

Newsletter of the Australian Society for History of Engineering and Technology

Election of office bearers and committee members

At the ASHET annual general meeting on Tuesday 22 April, all the former office bears and committee members retired, in accordance with the provisions of the constitution, and a new committee was elected, taking office at the end of the meeting. This committee will serve until the next annual general meeting in 2009.

The new committee is as follows:

- president: Ian Jack
- senior vice-president: Mari Metzke
- vice president: David Craddock
- secretary: Ian Arthur
- treasurer: John Roberts
- committee members: Felicity Barry, Glenn Rigden, Robert Renew

Bridges over the Cudgegong

ASHET member Wal Pilz has written asking if readers could provide information on the history of bridges over the Cudgegong River near Rylstone NSW. The Rylstone and District Historical Society is preparing a presentation for History Week 2008 on the bridges. Between 1860 and 1900 the Public Works Department built three timber bridges over the river at Rylstone. They no longer exist but there is a painting of them over the dining room fireplace of the Bridge Hotel that the society now owns as its museum. There were also two rail bridges, built in 1884, and replaced in 1924.

Contact the society's president Virginia Hollister, at PO Box 66 Rylstone NSW 2849 or email: hollister@winsoft.net.au.



Four writers

At an ASHET meeting on 24 June 2005, four writers spoke about their work in progress. This year three of them will have that work published.

ASHET member Vicki Hastrich's novel *The Great Arch*, has been published by Allen & Unwin. It was written under the umbrella of the University of Sydney as part of a Doctor of Arts degree and is Vicki's second work of fiction. The first, *Swimming with the Jellyfish*, was published by Simon & Schuster in 2001.



Vicki Hastrich

In her talk Vicki spoke about the difference between researching for fiction and non-fiction. The Reverend Frank Cash, an eccentric Anglican minister who was obsessed with the construction of the Sydney Harbour Bridge, was the real life model for the novel's central character.

In September this year, Ron Ringer's book *The Brickmasters* will be published by Dry Press Publishing. As an alternative history of Sydney,



Ron Ringer

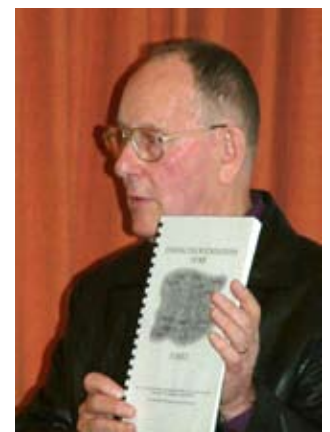
The Brickmasters explores the impact of social, economic, technological and architectural change on one of Australia's most historic and vital industries. It also examines the profound effect on brick-making of The Austral Brick Company and the enigmatic, yet brilliant figure of William King Dawes, 1898-1981.

This year Tony Griffiths will publish the second volume of his history of Lithgow and the Lithgow Small Arms Factory. Tony's first book *The Enfield Inch and the Lithgow .303*, published in 2003, took the story up to the time the factory commenced production in 1912; the second volume takes it to 1990, when the factory had become part of the government owned Australian Defence Industries. It covers the growth of the factory to the time of World War II when it employed nearly 6,000 people and Lithgow had a population of 25,000, and the decline after the war.

The fourth writer speaking at the 2005 meeting, Ros Maguire, is still researching her biography of architect and engineer William Weaver, and is not planning to publish this year.



Ros Maguire



Tony Griffiths

ASHET events

Tuesday 22 July 2008

Talk by Bob McKillop

Central Railway Station: politics, design, use and evolution, 1906 to 2006

Bob McKillop's, historical interests include the role of railway in shaping Australia's settlement patterns, industry and culture. He has published widely and has edited *Light Railways*, Australia's magazine of industrial and narrow gauge railways for 20 years.

Bob's talk focuses on his recent book, *A century of Central: Sydney's Central Railway Station 1906 to 2006*. It will include the political context for a central station to enhance Sydney's vision of its place in the world between 1857 and 1901; the design and construction of the various components between 1901 and 1932; and the function and use of the station, both in the public realm and for the hundreds of employees who worked behind the scenes. Particular attention will be given to 'railway culture', the fate of the attempts to reform the culture to cope with new challenges and the restoration of the station to its original glory and its future role.

This is a joint activity of ASHET and the Royal Australian Historical Society (RAHS).

Venue: History House, 133 Macquarie Street, Sydney
Time: 5.30 for 6 pm
Cost: \$7.00 Includes light refreshments on arrival
Bookings: phone RAHS on (02) 9247 8001 or email admin@rahs.org.au

Thursday 11 September 2008 (History Week)

Talk by Michael Clarke

Devastation, Disaster and Distress – living with floods in the lower Hunter Valley

Ever since 1818 when Europeans settled in the Maitland area they have battled flooding from the Hunter River. They put up levees, installed floodgates and established water brigades for rescue. However, floods rose higher, forced up by their inability to spread on the floodplain; there were drownings, stock and crop losses and houses washed away.

Finally the increased economic impact of flooding and the political pressure that came with more intense development, forced the formation of the Hunter Valley Conservation Trust in 1950. The Trust's charter was to tackle on a valley-wide basis, the erosion, degradation and flood mitigation problems posed by a century or more of land use, and of floods in the Hunter catchment. As part of the strategy and following the great flood of 1955, a large program of flood mitigation works commenced in 1957, on both the upper and lower river.

Michael Clarke was the Public Works Department's first resident engineer for the lower Hunter works and continued in the position for nine years. His talk will outline the history of flooding and describe the works and measures that have enabled floodplain inhabitants to live more comfortably with the flood hazard.

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Time: 5.30 for 6 pm
Cost: \$7.00 Includes light refreshments on arrival
Bookings: phone RAHS on (02) 9247 8001 or email admin@rahs.org.au

Broken Hill tour postponed until 2009

We are now planning for an ASHET/RAHS tour to Broken Hill in 2009. It was originally proposed to run the tour in August this year. However it proved impossible to organise the details of the tour we envisioned in the time available so it was necessary to re-schedule it for 2009 at around the same time of the year.

The tour we are currently planning will be by tourist coach from Dubbo via Nyngan, Cobar and Wilcannia to Broken Hill. It will include three days in Broken Hill, and will look at historic, architectural, industrial and scenic aspects of all the towns visited.

Travel to Dubbo and return from Broken Hill will be flexible. We expect that most participants will travel together by train (XPT from Sydney to Dubbo and from Broken Hill to Sydney via Ivanhoe by the Broken Hill Explorer). This will be at your own expense to take advantage of special fares such as the Pensioner Travel Voucher, Seniors discount, etc., as appropriate. We may be able to negotiate a group rate with CountryLink. Others may wish to fly, or spend a few extra days in Dubbo or Broken Hill or even go on to Adelaide from there.

Estimated cost per person twin share including bed and breakfast, coach travel and admissions, but not lunches, dinners or train travel, is estimated to not exceed \$850.

Further details of the tour will be announced in a future issue of *ASHET News*.

In the meantime, you may wish to read some of the history of Broken Hill and the far west of New South Wales. Commencing on the next page of this issue of *ASHET News* is a short summary of the history of Broken Hill, with suggestions for further reading.

About ASHET

ASHET, the Australian Society for History of Engineering and Technology, is a non-profit society, incorporated in New South Wales and affiliated with the Royal Australian Historical Society. ASHET currently has 94 members throughout Australia.

ASHET was formed in Sydney in 2003. Its objects are to encourage and promote community interest and education in the history of engineering and technology in Australia.

Annual membership of ASHET is \$20 for ordinary membership and \$30 for family membership. For more information or to download a membership application form, go to the ASHET website <http://www.ashet.org.au/>.

Broken Hill

Broken Hill, a massive rocky outcrop, forms part of the Barrier Ranges in the far west of New South Wales. It lies at the boundary between two huge sheep stations, Mt. Gipps and Kinchega. On 5 September 1883, Charles Rasp, a Mt. Gipps boundary rider, together with two dam-sinkers working at the station, David James and James Poole, pegged a 40 acre mineral lease on the centre of the outcrop. Rasp thought the heavy samples he collected might be rich in tin, but he probably believed that there could be valuable silver underground.

Rasp was no geologist, but he had trained in Germany as a technologist in the chemical industry. During a holiday in Adelaide he had acquired a *Prospector's Guide* and was on the lookout for silver. Fifty kilometres west, at Silverton, traces of silver had been found in 1875, and by 1883 there were several profitable mines in the area and a population of 3,000.

Once the Broken Hill claim had been registered with the local mining warden the three reported their action to the station manager George McCulloch. McCulloch organised a syndicate of himself and six others, including Rasp, James, Poole, George Urquhart, sheep overseer, Philip Charley, jackeroo, and George Lind, station accountant and storekeeper. Syndicate members, under McCulloch's leadership, agreed to peg six more claims, have samples assayed in Adelaide, and pay miners to explore below the surface. The assays showed that Rasp's samples were around 18 per cent lead, with varying quantities of silver. The syndicate members agreed to contribute up to £1 per week to continue searching for silver below the surface. Rasp later wrote 'For twelve months it was really doubtful whether we would make anything of it'. Some of the syndicate members wanted out.

Early in 1884 the syndicate members decided to divide their total shareholding into fourteen shares, each syndicate member holding two shares, with the right to sell. Lind and Urquhart sold out; William Jamieson, a government mining surveyor, and W.R. Wilson, manager of the Day Dream Mine and smelters at Silverton, bought in.

It was then agreed to expand the number of syndicate members to 14, each with an equal share. They were the five remaining member of the original seven, along with Jamieson, Wilson, Kenric Brodrigg of Poolamacca sheep station, Bowes Kelly, formerly manger of Billilla station, James Dalglish, surveyor, of Dubbo, Samuel Hawkins, a carpenter, Solomon Wiseman, a rabbit control inspector, W.C. Palmer, a Silverton land agent, and Alfred Cox, a young Englishman visiting the district.

Cox had famously acquired his one-fourteenth share for £120 by winning a game of euchre with George McCulloch. McCulloch agreed to sell for £200 if he won or £120 if he lost. He then bought another fourteenth share for £90 from a station hand.

Poole sold half his share to Sidney Kidman for ten steers. Kidman soon sold his interest cheaply and went on to make a fortune from cattle. Poole the rest of his share for £9,000 early in 1885.

During 1884 several geologists visited Broken Hill and were mostly unimpressed, though one, Norman Taylor, said 'The ridge contains the most extraordinary and largest lode I have ever seen on the Barrier Ranges silver field, or in fact anywhere'. He concluded it was one of the best mines in the world. Charles Wilkinson, government geologist reported in August 1884 that 'masses and veins of galena will be found

disseminated through the lode' and the rich silver ore will probably be found in the undecomposed sulphide of lead silver etc.' A few new leases were pegged around the original seven belonging to the syndicate.

The syndicate finally let a contract for a shaft, the Rasp Shaft, in October 1884. Philip Charley, poking around the lease in January 1885, found what he thought was silver chloride in the material tipped into a dump by the contractors. The samples, and other ones then taken from the shaft, assayed thousands of ounces of silver to the ton, comparable with the richest ore being mined at Silverton.

The syndicate members, who named their venture the Broken Hill Mining Company, appointed William Jamieson as manager on 25 April 1885. Meeting at Mt. Gipps on 3 June they agreed to form the Broken Hill

Proprietary Company Limited (BHP), with 16,000 shares, 14,000 for the syndicate members and 2,000 for sale to the public at £9 each. The shares were marketed in four equal lots, in Silverton, Adelaide, Sydney and Melbourne. The prospectus contained little information; the shares were rushed in Silverton, but sold slowly in Melbourne and Sydney.

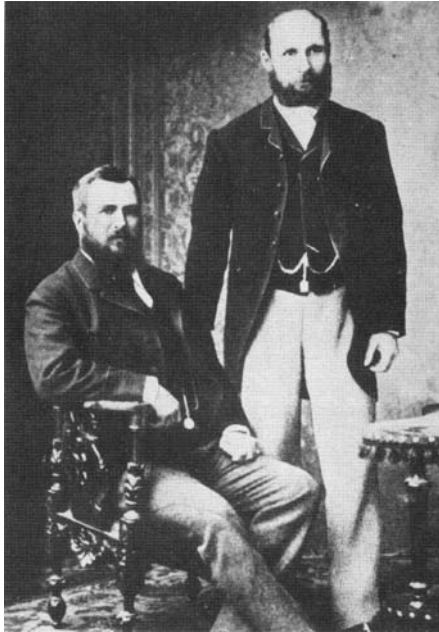
Serious mining got under way in 1885 and at the end of the year 3,000 tons of ore had been mined, valued at £43,000. Some of the ore was smelted to recover the lead and silver at Day Dream mine and some of the ore was exported for smelting in Europe. During 1886 BHP installed two smelters at Broken Hill.

Many other companies and syndicates were formed, most of them operating with little success. In those early years BHP was by far the largest and most profitable mine. By 1887 the population of Broken Hill was 6,000, of whom 900 were women. In that year BHP engaged one of America's most highly regarded mine superintendents, William Patton, at £4,000 per year as general manager and another American, Herman Schlapp, as metallurgist.

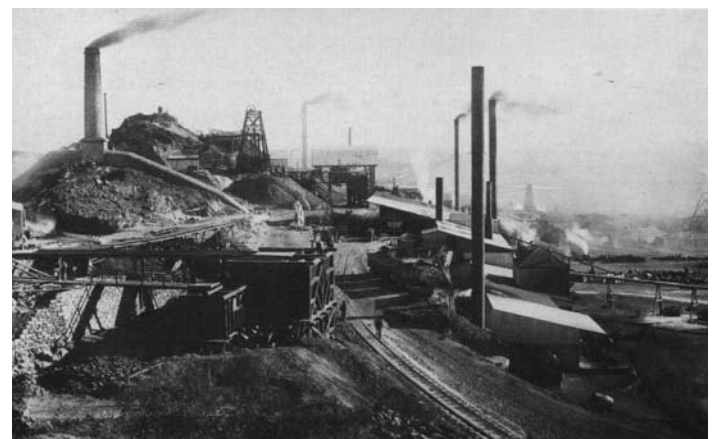
By 1890 the population of Broken Hill was almost 20,000, more than its population today. In each of the years 1890 and 1891 BHP paid out more than £1 million in profits.

The sulphide problem and other difficulties

The South Australian government, anxious to share in the riches of the mines just across its border with New South Wales, extended its railway to the border in 1888. The New South Wales Government refused to allow the South Australian railway to go further or to itself build the 100 km of line to serve Silverton and Broken Hill. When the Minister for Mines, on a visit to Silverton in May 1885, suggested that a private railway could be constructed, the locals took immediately steps to form a company for the purpose. The Silverton Tramway from Cockburn on the



George McCulloch and Charles Rasp



Broken Hill Proprietary Company mine, 1888

The syndicate of seven

Philip Charley

(1863–1838) born at Ballarat, Victoria, was a jackeroo on Mt. Gipps station. In 1886 he married Clara Evans of Adelaide. He purchased a property, Belmont Park, at Richmond NSW in 1889, built a palatial house and bred horses and cattle. There were eight children from the marriage.



Charley's house Belmont, at Richmond, now St. John of God hospital

David James (1854–1926) born in Wales, was a dam-sinker working at Mt. Gipps. He purchased a large farming property at Kapunda, established a racing stud, and owned a Melbourne cup winner, Auraria. He entered parliament in South Australia and represented the electorate of Wooroora for 16 years.

George Lind, book-keeper at Mt. Gipps, sold out in 1884 at a loss to Rasp and McCulloch and moved to Melbourne.

George McCulloch (1848–1907) Scottish-born manager of Mt. Gipps station of which his uncle Sir Jams McCulloch, Premier of Victoria was a part owner, became a director of BHP from its formation in 1886 and was chairman in 1892. In 1893 he married a widow, Mary Mayger, formerly a housekeeper at Mt. Gipps, and settled permanently in London where he became a patron of the arts. He died in London in 1907.

James Poole (1848–1924) dam-sinker at Mt. Gipps, took up farming in Western Australia, and eventually returned to Kapunda, South Australia.

Charles Rasp (1846–1907) was born in Stuttgart, and worked for a large chemical company in Hamburg before emigrating to Australia in 1869.

He moved around Victoria and New South Wales before being engaged as a boundary-rider at Mt. Gipps. In 1886 he married Agnes Klevesahl of Adelaide and bought a large house,



Ballroom at Rasp's house Willyama

Willyama, where his wife entertained in the grand manner. After her husband's death she went to Europe and married Count von Zedwitz in London in 1914. They lived in Germany until the end of war when the Count died. His widow returned to Adelaide where she died childless in 1936.

George Urquhart (1845–1915) was born in Scotland and spent his childhood in Melbourne. He worked for his uncle, manager of Kinchega station, before becoming sheep overseer at Mt. Gipps. He sold out for £10 to Charles Rasp in 1884. After living in Melbourne for several years, he returned to the outback. He died at Black Hill station near Silverton, where he was manager.

border to Silverton and Broken Hill opened in 1888. From the start these railways were hugely profitable, carrying ore and concentrates from the mines to the coast at Port Pirie, and coal, coke, timber and supplies to Silverton and Broken Hill.

1888 was a year of drought, in which 100,000 sheep and 8,000 cattle in the area died, 45,000 at Kinchega alone. Broken Hill was desperately short of water; The Minister for Mines refused to allow Broken Hill households to use water from the dam the government had built near Silverton for watering travelling stock. At a public meeting in September he was burnt in effigy, and shortly afterwards transport of water by train for sale to the public from water carts in Broken Hill was permitted.

On 5 November 1888 there was a disastrous fire in the centre of Broken Hill in which the whole of the western side of Argent street between Sulphide Street and Oxide Street was burnt out.

Agitation began for a permanent water supply for the town. A proposal for the government to build a pipeline from Menindee on the Darling was shelved. Two companies were formed to supply water to Broken Hill, and were taken over by the Broken Hill Water Supply Company Limited in 1890 to build a reservoir at Stephens Creek. Sir Henry Parkes, Premier of New South Wales, made his first visit to Broken Hill in 1890 and turned the first sod, as well as laying foundation stones for the town hall, a wing of the hospital and a hall for the Amalgamated Miners Association that was never built.

The Stephens Creek reservoir soon proved inadequate. There was some relief when the government completed the Umberumberka reservoir near Silverton in 1914, but in times of drought either or both the reservoirs ran dry. A reliable supply of water was finally secured in 1952 with the opening of a pipeline from Menindee, largely paid for by the mining companies, and the completion of the Menindee Lakes scheme in 1960.

From 1888 there were pressures to construct a rail link with Sydney. Deputations waited on the Minister for Works, but with conflicting

proposals for a route via Cobar and Wilcannia and one via Condobolin and Menindee. The Public Works Committee recommended the Wilcannia route and a Bill was passed for its construction in 1890, but no action was taken to implement the plan.

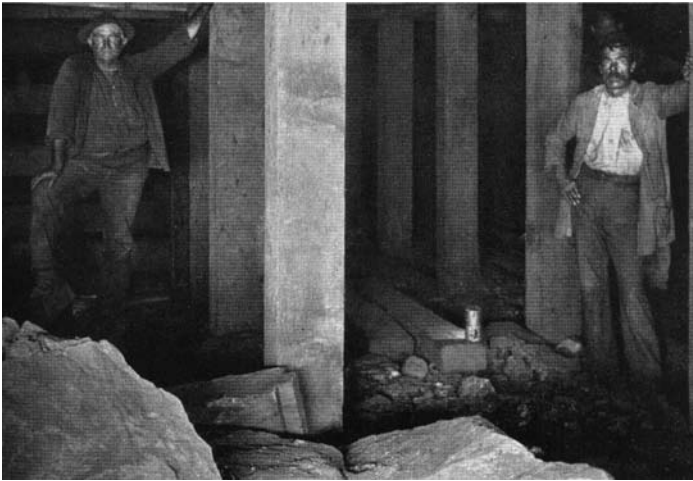
After further inquiries the government authorised construction of a railway via Menindee, and the section between Broken Hill and Menindee, useful for carrying water, opened in 1919. The final link between Ivanhoe and Menindee opened in 1927.

In 1970, with Commonwealth finance, the standard gauge line between Sydney and Adelaide was opened and the Silverton Tramway closed.

The early workings of the Broken Hill mines were conducted cheaply and dangerously. Mining timbers were scarce, and reliance was placed on leaving massive pillars of ore to provide some support. The mined out areas should have been filled with barren rock from the workings but they were not. Several disastrous underground collapses occurred, with loss of life. William Patten introduced the effective but expensive American method of square set stoping, in which a massive structure of imported oregon timber was erected between the floor and the roof of the mining stopes. The new method came too late to prevent the subsidence of many of the honeycombed upper workings, and there was serious damage to many surface structures. Several expensive mine buildings had to be relocated.

The price of silver had been declining since around 1870 as gold progressively replaced it as a currency metal in Europe, America and Asia. The Sherman Acts of 1890 compelled the US government to make regular purchases of silver, but after a short respite the decline in silver prices resumed. The profitability of the Broken Hill mines was under serious threat in the early 1890s. In addition, the Australian economy was close to collapse with falling export prices for agricultural commodities, mounting unemployment and bank failures.

It was therefore especially galling that a large proportion of the



Square set stoping

valuable metal in the ore mined at Broken Hill could not be economically recovered. This became known as the 'sulphide problem'. Everyone was aware of it because the town was becoming surrounded by vast dumps of material that would not yield up its valuable metal content.

Originally all the metal in the boomerang shaped deposit that was the Broken Hill ore body was in the form of metal sulphides of lead, zinc and a little silver. The ends of the boomerang were deep underground and the centre, where the BHP leases were located, exposed to the elements. Over hundreds of millions of years these surface layers were converted to oxides by the effects of weathering. It was these oxides that Rasp discovered and which were mined by BHP in its early years. The treatment process employed by BHP initially simply smelted the oxide ore to recover the lead and most of the silver. Some of the zinc was extracted along with the lead and silver, and this was a nuisance because it interfered with the subsequent refining process.

The sulphide ore that made up the bulk of the Broken Hill ore body contained less silver than the oxide ore, and around 33 per cent lead and zinc in roughly equal proportions. It was much more difficult to process economically than the oxide ore. Most of the smaller mines quickly ran out of the oxide ore close to the surface and had to process the difficult sulphides. By the early 1890s BHP shared the problem.

The first response to this problem was to treat the ore before smelting to separate as far as possible the lead from the zinc, making use of the large difference in the density of the two metals and their compounds. This required grinding the ore finely in water, and then using a variety of machines based on the same principle as gold panning. The ore treatment mills, installed on a large scale at Broken Hill in the 1890s, produced a concentrate for smelting that contained around 63 per cent lead and 8 per cent zinc. The waste material, containing most of the zinc and more than half the silver, accumulated in large dumps around the town.

In 1890 a strike by maritime unions had interrupted supplies of essential materials such as coke for melting and timber for the mines. The managers of the nine major mine gave notice on 5 September that they would need to close within a few days. The unions immediately withdrew all labour. The men were coaxed back to work after three weeks by a new contract that reduced working hours from 48 to 46, put an end to the practice of contract mining and included an agreement to refer future disputes to arbitration by a board with equal representation from unions and management.

On 27 June 1892, in the face of deteriorating prices for lead and silver, the mine managers gave a month's notice, as they were required to do under the 1890 agreement with the unions, that 'on economic grounds' contract mining would be resumed. They considered that this would be more palatable than a reduction on wages. A meeting of 6,000 workers on 3 July decided to strike. The mines closed, but on 16 August the companies issued a statement that the mines would be reopened in a week. Large numbers of unemployed

labourers flocked to Broken Hill and soon 1,500 'scabs' were employed. On 8 November the union ended the strike and the men returned to work under the contract system and with a ten per cent reduction in wages. By the end of 1893 there were over 1,000 unemployed at Broken Hill. The mines were employing 4,000 men, 3,000 of them at BHP.

BHP decided to move its smelting operations from Broken Hill to Port Pirie. Some of the other mines also moved their smelters to the coast, while the smaller mines mostly exported their lead-silver concentrates to Europe for processing. By 1898 smelting at Broken Hill had ceased entirely. The most radical move was made by the Central Mine, J.S. Reid, a former Silverton newspaper editor and promoter of the Silverton Tramway, had become interested in a proposal by a BHP engineer, Edgar Ashcroft, for a novel method of processing the Broken Hill sulphide ore. Reid went to London in 1895 to raise capital to take over the Central mine and form the Sulphide Corporation. All the ore from the mine was taken by rail to Port Pirie and then sea to Cockle Creek on the New South Wales coalfields, for treatment.

Ashcroft tested his revolutionary processing scheme successfully in Australia and London, and received the blessing of a celebrated German metallurgist, Dr. Carl Schnabel, before building the expensive plant at Cockle Creek. The ore was roasted to remove the sulphur, and then treated with sulphuric acid to dissolve the zinc. The zinc solution was purified and the zinc was extracted electrolytically. With the zinc removed, the lead and silver could be smelted cheaply in a blast furnace. The electrolytic process could not be made to work on a commercial scale. The expensive plant was scrapped, and replaced by a conventional lead smelter processing concentrate.

Sulphide Corporation did not give up. In 1898 it adopted a magnetic separation process to treat zinc-rich railings at Broken Hill to produce a concentrate with around 40 per cent zinc, which was then shipped to Europe for extraction of the zinc by a well-proven distillation process. Sulphide Corporation treated over half a million tons of tailings. Five other mining companies adopted magnetic separation processes, but by 1911 they had all closed.

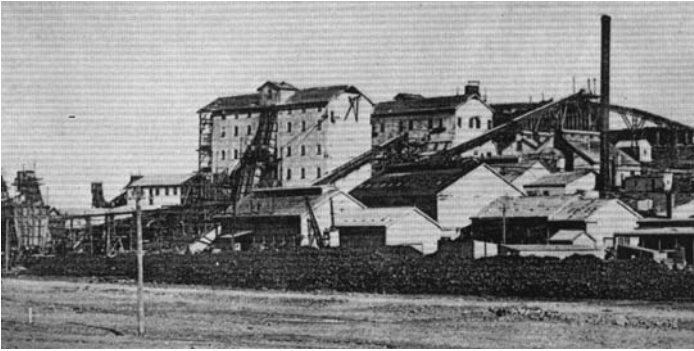
Flotation

The eventual saviour of Broken Hill was a different process for treating the ore, flotation. An inventive Melbourne brewer, Charles Potter, had developed in 1900 a process based on his observation that particles of sulphide ore would adhere to bubbles produced in a vat of hot water with sulphuric acid added. The process was taken up first by Block 14, an initially profitable Broken Hill mining company formed in 1887, which had been forced by low metal prices to cease operations in 1902. It opened a small flotation plant in 1903, using Potter's process, and was able at times to recover 60 per cent of the zinc in sulphide ore, a notable achievement.

By 1902, BHP had its own flotation process, known as the Delprat process. The Potter and Delprat processes were so similar that litigation ensued which was settled by an agreement to jointly develop and exploit the 'Potter-Delprat' process. A by-product of the litigation was the invention by Auguste de Bavay, another Melbourne brewer acting as

An exclusive club

The Broken Hill Proprietary Company Limited was formed by the syndicate of 14 leaseholders at Mt. Gipps station in 1885. For over thirty years they dominated the company's board of directors, which met in Melbourne. Three of them were sheep men, intensely practical, used to managing, but with no experience in mining or finance: Duncan McBryde who remained a director until 1920, Harvey Patterson until 1926, Bowes Kelly until 1930 and George McCulloch until 1906. A fifth member of the syndicate, William Jameson, formerly a government mining surveyor, became the mine's first manager. He joined the board of directors in 1906, retiring in 1926. The directors are said to have sat around playing two-up with gold sovereigns after board meetings.



de Bavay company treatment works, 1909

an expert witness, of a flotation process that was different enough to be clearly not an imitation. In 1905, two Melbourne brewery directors, W.L. Baillieu and Montague Cohen, supported de Bavay in forming a public company, Amalgamated Zinc (de Bavay's) Limited, that opened in 1909 a large plant to treat tailings purchased from the mining companies.

Encouraged by the success of Potter's process, a party of financial men and mining experts from Melbourne visited Broken Hill in 1905 to assess the possibility of treating the 6 million tons of mine dumps that had accumulated over 20 years. The value of the minerals contained was estimated at £12 million. Arising from the visit and a subsequent visit by Herbert Hoover, American mining engineer and future US president, the Zinc Corporation was formed in Melbourne on 6 September 1905 to treat the dump material from existing mines. It invested heavily in a flotation plant at Broken Hill, initially using the Potter process. Various other flotation processes were tried with some success, and in 1912 a breakthrough came when F.J. Lyster, a carpenter working for the company, showed that lead and zinc could be separated in a flotation process. Until then, flotation was used only to produce a mixed silver-lead-zinc concentrate from tailings.

Selective flotation soon became the primary method of treating Broken Hill ores to produce two concentrates, one containing almost all the lead and silver and the other almost all the zinc. It was quickly adopted by all the mining companies. In 1911 Zinc Corporation acquired the South Blocks company and commenced mining in addition treating dump material.

More big changes

In 1906, when the industrial award was due to expire, the unions submitted a claim for increased wages and reduced hours of work. Lead prices were high. The unions agreed to accept the mining companies' offer to reduce the working hours from 48 to 46 and to increase wages for the first time in 13 years, provided that lead prices remained over £16 per ton.

In 1908, when the award was due to expire, lead prices, which had been as high as £19 in 1907, had dropped below £14 and there were 4,000 unemployed in Broken Hill. Nine of the mining companies agreed to maintain the existing rates, but four companies, led by BHP, refused and announced that from the beginning of 1909 when the award expired, they would revert to the conditions that applied before the 1906 award. The BHP workers went on strike, while other mines continued to work.

When the dispute came before Mr. Justice Higgins, Delprat, the BHP general manager, argued that the mine was now yielding no profit and that its ore reserves would last less than three years. On 12 March Higgins ruled that BHP could not cut wages at Broken Hill and Port Pirie. BHP re-opened the works at Port Pirie from the end of May, ending the strike, but refused to open the mine. For the next two years BHP's only activity at Broken Hill was to treat the tailings dumps, paying award wages.

With its Broken Hill ore deposits almost exhausted, BHP's greatest asset was a vast deposit of high grade iron ore at Iron Knob near Port Pirie, which it had acquired to provide a flux for lead smelting. Delprat went overseas in 1911 to visit iron ore mines and steel works. The result was a decision to build the Newcastle steelworks, which opened in 1915.

BHP wound down its operations at Broken Hill, operating the mine only when met prices were high, and continuing to run the mill to process the waste dumps. It finally withdrew entirely from Broken Hill in 1939.

The outbreak of World War I in 1914 had an immediate effect on Broken Hill. The population of Broken Hill had grown to 35,000 and the mines were operating profitably. European smelters, mainly German, were processing more than half the mines' production of lead concentrates and nearly all of the zinc concentrates. The contracts with German smelters were scrapped on the outbreak of war. Over a few months employment at Broken Hill dropped from over 7,000 to around 5,000. Hills of lead and zinc concentrates began to pile up around the town,

In May 1815 Broken Hill Associated Smelters was formed as a cooperative with the largest shares held by the then biggest mining companies, Broken Hill South, North Broken Hill and Zinc Corporation, to expand and operate the Port Pirie lead smelters on behalf of the mining companies. By the end of the war they were the largest in the world, treating almost all the Broken Hill's output of lead and silver concentrates.

The British government, desperately short of zinc for its war effort, agreed to purchase all the Broken Hill dumps of zinc concentrate and all its future production until 1930. The Broken Hill companies, with pressure from the British and Australian governments, formed The Electrolytic Zinc Company of Australasia in 1916, to establish a zinc works at Risdon in Tasmania, based on electrolytic technology employed by the Anaconda company in America. Large-scale production began in 1922.

During the 1920s the North and South mines at Broken Hill became the largest and most profitable mines in Australia, with Zinc Corporation close behind. Ore reserves were sufficient to keep them operating until 1970 when the South mine closed. The remaining Broken Hill operations were merged into a new company, Pasmenco Limited, in 1989, and the North mine closed in 1993. Pasmenco sold its interests at Broken Hill for \$90 million to Perilya Limited in 2002, and that company is currently the only one mining and treating ore and waste at Broken Hill. Another company, CBH Resources Limited, is developing a new mine at Broken Hill and plans to merge with Perilya Limited this year subject to shareholder approval.

Mining at Broken Hill is expected to continue for at least another ten years. The population of Broken Hill is now 18,000, just over half that when Broken Hill was at the height of its activities. Mining is still the main industry.

Sources and further reading

The principal sources for this article are the series of books on the history of Broken Hill by R.H.B. Kearns, published by the Broken Hill Historical Society between 1974 and 1982, and the books by Geoffrey Blainey, *The Rise of Broken Hill* (1968) and *The Rush that Never Ended* (fourth edition, 1993). This article is no more than a brief summary of the saga that unfolds in these books. Blainey warns that so many myths have survived and flourished that until someone writes a careful history of the field it is safest to rely on mostly contemporary records.

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