

PART TWO - BROKEN HILL PROPRIETARY COMPANY LIMITED

Introduction

This part of the thesis concentrates on the core processes of the Company, that of turning the silver and lead ore into a product which could then be sold in the appropriate market. The aim of this part of the thesis is to demonstrate the role of structure and agency in the managerial decision making processes that were necessary to turn the ore into a marketable product. The specific aspects of the operations of the Company that will be examined are, first, in chapter three, the mining of the ore; second, in chapter four, the smelting of the ore. Chapter five examines, briefly, the decision made by the directors of the Company to venture into the iron and steel industry, a move which was seen to secure the long term viability of the Company. Chapter six examines what steps the Company took to secure an adequate supply of water for the operations of the Company as such a supply was essential for the mining and smelting of the silver and lead ore. Transport was also an essential component of the overall process of turning silver and lead ore into dividends for shareholders as human and physical resources had to be transported to the mine, and the finished product transported from the mine to reach the appropriate market. Communication systems were also an integral component of the process, as the mining and smelting operations were located at Broken Hill, while the administrative headquarters of the Company were located in Melbourne. Both these topics are discussed in chapter seven. Finally, the finished product (either in the form of bullion or pure silver, lead, zinc and so on) had then to be marketed. How this marketing was done forms the basis for chapter eight.

Each chapter demonstrates explicitly how structure and agency impacted upon managerial decision making processes. The structures which are of prime concern in this part of the thesis are both of a physical and social nature. Physical in the sense that the product was a physical product, which was the result of processes which converted the physical structure of the silver and lead ore into a different physical form. Physical also in that the location of mining and smelting operations imposed certain climatic conditions upon the production processes, and associated processes of water, transport and communications. Social structures in the sense that individuals were involved in every stage of the process and choices made were influenced by the physical factors outlined above. Other structures were also important. For example, the role of history and the historical development of both physical and social structures had a part to play. Specifically, mining and smelting techniques used at Broken Hill were the result of historical developments. The markets in which the products of the mine were sold were of a social nature which had also developed over time and as the result of certain historical forces. None of these structural elements acted to determine the choices of directors and senior managers. Certainly, structural elements either enabled or constrained choices, but such choices were not determined as there were always alternative choices open to directors and senior managers. It was the choices which were made by the directors and senior managers, within certain structural constraints, which directly affected the Company.

However, prior to discussing these core processes and associated activities, chapter two provides some necessary background in order to place the chapters that follow into an appropriate context. This background discussion is preceded by a chronology of the main events discussed in the body of the thesis.

CHRONOLOGY OF EVENTS

1883

Mineral leases pegged at the site that would become known as the Broken Hill lode.
Syndicate of Seven formed to exploit the find.

1884

Syndicate of Seven became the Broken Hill Mining Company.

1885

First company secretary appointed.

Telegraphic link established to Barrier Silver fields at Silverton.

The Broken Hill Proprietary Company Limited publicly floated after purchasing the assets of the Broken Hill Mining Company. Head office located in Melbourne.

1886

Smelting operations commenced at Broken Hill mine.

First chairman of the Company resigned over perceived conflict of interest.

Post office and telegraph station established at Broken Hill.

1887

First American metallurgist appointed (April).

First American general manager appointed (November).

1887-88

Four of the original seven mineral leases used as the basis for floating four separate companies.

1888

Broken Hill linked to the South Australian railways system.

1889

First significant industrial action.

The Company starts to refine its own silver.

1890

Capital of the Company increased from the amount on formation of £320,000 to £384,000. Formal agreement between the Company and Amalgamated Miners Association.

Bimetallic standard continued in the United States.

Barrier Ranges Mining Companies Association formed.

1891

Open cut mining commenced at Broken Hill.

1892

Barrier Ranges Mining Companies Association cancels 1890 agreement with Amalgamated Miners Association.

First significant industrial dispute at the Broken Hill.

The Company purchases a smelting plant at Port Pirie.

1893

Bimetallic standard ended in the United States.

Indian currency linked to sterling.

1896

All smelting operations transferred from Broken Hill to Port Pirie.

Sulphide ore problem solved.

Port Waratah (Newcastle) land purchase completed.

1899

Iron ore leases secured in South Australia.

1901

Company formed lead cartel for Australian and New Zealand markets.

1903

Flotation process for separating silver from zinc discovered.

1908

Second significant industrial dispute at Broken Hill

1909

The Company joined international lead cartel.

Mining suspended due to industrial action.

1910

Zinc spelter plant commenced operation.

1912

Capital of the Company increased from £384,000 to £600,000 to finance the expansion into iron and steel manufacture.

1914

Outbreak of World War I.

Permanent water supply connected to Broken Hill.

1915

Port Pirie smelting works sold to Broken Hill Associated Smelters Pty. Ltd.

Note: This chronology is not meant to be exhaustive. Rather it only highlights those events discussed in the body of the thesis (with the exception of the sale of the smelting works at Port Pirie in 1915).

Chapter two - Historical background of the company

Introduction

In relation to the individuals in charge of the Company, Blainey¹ has commented:

It hardly seemed the ideal recipe for the board of Australia's most important public company to take men of sparse formal education, men who knew far more about sheep and land than metals, and to give them virtually a lifelong seat [on the board of directors]; and yet the recipe worked.

But Blainey does not provide any explanation as to why the "recipe" worked. It was almost as if the directors could not help but be successful due to the size and extent of the silver-lead-zinc lode that they controlled. That is, success was assured and the actions of these individuals were determined. Structural elements were responsible for the success of the Company and individuals had, at best, only a limited role to play.² This inference is given further support when he also seems to assume that, during the life of the Company, the directors learnt nothing from their experiences. Blainey makes no mention of one of the first directors being a former mine manager with a great deal of experience on the Silverton silver fields. He seems also to imply

¹ Blainey, G., (1968), The rise of Broken Hill, Melbourne, p. 42.

² Blainey does concede to the first general manager, W. H. Patton, a 'starring' role in the development of the Company. Certainly, as will be demonstrated in a later chapter Patton was important. But by no means was he more central than, for example, the first metallurgist H. Schlapp. Both had a central role to play in transforming the silver and lead ore into a marketable product.

that the directors remained on the board of the Company for life. If this is what is implied, then he is wrong. Certainly, individuals who were associated with the early founding of the Company did serve as directors, but not continuously and, second, there was a relatively constant stream of new directors taking their seats on the board. Blainey does acknowledge the role of certain general managers of the Company, but again provides only limited explanations as to the contribution of the general managers or metallurgists to the operations of the Company. Yet, as Chandler³ has pointed out in relation to the American firms of Sears Roebuck, Jersey Oil, General Motors and Du Pont, there was an "...engineering approach to management and business problems." All the general managers of the Company (with the exception of the first general manager) were mining engineers (although their formal qualifications were somewhat varied), and, if Chandler is correct, even allowing for different social and economic contexts, then these mining engineers would also have had a significant effect on the operations of the Company.

But the individuals who are a part of these processes (and other individuals not directly connected with the enterprise) are also subject to the context within which they lived and worked. The directors of the Company were just as much influenced by the social, economic, political and legal structures as were the miners and other employees of the Company. Worth noting also is that many of the individuals were part of a broader institutional context, which included the Company, other organisations, and the State. It was not, however, institutions that made decisions, rather it was human agents; institutional contexts were simply another set of structural

³ Chandler, A.D., (1962), Strategy and structure: chapters in the history of the American industrial enterprise, Cambridge, Mass., pp. 317-319.

arrangements which enabled or constrained individual action. In the sections that follow the impression could be given that this is not the case. For the sake of convenience, instead of using individual names, titles have been used. This is not a case of reification, merely one of convenience.

Company Formation⁴

Broken Hill Proprietary Company Limited was granted Certificate of Incorporation in Victoria on the 13 August, 1885.⁵ The antecedents of the Company can be traced to the pegging, in 1883, of a series of mineral leases in the area now known as Broken Hill, but at that time the area was sparsely settled and used predominantly for pastoral activities. Silver was originally discovered in 1879 at Thackeringa, approximately twenty miles south west of Broken Hill. In 1883 richer silver finds were made in an area that centred on the township of Silvertown, which was approximately twelve miles north west of Broken Hill.⁶ In early 1884, it was reported that there were seventeen mines at Broken Hill, plus "...scores of others too numerous to mention."⁷

The Broken Hill leases, 40 acre lots (with one exception), were pegged over a period of several weeks with the first lease being pegged on 1 September, 1883 and the final

⁴ This section is predominantly descriptive, as it is the intention to provide some general information on the formation and development of the Company.

⁵ Copy of Certificate of Incorporation, dated 14/10/1912, BHPA/M8/78.

⁶ Cleland, E.D., (1888-1889), *Life on the Barrier*, The Centennial Magazine, p. 207; Clark, D., (1904), Australian mining and metallurgy, Melbourne, p. 337; Stokes, E., (1983), United we stand: impressions of Broken Hill 1908-1911, Canterbury, p. 8.

⁷ Supplement to the Mining Journal, 3/5/1884, p. 525. However, the accuracy of such statement may be questionable, as in the same article it is noted that the Barrier Reefs [Silvertown] is "...just over the border of New South Wales, in South Australia."

lease on 21 September, 1883.⁸ A total of seven leases were pegged, giving the lessees a total of 297 and 3/4 acres, which represented all the local landmark, a broken back hill, known throughout the district as the broken hill. The chairman of the Syndicate formed to exploit the leases was the Station Manager of Mount Gipps pastoral station, G. McCulloch, who took all the necessary steps to ensure that no mistakes were made in pegging out and applying for the leases and that all the provisions of the Mining Act were also carried out.⁹

In order to work the claims, a syndicate of seven was formed at a meeting at the Mount Gipps pastoral station on the night of 5 September, 1883. The Syndicate consisted of mainly pastoral workers who were connected with the Mount Gipps Station in one way or another. The members of the Syndicate agreed to contribute £70 (£10 each) so that the leases could be explored.

In May, 1884, with no significant finds of silver the Syndicate of Seven's shares were sub-divided into two and the Broken Hill Mining Company was formed (but not registered), with the fourteen shareholders each agreeing to contribute 10/- per week for the venture. (Even though Broken Hill Mining Company was not a registered company, it did not prevent the owners of the one fourteenth shares selling portions of their one fourteenth.) In March, 1885, at a meeting of shareholders, it was decided to split the claims into two companies. Broken Hill South Mining Company was to be formed with blocks 10, 11, 12, and 13 while the remaining blocks 14, 15, and 16 would be held as a private company. This decision was rescinded at a meeting on

⁸ Applications for leases, BHPA/M8/6.

25 April, 1885.¹⁰ Instead, as exploration was still unsuccessful, shareholders were asked to contribute £100 for every 14th share, initially paying £20. This finance was required to provide further working capital for the mine and to satisfy the various labour conditions which applied to mineral leases¹¹. This capital was still insufficient to develop the mine and a three quarter interest in the three northern claims (blocks 14, 15, and 16) was offered to the Barrier Mines Association, located at Silverton.¹² The sale offer was rejected by the Barrier Mines Association.¹³ The Broken Hill Mining Company was then wound up at a general meeting held on 3 June, 1885 when it was decided publicly to float the Broken Hill Proprietary Company Limited. At the same meeting it was decided that 16 000, £20 shares would be issued, with the fourteen members of the Broken Hill Mining Company receiving 1000 shares each, while the remainder were to be sold in Silverton (500 shares), Adelaide (500 shares), Sydney, (500 shares), Melbourne, (500 shares). The decision was also taken that the head office of the Company would be in Melbourne.¹⁴ Apparently it was not easy to sell the shares as a C. J. Buckland of Sydney wrote to Jamieson, (the general manager), on 6 July, 1885 in the following terms:

⁹ Jamieson to Dickenson, 15/3/1898, BHPA/A18/6, p. 2 and p. 5.

¹⁰ Minutes of the Broken Hill Mining Company, 18/3/1885, p. 9, 25/4/1885, p.11, BHPA/M59/1. The reason for rescinding the decision is not given. However, it would seem, from subsequent events, that the shareholders wanted to retain private control of the leases. Writing in 1898, Jamieson claimed that if the rich chlorides of silver had been found prior to the Company being floated, then the leases would have been held under private ownership. Jamieson to Dickenson, 15/3/1898, BHPA/A18/6, p. 4.

¹¹ In an endeavour to prevent land from being indefinitely held by leasees without making any attempt to develop a property, the New South Wales government made it a condition of leases that a specific amount of finance had to be expended on capital improvements on the land and a certain number of men engaged continuously if a lease was to remain valid. In later industrial disputes, the unions attempted to use this condition as a weapon against the Company. This tactic invariably failed as the colonial government approved the suspension of the labour conditions almost automatically whenever there were industrial disputes at the Broken Hill mine.

¹² Minutes of the Broken Hill Mining Company, 20/5/1885, BHPA/M59/1, p. 19.

¹³ General meeting of Broken Hill Mining Company, 3/6/1885, BHPA/A18/1.

Am sorry that Melbourne is doing badly, and trust that Adelaide and Silverton are over applied for.¹⁵

By the time that the Company was incorporated the distribution of shares was Silverton (663), Adelaide (425), Melbourne (332) and Sydney (580)¹⁶.

The assets of the Company was based on the seven mineral leases (blocks 10 to 16 inclusive) that had been originally pegged in 1883, but, at the time, "...local opinion was sceptical of its prospects"¹⁷. This may well have been the case, but the local newspaper based at Silverton told a somewhat different story. Beginning in October, 1884 up until the time the Company was incorporated, the editor had no doubt about the richness of the mine, but also recognised the potential difficulties of developing the mine.

In one of the first mentions of the mine, the editor pointed out that:

Water and fuel will be the most difficult matter to deal with; the supply of ore is practically unlimited, particularly at the Round Hill and Broken Hill...¹⁸

¹⁴ General meeting of Broken Hill Mining Company, 3/6/1885, BHPA/M59/1, pp. 25, 27, 29.

¹⁵ Buckland to Jamieson, 6/7/1885, BHPA/A18/6. Jamieson was, at this time, general manager of the Broken Hill Mining Company.

¹⁶ Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 22/8/1885, BHPA/S1/1, pp. 8-9.

¹⁷ Hore-Lacey, I. (ed) (1981), Broken Hill to Mount Isa: the mining odyssey of W.H. Corbould, Melbourne, p. 19.

¹⁸ Silver Age, 11/10/1884.

The editor may have been influenced by a report, compiled by Mr. Norman Taylor, late Field Geologist, Geological Survey of Victoria, on 13 September, 1884 and supplied to the shareholders of the Broken Hill Mining Company. Taylor reported:

This ridge [the Broken Hill] contains the most extraordinary and largest lode I have ever seen on the Barrier Ranges Silver field, or in fact anywhere...The ore in depth will almost certainly consist of mixed sulphides of zinc, copper, iron, lead etc - rich in silver and I have no hesitation in saying that in my opinion you have one of the most important properties on the field.¹⁹

Excerpts from this report were also published in the Silver Age.²⁰ Not too much credence can be placed on these reports as newspapers circulating in mining districts at that time all carried optimistic reports about mining properties that were being offered to the public.²¹

In early 1885, the editor was consistently publishing information relating to the mine at Broken Hill. For example, on 7 February, 1885 it was reported that ore from the shaft had given "...comparatively high assays..." which resulted in numerous enquiries for Broken Hill shares. On 28 February it was reported that prospects for the Broken Hill mine had improved to such an extent that a meeting of shareholders would be called to put on a comparatively large number of miners; on 28 March, 1885 it was reported "[g]reat attention is at present directed to the Broken Hill country [recent

¹⁹ Report to Shareholders, Broken Hill Mining Company, 13/9/1884, BHPA/A18/6, pp. 1-2.

²⁰ Silver Age, 18/10/1884.

discoveries at the Broken Hill Mining Company mine] produced the conviction that this line will become the most valuable of any on the Barrier silver field." In May, 1885 this tone was continued when the editor claimed "...it may be regarded as the most valuable mining property that has ever been opened in Australia, if not indeed the world." Two weeks later it was reported that "the daily improving prospects of the Broken Hill continue to be the leading topic in mining circles." In May it was announced that "during the week what is undoubtedly the most valuable discovery yet reported on the Barrier was made known by Mr. Thos. Low." By July, 1885, when the mine was being floated it was reported that

The prospect of the Broken Hill Company's property is improving daily, and it is becoming apparent that the true value of this mine is probably even beyond the widest conjecture of the most sanguine of its owners.²²

Given the inherent uncertainty surrounding the quality and quantity of mineral finds generally (for example, the silver and lead ore could suddenly 'pinch out', the quality and the quantity of the ore could suddenly change)²³ the editor possibly had an interest in ensuring that share prices remained, at the least, stable.

²¹ See, for example, the *Silver Age*, 21/4/1888.

²² The tone of the reporting about the leases of the Company may well have contributed to the largest number of shares being taken up by investors at Silverton where the newspaper was published. Silverton was also the site of significant silver mining operations. Local knowledge of the Broken Hill development may have also been a factor.

²³ Solomon, R.J., (1988), *The richest lode: Broken Hill 1883-1988*, Sydney raises the issue of the uncertainty of the extent etc. of the mineral deposit as a reason why Broken Hill did not secure a permanent supply of water until 1914.

But while the editor was optimistic about the future of the mine, once it was taken over by the Company, he did not hesitate to be critical. In September, 1885 he complained about the slowness in developing the mine; the slowness in the issuing of share script and the fact that a "...fatal mistake was made at its inception in placing the head office anywhere else than at Silverton." A lack of management was also noted.²⁴

In November, 1886 the possible sale of the northern claims held by the Company was raised by Horn and Reid, Stockbrokers of Adelaide. They proposed that the northern blocks be offered to English capitalists. The board agreed to call an extraordinary meeting of shareholders to consider this issue. This meeting was held on 7 December where the directors recommended that no action be taken to dispose of any blocks until further exploration had been carried out. This recommendation was carried unanimously.²⁵ In January, 1887, an offer was received from T.J. Thompson and Sons, Stock and Share Brokers of Sydney, to buy the mine on behalf of London investors.²⁶

Whether or not the above events had any influence on the board of directors, starting in early 1887 the original seven leases were consequently reduced to four. Kennedy has argued that the actions of the directors and shareholders were significantly influenced by the developments which had been taking place on the adjoining silver fields at Silverton, established prior to the discovery of the Broken Hill lode. In this case, the Barrier Ranges Silver Mining Association floated off the various claims for

²⁴ *Silver Age*, 7/2/1885; 28/2/1885; 28/3/1885; 2/5/1885; 2/5/1885; 16/5/1885; 4/7/1885; 19/9/1885

²⁵ Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 1/11/1886, p. 229; 7/12/1886, pp. 262-263, BHPA/S1/1.

²⁶ T.J. Thompson and Sons, to secretary, 11/1/1887, BHPA/A18/1. It appears nothing was done about this offer.

which they held leases into separate companies. One of the key personnel in the Association was W. R. Wilson, who lived at Silverton. Wilson was a director of the Association, and later a director of the Company, from 1886-1892 and thus in a position to influence the other directors who had little, if any, experience in silver mining.²⁷

Shareholders authorised the selling of block 14 at an extraordinary general meeting of shareholders on 16 February, 1887²⁸ to the Broken Hill Proprietary "Block 14" Company (hereafter Block 14); shareholders gave approval for blocks 15 and 16 to be disposed at an extraordinary general meeting on 28 July, 1887,²⁹ to the British Broken Hill Proprietary Company Limited (hereafter the British); while block 10 was disposed of in March, 1888 to Broken Hill Proprietary Block 10 Company (hereafter Block 10)³⁰ although there was some sharing of office space and key personnel between the original Company and the newly created companies. The rationale for disposing of the different blocks is unclear, but a plan of the leases in 1886 indicates that all the work was being carried out on the blocks that were retained, while those that were sold were virtually undeveloped.³¹ The reasons for this are unclear.³² It may simply have been that the Company could not afford to meet the labour conditions which applied to the leases or that the development of the entire property was too great for directors and shareholders to contemplate. Or it may have been the desire for shareholders to obtain an immediate cash benefit from the discoveries.

²⁷ Kennedy, B., (1980), Regionalism and nationalism: Broken Hill in the 1880's, Australian Economic History Review, XX/1, p. 69.

²⁸ Reports and Statements of Account, half year ending 31 May, 1887, BHPA/PE30/1, p. 7.

²⁹ Reports and Statements of Account, half year ending 30 November, 1887, BHPA/PE30/1, p. 7.

³⁰ Reports and Statements of Account, half year ending 31 May, 1888, BHPA/PE30/1, p. 8.

³¹ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p. 29.

While the Company restructured the value of the shares during the period of the study (from the original £20 to £2 to 8/-), the capital base was twice expanded. First, in 1890 when the capital base was increased from £320,000 to £384,000 to undertake an issue of shares in London.³³ The second time was during preparations for the expansion into iron and steel manufacturing in 1912 when the capital was increased to £600,000.³⁴ However, it must be remembered that although the capital was changed only twice, the selling of four of the seven leases effectively revalued the Company.

A further point of interest relating to the formation of the Company was the decision to locate the head office in Melbourne. The exact reasons for this are not clear, although several reasons could be suggested. First, Melbourne was the undoubted financial centre of Australia and many writers also considered it to have been the social and cultural centre of Australia.³⁵ Second, key shareholders had connections (either social or kinship) in Melbourne.³⁶ Third, it was not seen as a problem to have a head office located so far from the site of actual operations. A pattern of such ownership and control had been established early in relation to the pastoral, mining, sugar, finance and shipping industries.³⁷ The editor of the Silver Age writing in

³² Extant records do not provide any detail for why these actions were taken.

³³ Reports and Statements of Account, half year ending 31 May, 1896, BHPA/PE30/6, p. 32.

³⁴ Reports and Statements of Account, half year ending 30 November, 1915, BHPA/PE30/11, p. 21.

³⁵ Boehm, E.A., (1971), Prosperity and depression in Australia, 1887 - 1897, Oxford; Coghlan, T.A., Labour and industry in Australia, Melbourne, 1918; Davidson, G., (1978), The rise and fall of marvellous Melbourne, Melbourne.

³⁶ Blainey, G., (1963), The rush that never ended: A history of Australian mining, Melbourne, p. 53.

³⁷ Birch, A., and Blaxland, J.F., (1956), The historical background, in Lowndes, A.G. (Ed), South Pacific Enterprise, Sydney; Bolton, G.C. (1967), The rise of Burns, Philp, 1873-1893, in Birch, A., and Macmillan, D.S. (Eds), Wealth and progress: studies in Australian business history, Sydney pp. 111-127; Denholm, Z., (1967), James Tyson, Employer, in Birch A., and Macmillan, D.S. (Eds), Wealth and progress: studies in Australian business history, Sydney, pp. 128-148; Hirst, J.B., (1973), Adelaide and the country 1870-1917: Their social and political relationship, Melbourne; Linton, J.E., (1967), For some background to the history of a pastoral company, in Birch, A., and Macmillan, D.S. (Eds), Wealth and progress: studies in Australian business history, Sydney, pp. 149-159.

April, 1886 also suggested reasons that were similar to the first two but then went on to claim that now the new Company had been successfully floated and was operating satisfactorily, the reasons for locating the head office in Melbourne were no longer valid.³⁸ A further reason was undoubtedly connected with the physical differences between living in Melbourne, a cosmopolitan city, and Broken Hill, a primitive mining town.

Another point worth making at this early stage in the thesis is, as indicated above, that the Company was not the only one operating at Broken Hill. There were a number of other companies, but, as will be demonstrated, the Company held, either by chance or design, the richest leases which placed it in the position of dominating Broken Hill, both in a literal and figurative sense. Literally, as the leases were located on top of a hill and the town of Broken Hill grew around the bottom of this hill. There was nowhere in the town from which the operations of the Company could not be seen. Figuratively, as the mine was so large and significant that it was referred to as "The Company's mine", or, more simply and tellingly "the Big Mine." The general manager, addressing a conference between mining managers and the combined unions in 1908, had this to say:

We feel that the best course to follow is to deal with the Proprietary itself - as the Big Mine. I know more about the Big Mine than I do of the other mines and I feel that the prosperity of the Barrier is so mixed

³⁸ Silver Age, 24/4/1886.

up with the prosperity of the Big Mine that it is a good mine to pick on for example.³⁹

While there may be some question about the extent of the influence of the "Big Mine" after 1908 (as later events will demonstrate), there was no doubt that up until this time, the Big Mine did dominate the Barrier. Some idea of the early dominance of the Company on the Barrier field is revealed in a comparison of output between the Big Mine and other, more established mines at Silverton. For the quarter ended 30 September 1886 silver to the value of £129,849 was exported. Of this total, the Company mine contributed £87,549 with the next two largest totals being the Barrier Ranges Silver Mining Company with £7,494 and Umberumberka Silver Mining Company £8,740.⁴⁰ The following table is also indicative of the size of the Company in relation to a number of other companies mining the Broken Hill lode.

TABLE 1: COMPARATIVE PRODUCTION AND DIVIDEND FIGURES - FROM COMMENCEMENT OF MINING UP UNTIL 31/5/1892⁴¹

	Silver (ozs)	Lead (tons)	Dividends paid (£)
BHP	36,512,445	151,945	3,896,000
Block 10	4,887,958	1,290	485,000
Block 14	4,186,250	42,655	225,000
British	1,192,639	18,241	Nil
Central	3,167,597	7,765	105,000
Junction	1,061,379	4,258	10,000
South	1,043,398	3,181	Nil
North	319,043	1,786	Nil
Totals	52,370,769	231,121	4,721,000

³⁹ Report of Conference between the Broken Hill Mining Managers' Association and Combined Trades Unions' Delegates, 11/11/1908.

⁴⁰ Curtis, L. S., (1908), *The history of Broken Hill: Its rise and progress*, Adelaide, p. 18.

⁴¹ Jamieson, M. B., and Howell, J., (1892/3). Mining and ore treatment at Broken Hill, New South Wales, *Minutes of proceedings of the Institution of Civil Engineers*, Paper No. 2609, pp. 116-182.

In May, 1889, the value of the weekly output of the Company was £22,079, the Block 14 Company £4,747, the Junction £0, and the North £432.⁴² These differences in output are also reflected in the council valuations of the mines, with the annual value, for rating purposes, of the Company mine £5,146, Block 14 £2,093, and the British Blocks £1,500.⁴³ In July, the Company employed about 2,200 men, or nearly double the aggregate of all the other mines on the line of lode. Table 1 illustrates the Company employee numbers from 1886 to 1894. The types of employees are indicative of the development of the Company as the numbers employed at the mine remained relatively stable, while the numbers employed on ore treatment and smelting operations increased. Directors claimed that due to this reason "...whatever this Coy agreed to [regarding union claims] the other Coys would follow."⁴⁴ As subsequent events proved, this was no idle claim.

⁴² Barrier Miner, 1/5/1889.

⁴³ Barrier Miner, 20/4/1889.

⁴⁴ Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 23/7/1889, BHPA/S1/4, p. 13.

TABLE 2: BROKEN HILL PROPRIETARY COMPANY LIMITED - EMPLOYEE NUMBERS 1886 - 1894⁴⁵

YEAR	TOTAL	MINE	SMELTERS	GENERAL CONSTRUCTION AND REPAIRS	ASSAY OFFICE	GENERAL OFFICE AND STORE	GENERAL	ORE DRESSING MILL	LEACHING WORKS ⁴⁶	ELECTRICAL ENGINEERS
1886	500 ⁴⁷									
1887	664	406	142	88	5	3	20			
1888	1231	796	219	172	6	7	31			
1889	2127	1419	354	337	8	Office 6 Store 3				
1890	2309	U 1134 ⁴⁸ S 379	352	301	10	Office 7 Store 3		80	43	
1891	2545	U 1412 S 378	545	170	10	Office 8 Store 3		4	4	11
1892	3203	U 1686 S 666	585	196	10	Office 9 Store 3		7	32	9
1893	2938	U 1099 S 859 ⁴⁹	555	219	11	Office 10 Store 4		159		22
1894	3352	U 998 S 1105	738	198	9	Office 10 Store 4		16	249	25

45 Extracted from Half Yearly Annual Reports of the Company, 31/5/1887, p. 15; 31/5/1888, p. 26; 31/5/1889, p. 25; 31/5/1890, p. 25; 31/5/1891, p. 59; 31/5/1892, p. 62; General Manager's Supplementary Report, 25/1/1893, p. 48; 31/5/1894, p. 44, BHPA/PE30 series. There are no further precise figures available after this date, as the Company started reducing the amount of information being made available in the Half Yearly Reports. There are estimates contained in the Annual Reports of the Department of Mines, but there is some doubt as to the accuracy of such figures. For example, in 1888 the Mining Warden estimated that the Company employed about 1600 men, when the actual figure was much lower. See Annual Report of the Department of Mines for 1888, Sydney, 1889, p. 122.

46 For space reasons, this column includes those employed in the amalgamating mill (1893 - 70 employees and 1894 - 104 employees) and the crushing and chloridising works (1894 - 84 employees).

47 This was the number estimated by the Mining Warden, Annual Report of the Department of Mines for 1886, Sydney, 1887.

48 This was the first year the Company separated those who worked underground (U) from those who worked on the surface (S).

49 The figures for this year and the following year increased substantially due to the inclusion of the contractor's men employed in the open cut operation. The numbers of employees for the respective years was 457 and 647.

In terms of share market values the Company also dominated. In 1886, the share market valued the Company at £3,040,000; the next highest company was valued at £850,000.⁵⁰ In 1890 the position had not changed. On the 18 January, the share market valued the leading Broken Hill mines at a total of £23,259,000: the Company being valued at £14,400,000; the next nearest company was valued at £1,856,000.⁵¹ The main reason for this dominance of the share market can be seen in a comparison of dividends. From the inception of the mine up until June, 1907 the Company paid £11,136,000 in dividends; Block 10 was the next highest with £1,080,000. At the same time the Company employed 4 850 men, with a total fortnightly wages bill of £26,200. Block 10 employed 700 men, with a wages bill of £4,400. Also, by June, 1907 the total output of the mine was £30,161,914; Block 10 had produced £3,241,000. It was the sheer size of the Company and associated operations that gave the Big Mine the dominance of Broken Hill. A crude comparison of return on capital between the Company and Block 10 reveals that there was an almost identical rate of return on capital to investors - the Company had 960,000 shares, with total dividends of £11,136,000; Block 10 had 100,000 shares and total dividends of £1,080,000.⁵²

Figure 1 illustrates the relationship between profits and dividends for the period being studied. The sharp rise in profits and dividends paid in 1888-1891 can be attributed to both the richness of the ore being mined, the price of silver on the world markets, and the substantial drop in transport costs to and from the mine with the completion of a rail link from the South Australian Border to Broken Hill. The sharp fall in profits in

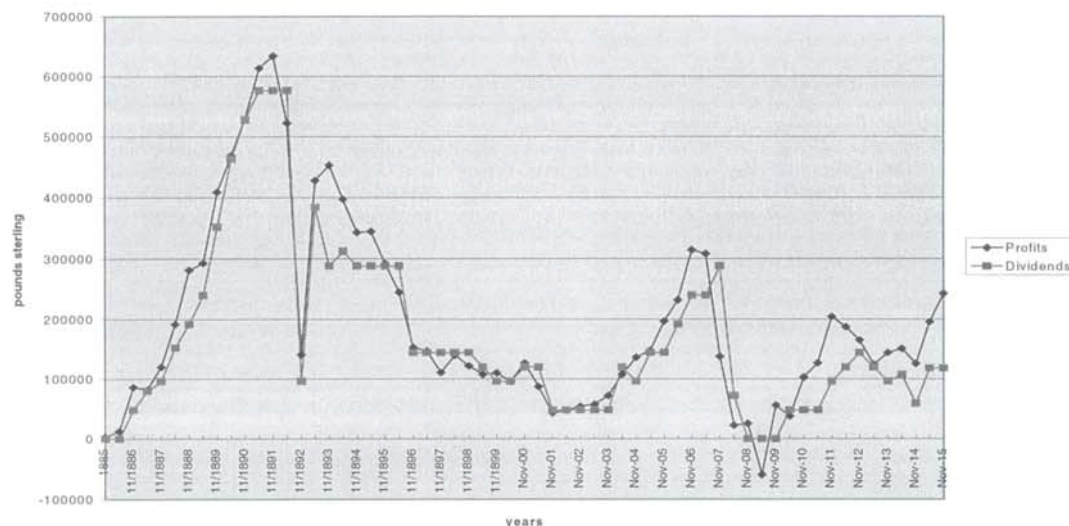
⁵⁰ Prospectus for Broken Hill Tramway, quoted in Curtis, L.S., (1908), The history of Broken Hill: Its rise and progress, Adelaide, pp. 27-29

⁵¹ Curtis, L.S., (1908), The history of Broken Hill: Its rise and progress, Adelaide, p. 27.

⁵² Curtis, L.S., (1908), The history of Broken Hill: Its rise and progress, Adelaide, p. 96.

1892 is directly attributable to the miners strike of that year. Profits never achieved the levels of the later 1880's early 1890's due to falling world silver prices. The fall in silver prices was due to the abandonment of bimetallic currency systems around the world which effectively reduced the demand for silver. Profits were again affected by an industrial dispute in 1908 and for the first time in the history of the Company a half yearly loss was recorded, as well no dividends were paid for the half years ending 30 November, 1908, 31 May, 1909, and 30 November, 1909.

Figure 1 Broken Hill Proprietary Company Limited - Half yearly profits and dividends from 1885 to 1915⁵³



⁵³ Half yearly annual reports for the Company, 1885-1915. The profit figure was obtained from the half yearly accounts. This was the net profit prior to the payment of dividends.

Scope of operations

It needs to be kept in mind that the scope of operations expanded with the mine.

When the silver deposits were first discovered, the head office and the site of mining operations were both located at Broken Hill. As the mining venture developed, and became more complex, the geographic, as well as the operational, aspects of the Company expanded. By 1915, the initial operation had expanded to take in the mine at Broken Hill; the shipping and smelting operations at Port Pirie; a mine at Iron Knob, a source, initially, of flux for the Port Pirie smelters and then the raw material for the iron and steel industry; agents in Adelaide, Port Pirie and Sydney; coke ovens at Bellambi; an office, with its own board of directors, in London; the head office of the Company in Melbourne and a works at Newcastle for the smelting and manufacture of iron and steel products.

There is no attempt to cover all the operations of the Company as this is beyond the scope of the thesis. The major focus of the empirical data is on the mining and smelting operations at Broken Hill and factors that impacted upon the choices made by directors and senior managers of the Company.

Chapter three - Mining operations at Broken Hill

Introduction

In this section it is proposed to discuss the discovery of the mine and the methods that were used in order to extract the ore.¹ After all, it is one thing to discover the ore, it is quite another for it to be mined and turned into, ultimately, dividends for shareholders. In so doing, it becomes apparent that aspects of physical structures, combined with social structures, impacted upon managerial decision making. While the location of the mine was determined by the ore deposits, even this did not mean that the actions of the board of directors and senior managers were determined. As the following section demonstrates, the location of the ore merely served as a physical constraint, which was overcome by other physical means. For example, ore was transported from the mine to the coast, after being treated at the mine. Even treating the ore at the mine or not was a matter of choice for the directors. In fact, while no decision could be made about the actual location of the mine, this merely served as a constraint with which directors and managers had to work. The various factors that impacted upon managerial decision making, and the role of agency in such decision making, as identified in Chapter 1 of the thesis, will become clear. Such factors include the geographic location of the mine, the natural and built environment, the role of history, the effect of time and space and the economic imperative of profit and loss. All these factors have been identified as enabling or constraining social actors in the choices

¹ For a more technical description of mining at Broken Hill, see Beaumont, E.K. (1903). Silver-lead ore mining and the various systems of stowing and timbering employed in Broken Hill, New South Wales, Proceedings of Australian Institute of Mining and Metallurgy, IX (1), pp. 117-144.

they are able to make and, as a consequence, the decisions that were made. An important point to note at this stage of the thesis is the role of institutions in enabling or constraining action. Institutions, in this sense, refers to various organisations involved in the operations of the Company, both directly and indirectly. These institutions, or organisations, were necessary in order to provide the resources in order to overcome physical obstacles to the development and management of the mine. These institutions represented social structures which could enable or constrain action. Importantly, the social structures represented by institutions did not have the capacity to act. This is a key point made by both Giddens and Lloyd. Social agents made choices while institutions provided both the structural frameworks within which such choices are made and the resources necessary to realise such choices. While it might be argued that managerial decisions were determined by the environment and thus the board of directors and senior managers had no choice but to be successful, this argument is rejected. As will be demonstrated in this, and following chapters, agency was important in the overall development of the Company.

Silver mining - early history

The first metal mine was not operated in Australia until the discovery of a lead/silver vein at Gawler, in South Australia, in February, 1841. While there were a number of other lead/silver finds in South Australia around this time, a combination of the gold rushes in Victoria, and the discovery of copper at Kapunda and Burra together with the generally limited nature of the silver/lead ore found meant that the lead/silver

mining was discontinued.² It was not until the discovery and exploitation of the silver/lead ores at Silverton and Broken Hill that this type of mining was revived.

However, in the intervening years from the cessation of silver/lead mining in South Australia to the commencement of silver/lead mining in the Barrier Ranges in the far west of New South Wales, there were significant discoveries of silver/lead in the United States of America, in the states of Nevada, Colorado and Arizona, dating from 1859 to 1876. The most famous was the Comstock silver lode, located in Nevada.³ In the context of this study, this discovery and exploitation of the Comstock lode is important, as will be demonstrated later. Many of the managerial and technical staff recruited by the Company came directly from the American silver fields, bringing with them mining and metallurgical techniques they had learnt on these fields. They also brought with them their own histories and experiences of the various contexts within which they worked and lived. This meant they also brought with them attitudes and values which had been formed in the general context of American hard rock mining.⁴

While the Comstock was of direct relevance to Australian silver mining, the Comstock was itself simply another stage of mining and smelting history which stretched back into time. Historically, silver had always presented problems, not so

² Hart, E.K., (1987), Wheal Gawler, in Selby, J.,(ed), South Australia's mining heritage, Adelaide, pp. 37-40.

³ De Quille, D.,(1889), A history of the Comstock silver lode and mines, Virginia. [1974 facsimile]; Rickard, T.A., (1932), A history of American mining, New York.

⁴ For a good description of this context see Lingenfelter, R. E., (1974), The hardrock miners: a history of the mining labour movement in the American West, Berkeley. Silver mining was classified as hard rock mining in order to differentiate it from coal mining. The techniques of mining both were different due to the nature of the resources being mined, although they did share similar risks.

much for mining,⁵ but rather for smelting. Spence⁶ points out that silver "...is a complicated, deceptive metal. Frequently, it, or gold as well, was in combination with sulphur and base metals and stubbornly resisted early attempts at separation." He then goes on to discuss various methods used to separate silver by European born, German trained engineers, using the best 'Old World' methods and modifying them to produce "...a working milling and smelting technology second to none."

Relationship between mining and smelting

However, while mining and smelting processes have been treated separately in the thesis, as Temple⁷ points out, miners owe a debt to metallurgists as metals rarely occur in pure form in nature and thus the miner (and mine owner) has to rely on the metallurgist to turn the crude ore into a marketable product. In the history of silver mining and smelting, more importance has been placed on the manner in which ore was turned into a marketable product. For example, Nef⁸ has argued that the invention, in 1451, of a process that separated silver from rich argentiferous copper ores accounted "...for the great prosperity of mining and metallurgy during the century that followed." Temple⁹ has argued that as well as this invention being important, so too was the invention of larger furnaces for the smelting, of, initially, iron ore. These larger furnaces could then be used for smelting other metals, of which silver was one.

⁵ See Aitchison, L., (1960) A history of metals, London, Vol. II, p. 505; and Temple, J., (1972), Mining: an international history, London, pp. 14-15.

⁶ Spence, C. C., (1970), Mining engineers and the American West: the lace boot brigade 1849-1994, New Haven, p. 238.

⁷ Temple, J., (1972), Mining: an international history, London, p. 6

⁸ Nef, J. U., (1941), Silver production in Central Europe 1450-1618, Journal of Political Economy, p. 576.

⁹ Temple, J., (1972), Mining: an international history, London, p. 27.

Bakewell¹⁰ claims that the advanced knowledge of smelting silver was known in Europe by the beginning of the sixteenth century and these skills were then transferred to South America and Mexico. Due, however, to a combination of factors (the nature of the silver ores and the shortage of suitable lead to mix with the ores) smelting was replaced for large scale use by an amalgamation process. At the great silver mines at Potosi, for example, early ore discoveries were rich silver oxides suitable for smelting. The nature of the ores changed and in 1545 smelting gave way to amalgamation.¹¹ Amalgamation was a slower but far cheaper method of treating silver ores and, according to Probert,¹² lasted 350 years and generally replaced smelting.

The scale of metallurgical operations also increased during the fourteenth and fifteenth centuries as a consequence of the application to treatment processes of mechanical power and spur gearing.¹³ Technological progress was also being made in improving mining methods. Until the introduction of the steam engine into mines in the eighteenth century, subterranean water flooding the mines had been the most serious of all problems confronting miners and mine owners. The invention of the steam engine also solved the problem of lifting ore from deep mines.¹⁴

¹⁰ Bakewell, P. J., (1971), Silver mining and society in Colonial Mexico - Zacatecas 1546-1700, Cambridge, pp. 144-145.

¹¹ Craig, A. K., (1989), Mining ordenanzas and silver production at Potosi: the Toledo reforms, p. 160.

¹² Probert, A., (1975), Episodes of mining history, Journal of the West, XIV/2, pp. 10-11.

¹³ Aitchison, L., (1960), A history of metals, Vol. II, London, p. 377.

¹⁴ Temple, J., (1972), Mining: an international history, London, p. 27, p. 41.

The Comstock lode

These were some of the major developments in mining and smelting up to the time the Comstock lode was discovered in the 1850's in Nevada, in the United States of America. The mining and smelting knowledge that had been accumulated from the 1400's onward was initially used on the Comstock lode. De Quille,¹⁵ a contemporary observer of the Comstock silver fields, makes the point that when silver was first discovered in payable quantities, the Americans knew nothing about silver mining and in fact there was probably not more than "...a dozen American miners" on the Pacific Coast who had ever seen a sample of silver ore. Knowledge concerning the mining and treating the ore was obtained from Mexicans, whose "...word was law." Mexican methods of amalgamation proved to be too slow and small scale for the Comstock lode and was modified by 1862 by using steam to hasten the process.¹⁶ The amalgamation process basically involved first separating the silver and gold and then when in bullion form was placed in "melting" pots, made into bricks and then assayed.¹⁷ Actual smelting of ore to extract the gold and silver first took place in Colorado in January, 1867, with large reduction works becoming concentrated at Denver and Pueblo.¹⁸

¹⁵ De Quille, D., (1889), The history of the Comstock silver lode and mines, Virginia, p. 40

¹⁶ Smith, G. H., (1943), The history of the Comstock lode 1850-1920, Nevada, pp. 41-45;
Rickard, T. A., (1932), A history of American mining, New York, pp. 100-102. Smelting was little used on the Comstock due to the high cost of fuel and the lack of base metal ores to be smelted. See Bernstein, M. D., (1964), The Mexican mining industry, New York, p. 10. This work also contains a good description of the amalgamation process.

¹⁷ De Quille, D., (1889), The history of the Comstock silver lode and mines, Nevada, pp. 70-78.

¹⁸ Rickard, T. A., (1932), A history of American mining, New York, p. 120; p. 122.

Advances in mining technology

During the middle to the late nineteenth century a number of other key advances in mining methods were made. For example, mechanical ventilation was used in coal mines in the mid 1860's; power drills were developed at the 1850's; in 1863 Nobel invented dynamite which gave much greater rock breaking power than gunpowder; compressed air drills were used on the Comstock in 1872; and wire rope was used in 1864.¹⁹ The Comstock lode was finished as a profitable mining region in 1880, although there were still mines operating.²⁰ This was part of the historical context of mining and smelting in which the Broken Hill silver fields need to be placed. Even though the Comstock might have been thousands of miles from Broken Hill, those living at Broken Hill were aware of developments that were taking place on the Comstock. A local newspaper, the Silver Age, would regularly publish information relating to silver mining and treatment, not only in America, but also in Germany.²¹ The first silver smelting works in Australia had been established at the Sunny Corner gold, silver and lead mine (near Bathurst in New South Wales).²²

The above represents the international context of the Broken Hill discoveries. The silver lodes discovered at the Barrier were, in international terms, simply the most recent important discovery after the Comstock. Certainly, such a large discovery was unique to Australia, but not to the international mining and smelting community.

¹⁹ Temple, J., (1972), Mining: an international history, London, p. 44, p. 57, p. 58.

²⁰ Smith, G. H., (1943), The history of the Comstock lode 1850-1920, Nevada, p. 231.

²¹ For example, see the Silver Age, 20/9/1884. This article had also been published in the Adelaide Register.

²² Silver Age, 27/9/1884.

The discovery of the Barrier silver fields²³

Although it was the Broken Hill mines that achieved world wide fame as a producers of lead, silver and zinc, the initial silver finds were not at Broken Hill, but rather in a location approximately 12 miles north west of Broken Hill at the site of what was to be known as Silverton. It was to Silverton that the first "rush" occurred in 1883 but the life of Silverton and the surrounding silver mines were eclipsed after a few years when the true extent of the discovery at Broken Hill became known.²⁴

The discovery of the Broken Hill lode²⁵

The location of the find was on Mt. Gipps, a 1400 square miles pastoral station. Located on the property about twelve miles from the homestead was a hill about 150 feet high and about 350 yards long. At the peak of this hill was a black, burnished ridge which a boundary rider, Charles Rasp from the Mt. Gipps Station, thought was comprised of tin. Accordingly, on the 1 September, 1883 he pegged out a 40 acre block, disregarding advice he had been given that all the hill consisted of was mullock.²⁶

²³ This was the name given to the area where the silver discoveries were made.

²⁴ Cleland, E.D.,(1888-1889), Life on the Barrier, The Centennial Magazine, Vol.1, pp. 205-212.

²⁵ There are a number of accounts of the initial discovery of the Broken Hill lode. The following account relies on versions produced by individuals intimately involved in the discovery and subsequent exploitation of the lode. The first is: Jamieson, W to F. Dickenson, 15 March, 1898, BHPA/ARC312/2B. (Jamieson bought a share in 1884, and was appointed the first general manager in May, 1885). Jamieson, M B., and Howell, J., (1892-1893), Mining and ore-treatment at Broken Hill, N.S.W., Minutes of proceedings of the Institution of Civil Engineers, Paper No. 2609, pp. 116-180. (Howell was general manager of the Company from 1890 to 1895); Bridges, R., (1920), From silver to steel: the romance of the Broken Hill Proprietary, Melbourne. (The board decided on 10 August, 1917 that a history of the Company should be written. Bridges, a journalist was contracted to write this history and he was assisted by P. Charley and W. Jamieson, both of whom had been involved in the Company since its earliest days. Personal correspondence, Corporate Archivist, 15 October, 1997, ARC312/2A.)

²⁶ Mullock is a mining term indicating rubbish rock.

After Rasp had pegged the initial block, he went to the Station Manager, G. McCulloch, to resign. McCulloch, instead of accepting Rasp's resignation, decided to form a syndicate, later to become famously known as the "Syndicate of Seven", on 5 September. The Syndicate then pegged out leases over a period of several weeks on the remainder of the Broken Hill. McCulloch could have decided simply to accept Rasp's resignation. He chose not to, instead organising the Syndicate and ensuring that all leases were pegged and registered in accordance with mining law. In the various writings about the early discovery of the Broken Hill lode, two reasons have been advanced for McCulloch acting as he did. First, McCulloch thought so highly of Rasp as a boundary rider that he did not wish to lose the services of Rasp, especially if, as was thought at the time, the hill contained no ore of significance. The second reason was that McCulloch, as station manager, wanted to avoid the possibility of his station being over run by prospectors should any ore of value be found. There was, apparently, no expectation at this stage that the actions of McCulloch would result in him eventually becoming a wealthy man.

By the 21 September, 1883 a total of seven blocks had been pegged, representing a total of 297 and 3/4 acres and extending the length of the hill. An exploratory "shaft"²⁷ was sunk to 65 feet, but the results did not justify its continuance, an assay revealing only a few ounces of silver to the ton of ore when payable ore was considered to assay 80 ounces of silver to a ton of ore.

²⁷ Bridges, R., (1920), From silver to steel: the romance of the Broken Hill Proprietary, Melbourne, p. 60 described it as a "post hole".

Due to a lack of financial resources, and a severe drought which occupied the members of the Syndicate of Seven no further exploratory work was undertaken on the claims until late in 1884, when a rother shaft was sunk on the site of the original "post hole". Again the results were disappointing, the ore being assayed at 10 ounces to the ton. In the meantime the Syncicate of Seven had been reformed as the Broken Hill Mining Company. The shareholders of this company commissioned a report on the site of the leases from Mr. Norman Taylor, late Field Geologist, Geological Survey of Victoria. He supplied such report on the 13 September, 1884. He was sure that the lode comprised an "...enormous body of mineral - how highly argentiferous [containing silver] can only be proved by assay..." and suggested that a "...drive or adit should be put in ...from the flat." He concluded his report:

The ore in depth will almost certainly consist of mixed sulphides of zinc, copper, iron, lead etc - rich in silver: and I have no hesitation in saying that in my opinion you have one of the most important properties on the field.²⁸

In April of the following year, rich chlorides were found at the base of the hill and further exploratory work was carried out, revealing more surface chlorides as well as chlorides at the 150 foot level of the Rasp shaft (the first shaft to be sunk). However, the various finds still did not produce sufficient finance for further exploratory work and the leases were sold to the Broken Hill Proprietary Company Limited in order to raise the necessary finance to further develop the find. At the time shares were

²⁸ Report to shareholders, Broken Hill Mining Company. 13/9/1884, BHPA/A18/6, p. 1.

offered in the new company in June, 1885, two shafts had been sunk.²⁹ A visitor to the site in 1885 recorded his impressions of the developments taking place at Broken Hill.

In 1885 I went to the Hill of Mullock, called Broken Hill, and beheld primitive mining which started me. Nobody knew anything about silver mining, and the directors and managers were learning their business at the expense of the mines. Without exception, every mine was being mismanaged.³⁰

Once the Company had been floated on the Stock Exchange the necessary capital was available to expand mining operations. A report prepared for the board of directors by another mining consultant John Provis,³¹ an American mining engineer, on 6 December, 1886 reiterated the report submitted by Taylor in 1884, concluding that "...a week spent at the mine itself, in examining into the nature and extent of the vein and its value, will convince the most sceptical that the mine is destined to rank among the foremost of the leading silver mines in the world."³² His report also illustrated the progress that had been made since the Prospectus had been written in June, 1885. At the time of his report, mining had "... been confined almost exclusively to Blocks Nos.

²⁹ Prospectus for Broken Hill Proprietary Company Limited, 20/6/1885, reproduced in Bridges, R., (1920), From silver to steel: The romance of the Broken Hill Proprietary, Melbourne, pp. 104-107.

³⁰ Meudell, G., (1929), The pleasant career of a spendthrift, London, p.101. As Meudell was a stockbroker, the veracity of his judgement appears open to question. He was also writing with the benefit of hindsight.

³¹ Provis was a mining engineer with "...experience in silver mining in America and elsewhere". Reports and Statements of Account, half year ending 30/11/1886, BHPA/PE30/1, p. 10.

³² Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p. 38.

11, 12, and 13."³³ A total of five shafts had now been sunk, with a number of drives running off the main shafts at a variety of levels (for example, the McCulloch Shaft, "...the largest and best equipped..."³⁴ had three levels, one at 150 feet, one at 216 feet, and one at 316 feet³⁵) The "dirt" was being removed from the mine using the "horse and bucket" method.³⁶

Mining the lode

The initial method of mining the lode was the "pillar and block" method.³⁷

Essentially, this method involved leaving pillars of ore to support the roof (or back, in mining terminology) and mining the ore between the pillars. The lode was divided into levels (with about one hundred feet between levels) and the ore was then extracted between these levels. Horwood recalled that:

In the early days the ore was mined in much the same way as narrow lodes viz by working out a comparatively narrow section in a horizontal slice about 6 feet deep, supporting the roof with props and timber sets pending the close filling of the cavity with country rock sent down from the surface through chutes or shafts leading to the workings.³⁸

³³ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p. 26.

³⁴ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p. 29.

³⁵ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, pp. 29-31.

³⁶ Sleep, S [underground manager] to Jamieson [general manager], 5/9/1885, BHPA/A18/6.

³⁷ Reports and Statements of Accounts, Half year ending 31/5/1890, BHPA/PE30/2, p. 21.

³⁸ Horwood, E.J., (1925), Notes descriptive of the Broken Hill mine and its operations past and present, The B.H.P. Recreation Review, 2/9, 22/10/1924, BHPA/PE32/3, p. 6. Horwood had a long association with the Company in a number of managerial positions.

The above description would seem to indicate an advance on the pillar and block method that was adopted in the very early stages of the mine.³⁹ The timber used to provide a measure of support and stability to the workings was, until there was a change in the method of mining, obtained locally.⁴⁰ The ore that had been mined was then transported to the shaft and into the cages provided for this purpose in iron or steel cars. The main shaft consisted of three compartments, two for cages for hoisting rock and the third for a footway.⁴¹ The early mining methods at Broken Hill were assessed by Beaumont in the following terms:

...the methods adopted were of the crudest description until with great advance of output and rush of population, more modern and advanced systems were adopted, and the arrival of American mining managers and engineers with the 'square set' system of timbering, as carried out in ore mines of America and elsewhere.⁴²

While these methods may have been crude, they simply reflected the practices of the day.⁴³ A consulting engineer, Mr. Rees Davies, was asked to submit a report on the machinery at the mine in 1887 and he concluded "...I may state that, in my opinion, your mine and plant is one of the finest in Australia, and well worthy of the money

³⁹ This advance is confirmed in Reports and Statements of Account, half year ending 31/5/1888, BHPA/PE30/1, p. 21.

⁴⁰ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p.34.

⁴¹ Reports and Statements of Account, half year ending 30 November, 1886, BHPA/PE30/1, p. 34.

⁴² Beaumont, E.K., (1903), Silver-lead ore mining and the various systems of stoping and timbering employed in Broken Hill, New South Wales, Proceedings of Australian Institute of Mining and Metallurgy, IX(1), p. 119. It must, however, be remembered that this judgement was being made with the benefit of hindsight and that the Broken Hill ore deposit was the first large silver orebody to be mined in Australia and Australian engineers lacked experience with an orebody of this type and size.

expended on it, great credit being due to the General Manager and the officers under him."⁴⁴

The Company did introduce at least one new mining technique into its mining operations. The first was a new method of shoring up the workings. Prior to the use of this new technique, the existing method of shoring up the workings was found to be unsuitable, on account of the weakness of the orebody, of the walls, and the size of the deposits.⁴⁵ The new technique was known as the square set method of timbering and it used so much timber that the colonial timber market was too small to supply the needs of the mine. The timber had to be imported from America and, although higher priced, was lighter than the available colonial timber and "...more advantageous and really cheaper in the end..." than colonial timber.⁴⁶ The new technique involved constructing square timber frames (cubes would be a more appropriate term), which provided support for the walls and backs of the lode. This technique allowed the miners to construct a system of square sets, one on top of the other, in order to extract the ore between the various levels - for example, if there was one hundred foot between levels, approximately ten "layers" of square sets would be used to extract ore - starting from the lower level and working to the higher. The square sets also provided safer access between levels for the miners and made the removal of the ore from the working faces to the ore trucks easier. By using this method of reinforcement a greater volume of ore could be extracted than previous methods permitted and at the

⁴³ Jamieson, M.B., and Howell, J., (1892/3) Mining and ore treatment at Broken Hill, New South Wales, Minutes of Proceedings of the Institution of Civil Engineers, Paper No. 2609, p. 122.

⁴⁴ Reports and Statements of Account, half year ending 31/5/1887, BHPA/PE30/1, p. 28.

⁴⁵ Some features of Broken Hill mining, (1913), Proceedings of Australian Institute of Mining and Metallurgy, 10, p. 129.

same time afforded greater safety for the miners, was less expensive and also helped to alleviate the problems of creep.⁴⁷ The first American general manager introduced this technique as a result of his experience working the Comstock silver lode in Nevada where the method was inverted and introduced to the Comstock by a German miner, Philip Deidesheimer.⁴⁸ This introduction and use of the square set method of timbering a mine was a good example of how the prior experience of an individual impacted upon mining operations at Broken Hill.

Essentially, the square set method of timbering meant that pillars of ore no longer had to be left supporting a stope (the area in the mine from which ore was extracted); instead a square set of timber usually 12 feet high was used to support the back. While this meant that more ore could be recovered, there were a number of other reasons for the adoption of this system of timbering the mine:⁴⁹

1. The extreme width of the lode, which, under the old system of timbering, increased the danger of falls.
2. The use of "debris" (waste rock) broken up on the surface to used as a fill meant double handling which increased the costs of mining operations - the square set method of timbering reduced the necessity for this to be done.

⁴⁶ Chairman's report to shareholders, Minutes of half yearly meeting of shareholders, 31/1/1889, BHPA/S3/1.

⁴⁷ Reports and Statements of Account, half year ending 31 May, 1888, BHPA/PE30/1, p. 8. Creep occurred when there were movements in the ground caused by the ore being removed.

⁴⁸ De Quille, D., (1889), A history of the Comstock silver lode and mines, Virginia, p. 40.

⁴⁹ Reports and Statements of Account, half year ending 31 May, 1888, BHPA/PE30/1, p. 21.

3. The continuous clouds of dust caused by the falling rock seriously affected the health of the miners.
4. The current system would be impracticable as greater depth was attained.

Jamieson and Howell⁵⁰ also advanced another reason of importance. The square set method of timbering "...enables larger faces of ore to be exposed and worked at one time...". This advantage is of particular significance when the ore is being smelted, a topic discussed below. But the square set method of timbering also brought with it an added risk to those the miners were already subjected to (such as lead poisoning,⁵¹ dust on the lungs, rock falls,⁵² falling into shafts or winzes, explosions,⁵³ being run over by ore trucks,⁵⁴): that of fire. As the workings of the mine were extended over the full extent of the property, the number of shafts, drives and tunnels that were connected increased to the extent that by November, 1890 there were seven main working shafts⁵⁵ with a consequently increased potential danger of damage caused by fires. For example, in 1896, 368,000 super feet of timber per month were being used

⁵⁰ Jamieson, M. B., and Howell, J., (1892/3, Mining and ore treatment at Broken Hill, NSW, Minutes of proceedings of the Institution of Civil Engineers, Paper No. 2609, p. 123.

⁵¹ The question of lead poisoning was first raised at board level on 22/1/1886, when the general manager was authorised to obtain medical advice, if necessary, as to prevention and treatment. Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 22/1/1886, BHPA/S1/1, pp. 80-81.

⁵² The first fatalities, two miners, recorded in the board Minutes was on 8/12/1886. These miners were killed by falling ore. The directors set up a subscription fund with £100 from the Company. Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 8/12/1886, BHPA/S1/1, p. 265.

⁵³ For a discussion of this aspect of mining accidents, see Godfrey, J.R., (1903), Common causes of accidents from explosives in mines, Proceedings of Australian Institute of Mining and Metallurgy, IX(1), pp. 30-63.

⁵⁴ Warren, P.H. (1932), Accidents in the Broken Hill mines, Proceedings of Australian Institute of Mining and Metallurgy, 86, pp. 19-20. The only difference between the mining hazards at Broken Hill and on the Comstock silver lode in America was the volume and temperature of water miners on the Comstock had to contend with. See Lingenfelter, R.E., (1974), The hardrock miners: A history of the mining labour movement in the American West 1863-1893, Berkeley, p. 23.

in the mine.⁵⁶ By 1907 this usage had grown to 663,500 super feet per month.⁵⁷ In an effort to minimise the possibility of a fire spreading through the entire mine, iron doors were placed in drives in order to close off draughts from one part of the mine to others. Another risk the square set method of timbering could alleviate, but not remove, was that of creep, that is the ground settling, or moving over where the ore had been removed.⁵⁸ Two modifications to the square set method of timbering were found to be necessary to address the problems of creep in the mine. Creep occurred due to the inability of the original square set method to restrain the weight above it.⁵⁹ The first modification was to reinforce the square sets with the addition of extra pieces of timber in an effort to give the square set more strength and when this modification failed, the sets were then close filled with country rock. This then fixed, in the main, the problem of creep in the mine⁶⁰ although in April, 1904 creep was reported between the 300 and 400 foot levels of the mine and the general manager considered it prudent to keep the men out of the area "...for a while".⁶¹

There were at least two serious instances in 1895 of both creep and a fire taking place.

On 28/5/1895 the acting general manager sent a coded telegram to the secretary in

Melbourne that:

⁵⁵ Reports and Statements of Account, half year ending 30/11/1890, BHPA/PE30/3, p. 28.

⁵⁶ Acting general manager to secretary, 7/2/ 1896, Letterbook, BHPA/M3/5, p. 470.

⁵⁷ Acting general manager to secretary, 25/6/1907, Letterbook, BHPA/M3/7, p. 684.

⁵⁸ Acting general manager to secretary, Letterbook, BHPA/M3/5, pp. 125-126; Jamieson, M. B., and Howell, J., (1892/3), Mining and ore treatment at Broken Hill, NSW, Minutes of proceedings of the Institution of Civil Engineers, Paper No. 2609, p. 125.

⁵⁹ Beaumont, E.K., (1903), Silver-lead ore mining and the various systems of stoping and timbering employed in Broken Hill, New South Wales, Proceedings of Australian Institute of Mining and Metallurgy, IX(1), p. 120.

⁶⁰ Beaumont, E.K., (1903), Silver-lead ore mining and the various systems of stoping and timbering employed in Broken Hill, New South Wales, Proceedings of Australian Institute of Mining and Metallurgy, IX(1), p. 120; Horwood, E. J. (1925), Notes descriptive of the Broken Hill mine and its operations past and present, The BHP Review, 2/9, 22 October, BHPA/PE32/3, p. 6.

⁶¹ Delprat, G.D., Diary, 19/4/1904, NLMS1030/15.

Heavy movement commenced midnight Block 11 in ground between Drew's shaft and McBryde's shaft embracing whole width of lode to McGregor's new shaft. Men withdrawn. Meantime expect to maintain output by forcing other places. Will telegraph later how it will be affected.⁶²

Another coded telegram was sent the same day where the acting general manager advised that "[j]udging by what can be seen at the present time do not expect production will be affected longer than 3 days by movement."⁶³

While the problems caused by the "creep" in this instance were not significant, this was not the case with the fire that broke out later that same year. The possibility of fire had been specifically addressed in 1890 when the general manager advised:

I might mention that, in the remote possibility of fire (this can only occur through a wilful act), all means of communication, air passages and gangways can be cut off by means of iron doors, constructed for that purpose, and the fire confined to a section, or small portion of the workings....[resulting in a] temporary delay in that section only.⁶⁴

⁶² Acting general manager to the secretary, 18/5/1895, Letterbook, BHPA/M3/4, p. 93. The translation is provided in the Letterbook on the same page as the coded telegram.

⁶³ Acting general manager to secretary, 28/5/1895, Letterbook, BHPA/M3/4, p. 94.

⁶⁴ Reports and Statements of Account, half year ending 31/5/1890, BHPA/PE30/2/, p. 29. In this, of course, the general manager was simplifying the position. Snee, R.T., (1911), Fires in metalliferous mines, Proceedings of Australian Institute of Mining and Metallurgy, XV(2), p. 604 identifies three main reasons - arson, spontaneous combustion, or carelessness. He also states that in relation to arson in mines that "...direct evidence is usually lacking."

This "remote possibility" occurred between 20 and 22 July, 1895 when the acting general manager sent a telegram to Melbourne that "[f]ire has broken out in the mine Block 11 between [?] and Weatherly's [shafts]..."⁶⁵

The progress of the fire, and the efforts made to stop it can be traced through a series of telegrams sent from the mine, initially by the acting general manager, and then the secretary who left Melbourne to be present at the mine.⁶⁶ Warren noted that more damage was caused by the water used to try and extinguish the fire, than by the fire itself.⁶⁷ The acting general manager estimated that the cost of fighting the fire up until 8 August, 1895 was £8,150/12/5.⁶⁸

The fire was still "present" on 30/7/1897, two years after the initial outbreak.⁶⁹

Another fire also broke out in January, 1898 killing three men.⁷⁰ It seems that the fire was not extinguished for some time as periodic references were still being made to it in 1898,⁷¹ 1900⁷² 1906⁷³ and 1907.⁷⁴ In order to lessen the fire risk the general manager suggested (and the board agreed) that timber in the shafts be replaced with

⁶⁵ Acting general manager to secretary, no date, but the copy of the telegram occurs between letter and telegrams of the 20 and 22 July, 1895, Letterbook, BHPA/M3/4, p. 364a.

⁶⁶ The following accounts are, unless otherwise stated, taken from a Letterbook, BHPA/M3/4, p. 365, p. 370, p. 374, p. 412, BHPA/M3/5, p. 6.

⁶⁷ Warren, J., (1902), Reminiscences of Broken Hill, Proceedings of Australian Institute of Mining and Metallurgy, IX(2), pp. 11-12.

⁶⁸ Acting general manager to secretary, 8/8/ 895, Letterbook, BHPA/M3/4, p. 428.

⁶⁹ Chairman's address to Shareholders, Minutes of meeting of shareholders, 30/7/1897, BHPA/S3/2.

⁷⁰ Chairman's address to shareholders, Minutes of meeting of shareholders, 28/1/1898, BHPA/S3/2.

⁷¹ Chairman's address to shareholders, Minutes of meeting of shareholders, 29/7/1898, BHPA/S3/2.

⁷² Chairman's address to shareholders, Minutes of meeting of shareholders, 26/1/1900, BHPA/S3/2.

⁷³ Delprat, G. D., Diary, 17/2/1906, NLMS1630/15.

⁷⁴ Report of acting general manager to secretary, 1/6/ 907, Letterbook, BHPA/M3/7. p. 854.

iron.⁷⁵ Water used to combat the fire also caused damage to the mine. The general manager noted in his diary in October, 1902 that "water going into stopes caused some fall underground."⁷⁶

It was as a result of ground movements and the consequent effect on share prices that the directors, at a board meeting held at Broken Hill on 29 September, 1891 authorised the general manager (Howell) to investigate and report on the open cut method of mining.⁷⁷ As well as relieving pressure on the underground workings, open cut mining also enabled ore to be removed more cheaply.⁷⁸ Open cut work commenced in the last quarter of 1891 and in 1907 was 300 feet deep, by three quarters of a mile long, by 360 feet wide⁷⁹ and was continued for the period of this study. According to Mawson the original idea for open cut mining had been raised first by S. R. Wilson (general manager, 16/12/1885 to 8/11/1887), but no evidence is provided to substantiate this claim.⁸⁰ This seems unlikely as there was no necessity, at that stage, for taking such steps, and there is no mention of such a suggestion in the board minutes or associated material.

Concurrently with the open cut operations, underground operations also continued, the only changes of significance taking place as the nature of the ore body altered. As mentioned above, the ore body was so large that a new (to Australian silver mining)

⁷⁵ Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 30/11/1907, BHPA/S1/17, p. 480. There is no record of this suggestion being implemented.

⁷⁶ Delprat, G.D., Diary, 6/10/1902, NLMS1 530/15.

⁷⁷ Minutes of Meetings of Directors, Broken Hill Proprietary Company Limited, 29/9/1891, BHPA/S1/6, p. 218.

⁷⁸ Jamieson, M. B., and Howell, J., (1892/3), Mining and ore treatment at Broken Hill, NSW, Minutes of proceedings of the Institution of Civil Engineers, Paper No. 2609, p. 126.

⁷⁹ Sewell, F.W., (1907), The mining and metallurgy of copper, silver, lead, and zinc, Proceedings of Australian Institute of Mining and Metallurgy, XII, p. 112.

method of securing the ground from rock falls. the square set method of timbering, was adopted. However, as the ore body went deeper into the earth, the nature of the ore changed and it became possible to mine the ore using the open stoping system.⁸¹ Essentially, this system was used where the ore was being extracted from hard ground. It was not necessary for the square set method of timbering to be used as extensively as it was for the softer oxidised ores as there was less danger of falls of rock and ore occurring. If any support was required timber bulks were used as supports until such time as the ore had been extracted. The space left after the ore was extracted was filled with waste rock and the timber bulks removed to be used elsewhere in the mine. Under the square set method of timbering it was not possible to remove any timber once the ore had been extracted.⁸²

But not only did the ore have to be mined, it also had to be moved to the surface and to the ore treatment works. Up until March, 1886 horses had been used to bring the ore to the surface, but in April, 1886 winding engines started to be used for this purpose.⁸³ With the development of the mine it was necessary for a whole infrastructure to be built which would enable men, ore, supplies and other necessities of mining, to be moved from the surface to the underground workings. Once underground, the men and materials had to be transported from the shaft to the faces where the ore was being stoped. Ore and mullock, as well as men, had then to be returned to the surface. There was thus a whole infrastructure which was an integral

⁸⁰ Mawson, P., (1958), *A vision of steel: the life of G. D. Delprat*, Melbourne.

⁸¹ This is a simplification. While the nature of the ore body did change, from soft oxides to harder sulphides generally, there was still areas of oxidised ores that required the use of square sets.

⁸² Chairman's address to shareholders, 29/7/ 898, BHPA/S3/2: *Royal Commission into Mining at Broken Hill*, 1914, Sydney, p. vii.

⁸³ *Silver Age*, 6/3/1886, 3/4/1886.

part of exploiting the ore. For example, in the six months up until the 31 May, 1887, the general manager reported the following infrastructure work had been carried out:

the excavation of 22,000 tons of earth and rock for the foundations of the engine and pump house and the smelting works. 1578 feet of railway track had been laid. 700 feet of tram lines laid. 2,640 yards of 2 feet high masonry work built.⁸⁴

It must be remembered that the various levels of the mines had also to be adequately ventilated, otherwise miners suffered from foul air, poisonous gases (from either fires or explosives), and dust.⁸⁵ In the early life of the mine, ventilation was provided by the use of upcasts⁸⁶ and, as the mine was developed, artificial ventilation using fans was introduced. Artificial ventilation meant that drives of considerable length could be made without special air passes between the several levels and the surface.⁸⁷ The method of ventilation was also important if fire did break out in the underground workings as it was important to be able to control the flow of air throughout the workings if a fire was not to spread throughout the entire workings underground.

⁸⁴ Broken Hill Proprietary Company Limited, Reports and Statements of Account, half year ending 31 May, 1887, BHPA/PE30/1, p.14. For a more detailed account of the mining equipment in place in March, 1887, see the Report on Machinery, by R. Davies, Consulting Engineer, in Broken Hill Proprietary Company Limited Reports and Statements of Account, half year ending 31 May, 1887. BHPA/PE30/1, pp. 23-28.

⁸⁵ Lingenfelter, R.E., (1974), The hardrock miner: a history of the mining labour movement in the American West 1863-1893, Berkeley, p. 15.

⁸⁶ Shafts specifically designed to move air from the bottom of the mine, up through the workings to the surface.

Conclusion

There were no further developments in the methods of mining the ore for the remainder of the period. All three methods (square set timbering, open stopes, and open cut) were used as and when the general manager thought appropriate. However, the above discussion does not provide any real sense of the overall development of the mine. Some idea of the scope of development which took place from the formation of the Company in 1885 up until the end of 1915 can be seen from the statistics included in a Chapter 4 which discusses the production of the mine.

As can be seen from the foregoing, human agency was a key factor in mining operations. Right from the time when the leases were first pegged. Exactly what was, or was not possible, was tempered by various structural constraints - such as the location of the ore body, the methods used in mining the ore, steps taken against danger both to the miners and the continued operations of the mine. As well as these structural constraints, agents were also constrained by their own embedded experiences and the availability of mining knowledge generally. It was not simply a matter of finding the ore body, and then letting events take their course. Decisions had to be made at many points along the way, decisions which were influenced by a number of factors - such as the nature of the ore body, the various methods used in working the ore body and so on. Mining history also had a part to play by being embedded in the experience of those who were developing the mine. As the above

⁸⁷ Reports and Statements of Account, half year ending 30/11/1886, BHPA/PE30/1, pp. 28-34; Jamieson, M.B. and Howell, J., (1892/3), Mining and ore treatment at Broken Hill, New South Wales, Minutes of proceedings of the Institution of Civil Engineers, pp. 126-127.

account demonstrates, there was only a limited history of silver mining in Australia and certainly that experience did not equip Australian mine managers with the necessary technical expertise to efficiently and effectively mine the Broken Hill lode. Mining managers who did possess the necessary experience came from America where they had gained experience on the Comstock lode, a lode which was similar in respect to size to the Broken Hill lode. History does not, however, actually do anything. The historical developments of mining were incorporated into the body of knowledge possessed by those who managed mines. It is these individuals who translate historical developments into everyday reality.

Once the ore was raised to the surface, it then had to be treated prior to being transported to market. As the following chapter demonstrates, just as with the process of mining, so too was it necessary for agents to make choices concerning the method of treating the ore; choices that were enabled or constrained by the technical knowledge possessed, or available to, those in overall charge of the processes.