the construction of the hydro-electric power station and the new zinc plant. The losses accrued by the mine in the period under discussion were mainly due to expenditure on construction work and less to do with the effects of changed economic conditions. The drain on profits due to construction work was actually responsible for deferred dividends as well as revaluation of the property in bid for recovery in 1927. In a similar fashion, delays in construction work, inadequate sulphuric acid and pumping machines were responsible for the decline in production of zinc, vanadium and lead. Besides these problems, the mine could not meet the expected production per year due to the smallness of the treatment plants. Future policy, therefore, was guided by effort to expand the power supply and treatment plants so that production, sales, profits and dividends could in turn increase. Nonetheless, such expectations were not met as economic uncertainty and price fluctuations caused delays in construction work.

Throughout this period, cheap black labour also contributed to the low cost of production. Broken Hill mine was known for low cost of its labour and electric power compared to many mines in the world. Black workers at Rhodesia Broken Hill mine were paid less than half

⁴²¹ ZCCM Archives, 19/4/3A / B.H.D.Co, Mining at Broken Hill: Metallurgical Operations. 1919.

their counterparts' wages on the Rand and even at Wankie Colliery in the years after the First World War. But it has to be conceded that the living conditions of black workers at Broken Hill mine were much better than for those working on the Rand and Wankie Colliery. The colour bar was less rigid at Broken Hill compared to the Rand and Wankie. Most important of all, African workers at Broken Hill were given five acres plots where they were allowed to build huts and stay with their wives and families; a scenario not allowed even on the Copperbelt mines at that time. However, though the five acre plots proved to be successful way of lowering costs and establishing labour, the company made sure the black workers could not profit from growing crops. The authorities did not want Africans to become permanent urban dwellers at this time. Finally, black labour at Broken Hill mine was particularly cheap as it was largely voluntarily procured. It was not 'Chibaro' labour recruited through the Native Labour Bureau, which, quite apart from other considerations, was expensive since the mines had to purchase each labourer at about £10.⁴²²

Above all, the cost of production of lead and zinc per ton was low, costing only £11 and £18 per ton during and after the war respectively. This was very low compared to the price of spelter at above £27 per ton. In this situation, the Broken Hill mine was able for a brief period to make huge profits. But in 1926 the mine again operated at a loss, and the subsequent deferred dividends of 1927 and 1928 were less a result of fluctuations in the price of base metals at this time, than the result of expansive construction work and renewed problems concerning the recovery of complex ores.

This dissertation had done more than only filling a gap, however large and important, in the mining history of Northern Rhodesia. It also engages with national, regional and international historiographies. As discussed in the literature review in Chapter One, Broken Hill's history was placed in the wider context of the Mineral Revolution that transformed Southern and Central Africa between 1870s and 1930s. The mine's history provides further evidence in support of studies by van Onselen identifying a regional economic system in which black workers exhibited worker consciousness. The so-called 'wastage' noted in Chapter Four is a case in point. Yet in discussing railway rates and the Broken Hill Company's financial manoeuvres, this dissertation also provides glimpses of the world of company manipulation associated with Edmund Davis and identified by Phimister. This adds an interesting

⁴²² NAZ, A5/3/4/1 Native Commissioner, p. 3.

qualification to Ackson Kanduza's illuminating study of the political economy of the underdevelopment in Northern Rhodesia between 1918 and 1960. In the period before the late 1920s, more attention needs to be given to Broken Hill mining than in the past. It also suggests that the ways in which railway rates were set should look at the profitability of zinc and lead production as well as copper. It is hoped that this dissertation has made a contribution to asking and answering these questions.

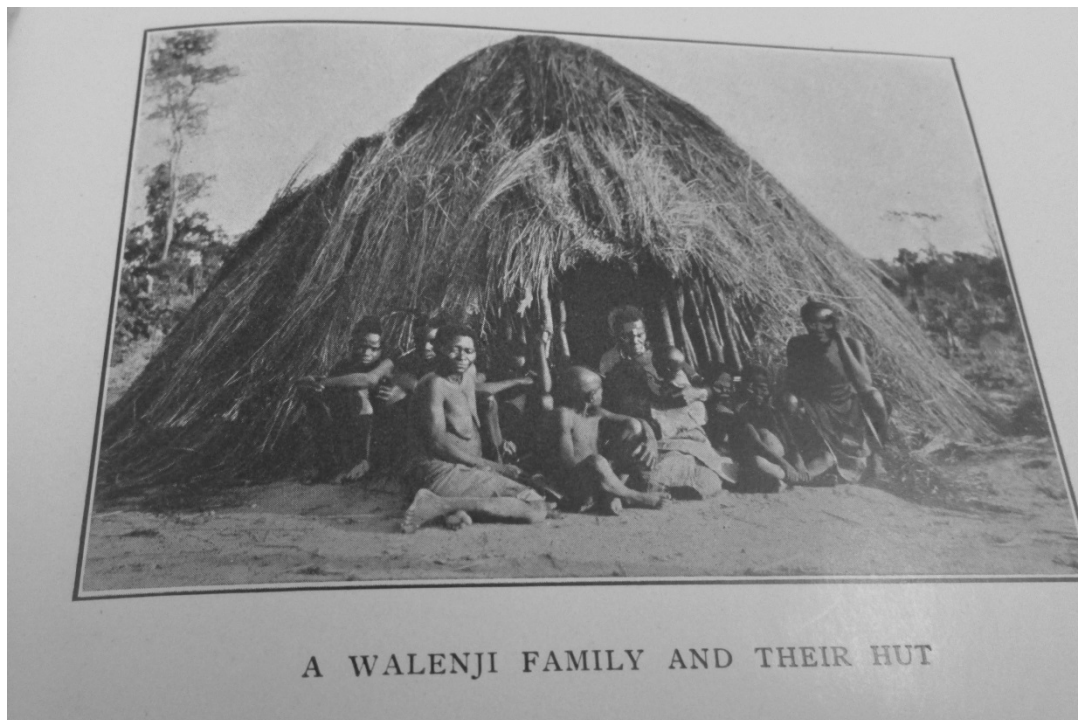


Figure 3: Location mine plots

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APPENDICES

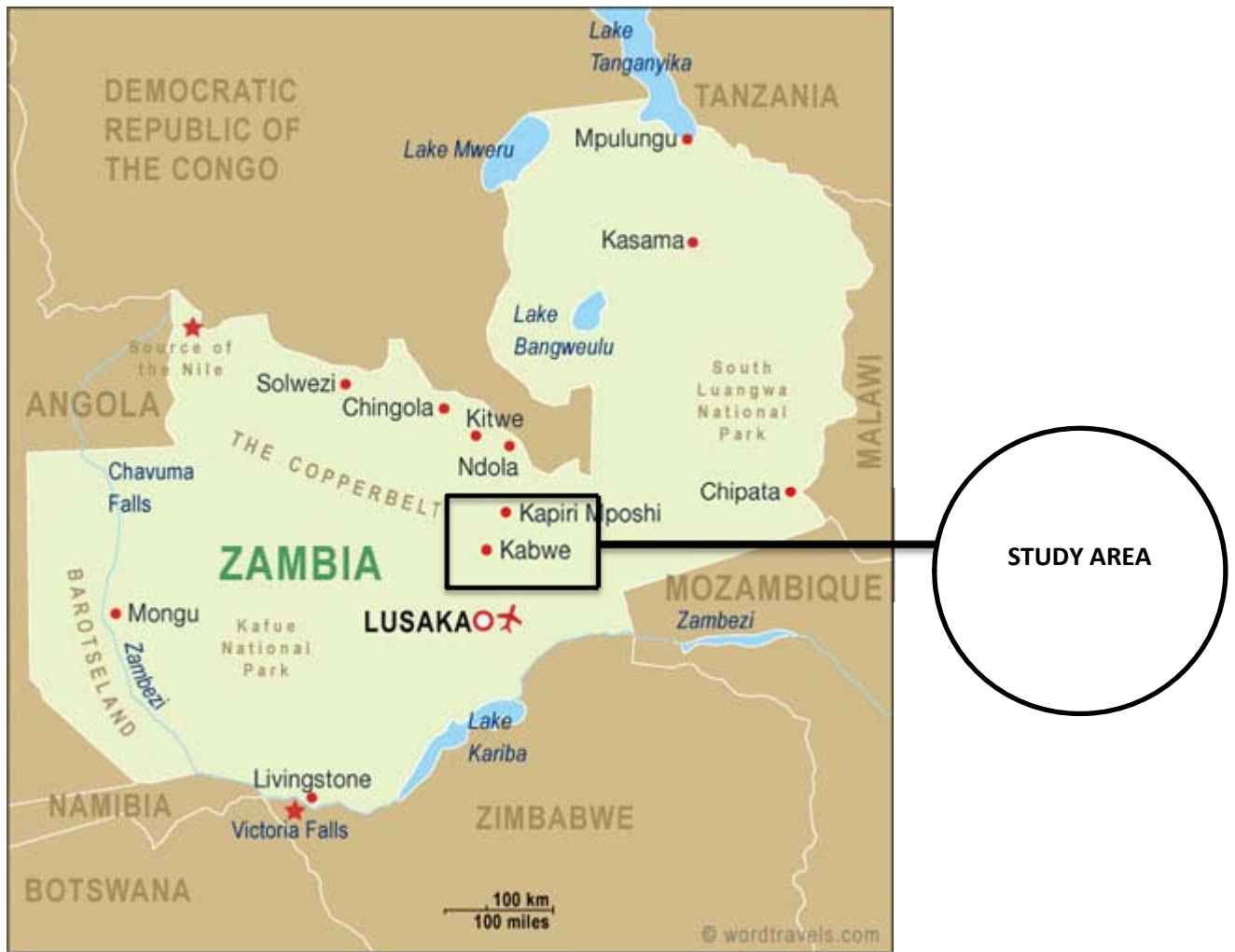
Appendix I: Broken Hill Lead, Zinc and Vanadium Production 1915-1929

Year	Sales (£)			Profit (£)	Loss (£)
	Lead	Zinc	Vanadium		
1919	366,851.011	-	-	100,889.48	-
1920*	-	-	-	-	-
1921	359,156.91	-	7,995.172	104,088.158	-
1922	486,730	-	15,543.188	99,849.112	-
1923	301,293.111	-	8,075.73	139,731.121	-
1924	209,577.53	3,842.120	40,723.69	63,325.72	-
1925	120,738.117	6,697.162	51,978.104	-	104,076.81
1926	77,133.182	1,195.174	6,287.191	-	75,086.01
1927	151,890.46	249.109	6,135.161	201,588.144	-
1928	93,690.59	233,725.96	33,437.97	-	26,078.311
1929*	-	-	-	6,530.144	-

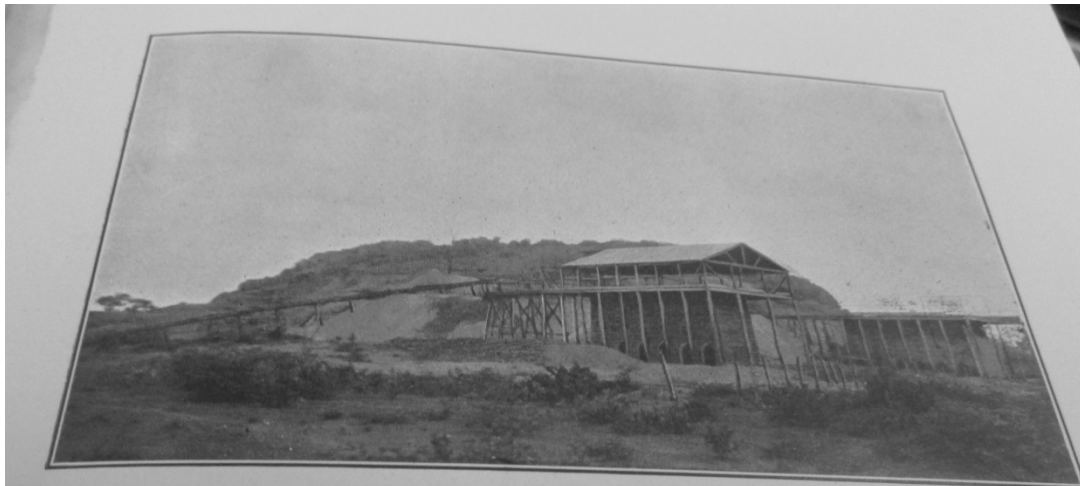
ZCCM Archives: Annual Reports for RBHD Co., 1919-1936

* NB: There are no available figures for 1920. For year 1929 a combined sale of lead, zinc and vanadium amounted to £371,617.199

APPENDIX 2



APPENDIX 3



CALCINERS AT BROKEN HILL, WITH NO. 2 KOPJE
IN THE BACKGROUND

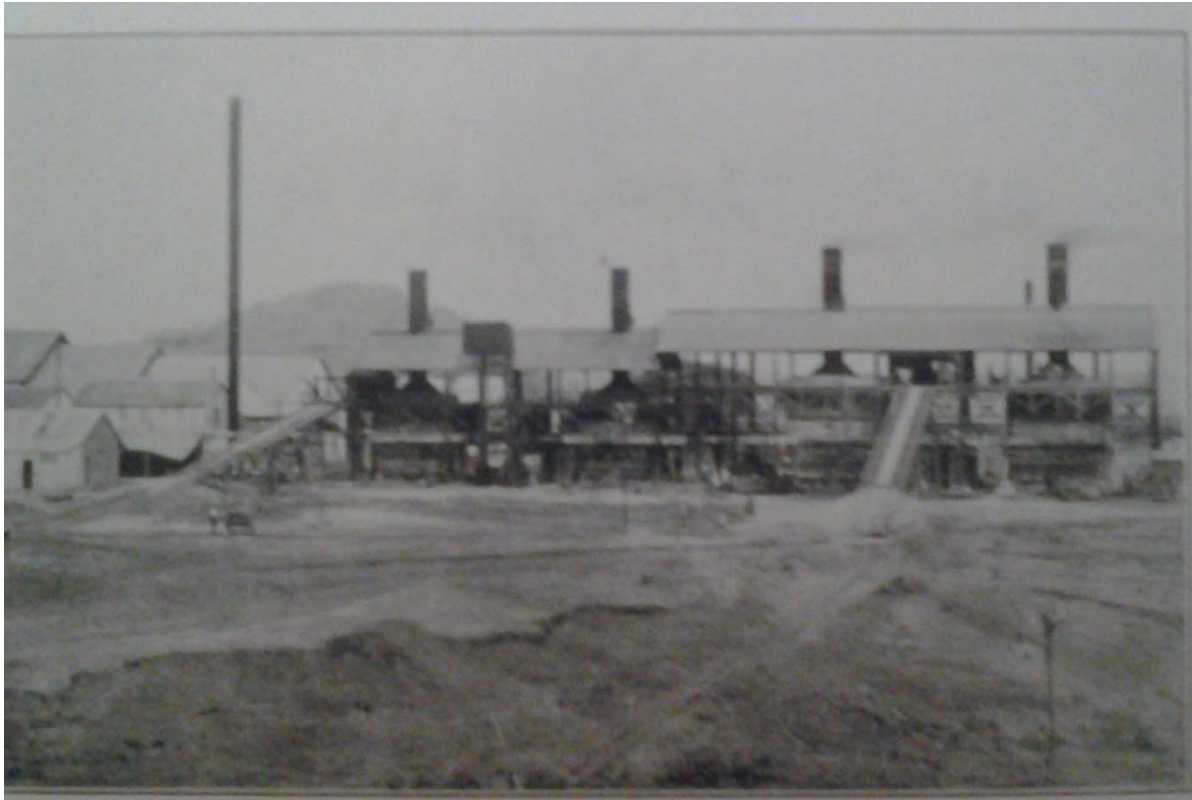
APPENDIX 4



GENERAL VIEW OF COMPANY WORKS AT BROKEN HILL MINE, NORTHERN RHODESIA, LOOKING WEST FROM NO.2 KOPJE OIL BODY, AUGUST 1926.

(SOURCE: Special Report: Rhodesia Broken Hill Company Development Co Ltd, Submitted to Shareholders, February, 1927.)

APPENDIX 5



THE LEAD BLUST FURNACES: Pilot Zinc Plant to left and No. 2 Kopje in background

(SOURCE: Special Report: Rhodesia Broken Hill Company Development Co Ltd, Submitted to Shareholders, February, 1927.)

APPENDIX 6



OPENING THE MULUNGUSHI HYDRO-ELECTRIC POWER SCHEME- BROKEN HILL 1925