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The Machine Shop, Port Melbourne Engineering Works, circa 1920.

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EDITOR:
Margret Doring, FIEAust. CPEng. M.ICOMOS

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EHA@engineersaustralia.org.au
or visit the website at:
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Cover Images:

Front: The Machine Shop of A.T. Harman's Port Melbourne Engineering Works, circa 1920.
Source: Port Melbourne Historical & Preservation Society.

Back: The back cover of David Jehan's book "A History of Clyde Engineering – 1898 to 1948", showing a variety of the products manufactured by the Company.
Source: Australian Railway Historical Society (NSW).

This is a free magazine covering stories and news items about industrial and engineering heritage in Australia and elsewhere. It is published online as a down-loadable PDF document for readers to view on screen or print their own copies. EA members and non-members on the EHA mailing lists will receive emails notifying them of new issues, with a link to the relevant Engineers Australia website page.

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This EA Centenary book is still for sale at
https://www.eabooks.com.au/Anything-is-Possible

Editorial

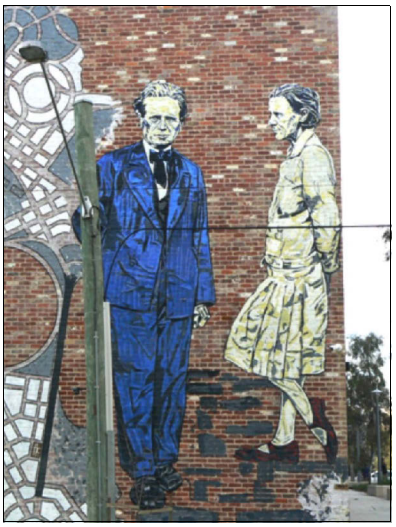
Some of the stories in this issue are both dense and longer than usual – so much so that the magazine runs to eight more pages than usual. And it appears that most stories required a great deal of intensive research, by their authors, to get the facts right. I can tell them all, that they have been extremely fortunate to have had access to so many of their subject's historical records – fortunate indeed, that such records still existed at all. It is very unfortunate – and sad – that the records of probably hundreds of prominent businesses and companies since (say) the 1800s have entirely vanished over the years – often through carelessness, but also often through deliberate destruction. That old rubbish? Just take it all down to the tip! A classic careless example was the Government Department (no names, no pack drill) which microfilmed its historic drawings, then shredded the originals because they took up too much space, then discovered the microfilm camera hadn't been working!

Bob Taaffe and other volunteers at Engineering Heritage Tasmania (see *Tasmania Division Archives & Library Go Digital* – p34) should be congratulated for their forethought and efforts in forestalling a similar disaster happening to the records of the Engineers Australia's Tasmania Division. Further, in reviewing David Jehan's book (*A History of Clyde Engineering, Engineers & Manufacturers – The Steam Era: 1898–1948*. – see p35), Bill Phippen recognises the significance of the actions of a Clyde Engineering employee Ronald Drummond who *collected and saved records as the company moved locations and eventually closed. His was the garage to which colleagues took otherwise to-be-discarded volumes when offices were emptied.* Would that other employees of other companies in the past, with managements which had no understanding of their place in history, had a similar prescience of mind to Drummond! In our nearly 40 years of work as heritage conservationists, we (Carl and I) have come across many painful examples of careless or deliberate destruction of records inhibiting our industrial heritage research – and a few (very few) serendipitous examples of actions like Mr Drummond's. I might write about them sometime, if that doesn't prove too depressing.

Balls Head Coal Loader seen from Cockatoo Island. Photo: Max Underhill, 27th May 2021.

And now a couple of other stories in this issue. Frank Johnson, Chair of the Engineering Heritage Sydney (EHS) Committee, has been a railway engineer throughout his career, but has developed many new interests through his membership of EHS – a notable example being the history and workings of the Balls Head Coal Loader, and its recent transformation into a source of civic recreation and pride without losing all reminders of its industrial history. Frank has done an excellent job in recounting to me the significance and operation of a site I never understood. In the 1980s, Carl and I lived in Wollstonecraft and used to walk the dogs down to Berry Island and around Balls Head Bay, past the Gas Works and the Coal Loader towards Balls Head. The Coal Loader was thriving industrially then, but the Gas Works was a sad relic. I wonder if any of it still exists? Perhaps one of our readers can revive its memory for me, with a future story?

The author of *Canberra's ill-fated City Railway: a particularly sorry tale*, Mark Butz, tells us he is a freelance consultant and writer and researches social and environmental history with a focus on the Canberra area. He says he is close to finishing a history of the Molonglo floodplain in Canberra. Perhaps he under-estimates his talents as an historian. He has been very successful in reviving for us here the memory of a long-lost project of the famous designer of Canberra – the American architect Walter Burley Griffin. I am unfamiliar with Canberra, despite being a long-time student of the works of WB and Marion Mahony Griffin. To me the words WB Griffin and Canberra are almost synonymous, and I was not aware that there was no physical memorial in the city, of the old fashioned sort, to either of them, except a mural created recently. Mark sent a photograph of it, so here it is, with his caption.



Canberra designers Walter Burley Griffin and Marion Mahony Griffin memorialised on a new building adjacent to The Causeway, flanked by a stylised 1913 city plan, with the proposed railway on the Causeway Axis in bold black (and with lamp post in foreground. Ed..). Photo: Mark Butz, 2020.

And now I have left little space to discuss the other stories and authors. Peter Brown, the author of *The Lake Canobolas Pump House, Orange, NSW* is a local of Orange, an accountant with a strong interest in things mechanical, and great skill in mechanical model making. David Radcliffe, the author of the *Alfred Thomas Harmon* story is an engineer and academic, who settled in Port Melbourne and became interested in its industrial history. In our issue a year ago, we published his story of Malcolm Moore Ltd, a former Port Melbourne firm. ***M.J. Doring***.

Sydney's Balls Head Coal Loader

Engineering Heritage becomes Heritage Engineering

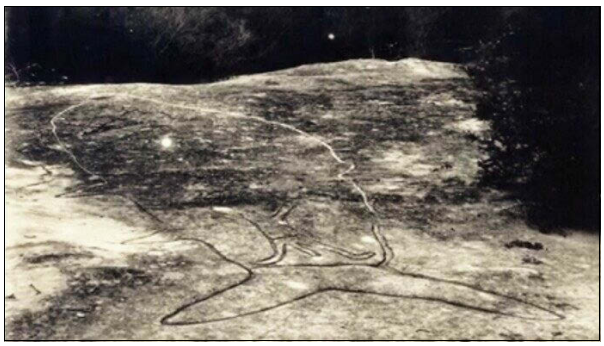
By Frank Johnson

Introduction

The Balls Head Coal Loader site, at Waverton in Sydney, is a striking example of how engineering has changed Sydney Harbour over the past two centuries and how it is still changing. The site has developed from one of striking natural beauty, through construction and operation of a dust laden coal loader, to now a centre for sustainability and public enjoyment. Thus, while the Balls Head Coal Loader is a significant example of engineering heritage, it is also an excellent example of heritage engineering, re-purposing it from an abandoned industrial site into a vibrant community facility.

Map showing the location of the Balls Head Coal Loader in Sydney Harbour. Source: Sydway Directory..

History of the Site & Area – Indigenous history

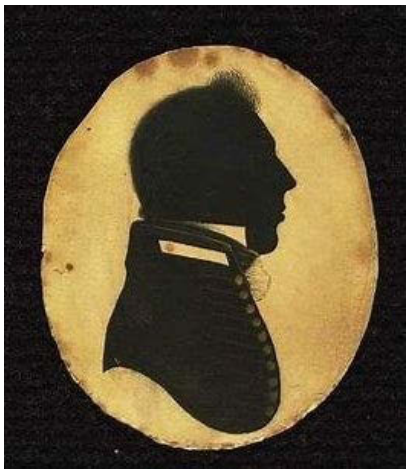


The carving of a whale at Balls Head, photographed around 1900, Source: Stanton Library, North Sydney Council (NSC).

Balls Head had a history for thousands of years before European settlement, with the original inhabitants being Cammeraygal people, who called it Yerroulbine. The peninsula was a shellfish gathering area for women and children, and part of a "canoe highway" on the harbour where men fished with spears. Evidence of the first inhabitants include fire-charred caves and middens of whitened seashells. Further, the site also had important spiritual significance, demonstrated by the stencilled hands painted on stone and engravings of animals and weapons on rocks. The largest engraving was that of a whale, which is still visible today.

History of the Site & Area – European History

The European history of this part of Sydney began in 1788. The headland was named after Lieutenant Henry Lidgbird Ball, who commanded H.M.S. Supply in the First Fleet. Ball also undertook voyages to Lord Howe Island, Norfolk Island and Batavia. It seems appropriate that he is remembered on a site so closely associated with shipping.



Henry Lidgbird Ball. Source: National Library of Australia - 4549406.

The Coal Loader is located in what was Alexander Berry's North Shore Estate. Berry and his business partner, Edward Wollstonecraft, were the first Europeans to utilise Berrys Bay for maritime purposes in the 1800s. They constructed a stone wharf, then a stone warehouse, and workers' cottages and huts.

The NSW Government took over the harbour foreshore in 1906 and leased the land to the Sydney Coal Bunkering Company, a subsidiary of the Union Steam Ship Company of New Zealand. At that time, most big ships were still coal fired, but Sydney did not have any modern facilities to handle the large quantities of coal fuel required by the many big ships passing through the Port.

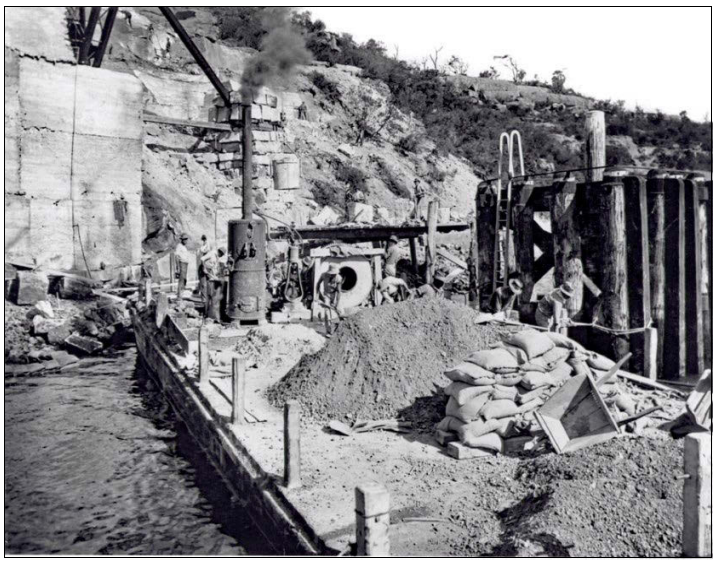
Sydney's Balls Head Coal Loader

Coal Loader History

The Coal and Bunkering Company engaged Francis Ernest Stowe as the engineer for the project. Stowe received "no objections" in May 1914 from North Sydney Council for his proposals, but wartime shortages delayed start of work on site. However, Stowe did travel to the United States to research the latest techniques in coal handling facilities.

Image at Right: A portrait of Lieutenant Colonel Francis Ernest Stowe, VD*, MIE Aus, MAm SME, Hon Ass MM&PE, MESA,, in his uniform as an officer of the 7th Light Horse (NSW Lancers). Stowe set up practice as an architect and Civil Engineer in Sydney in 1889. *Volunteer Officer's Award - First awarded 1892.
Source: LEICHHARDT HISTORICAL JOURNAL NO 4 JULY 1973.

In 1916 Stowe received the go-ahead from his client to recommence documentation of the coal loader. Stowe and Kay McNicol worked as joint engineers on the project and the Mead-Morrison Manufacturing Company in Chicago was responsible for the supply and installation of the coal loading equipment.



Construction of the seawall on Balls Head Bay. Source: Stanton Library, NSC.

Construction then commenced, with major excavations of the sandstone cliffs of Balls Head Bay. A project of this size and complexity must have been difficult at that period, at the end of WW1 and then the impact of the Spanish Flu. However, the work did advance, with limited machinery and much day labour. Most materials were sourced locally, including steel from Hoskin's Lithgow plant, brush box timber from the North Coast of NSW and ironbark from down the south coast at Cuttagee.

The engineers were quite innovative for their time and did manage to recycle materials, such as Thames River gravel from ships' ballast, that was then used in concrete. Other innovations included the localised use of reinforced concrete cellular construction for the chambers along the western edge of the storage platform, to address settlement issues of the sea wall.

Come May 1919, work was well advanced and an engineer from Mead Morrison arrived to supervise the erection of the machinery and surface gear. The Sydney Morning Herald reported that he considered that Balls Head would be "the most efficient big coal handling plant south of the line." Obviously, his work and that of the Australian contractors was quite successful, for operations started in November 1919.

Construction of tunnels 1-4 and the south sandstone wall, Balls Head Coal Loader, 1918. Note the incoming coal unloading gantry cranes already in situ, and probably in use unloading building materials from the ship lying alongside the wharf. The coal outloading pier is under construction in the background.
Source: Stanton Library, NSC.

However, at this stage the full Mead-Morrison cable railway out-loading system had not yet been fully installed. Therefore, operations started in a limited way, using the rolling gantry cranes on the main coal loader floor to both unload coal from the colliers onto the platform, and to bunker vessels with coal. The out-loading system was not fully completed until 1923, which is not surprising, given the complexity of the system.

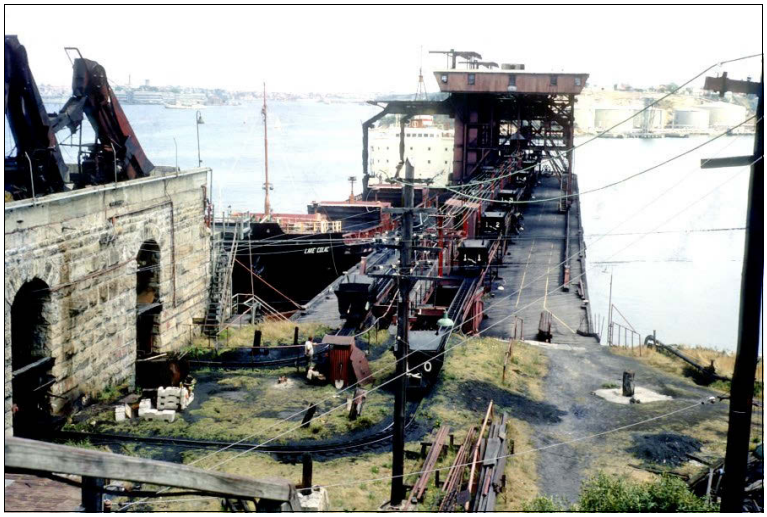
The key function of the coal loader was to transfer coal from small coastal vessels to the large ocean-going ships, which were the key operation of the Union Steam Ship Company, operating world-wide. Some coal was also taken by road to Sydney facilities that were coal powered.

With a slump in the coal industry and the diminishing need for bunkering coal powered ships, the loader was taken out of service in 1964. After some 10 years and changes in the coal industry, Balls Head was re-commissioned in 1974 as a coal export facility, transferring coal from smaller coastal carriers to large export ships, with Japan being a key customer.

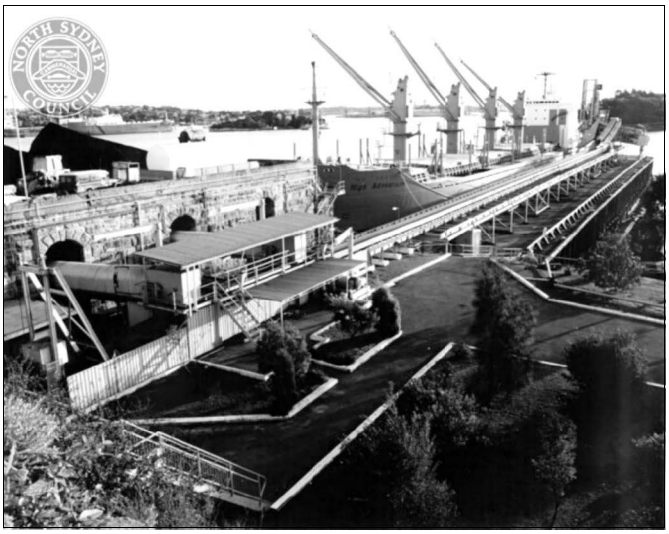
This change in operations saw the need for greater efficiency, with the site being upgraded in 1976. The outloading cable tramway was replaced by a high-speed conveyor belt coal retrieval system for loading onto the bulk carriers, which increased capacity to about 1,000 tonnes per hour. The new system was designed by the Sydney engineering consultants Soros Longworth and Mackenzie, and was constructed by Malco Industries of Adelaide. This innovative site adaptation was recognised with an Engineering Excellence award from Engineers Australia, South Australian Division.

In 1992 the coal loader ceased operations altogether. The last ship loaded was the *Sunny Success* on 21 May.

A 1942 aerial view of the Balls Head Coal Loader, showing the whole layout of the structure as originally built. Its north extent is marked by two tanks (centre of photo). The western pier where the coal is "Outloaded" onto ships has a small ship alongside. The roofs of two outloading machinery structures (N-S white lines) are visible. There are piles of coal on the platform, Seen at the south end, cleared of coal, are the holes for the chutes carrying coal down to the hopper cars in the tunnels below. Only one coal unloading gantry crane is in situ on the platform at this time. Source: Internet - no further details found. .



The Coal Loader in its original configuration, photographed in the 1960s. Shows the automated hopper cars circulating between the pier and the loading tunnels, with the ship Lake Colac docked at the pier and being loaded with coal from the hoppers.. The emptied hoppers travel into one tunnel, do a loop at the far end, and come out full from the next tunnel. Photo by Noel Mannering, Source NSC.



The Coal loader in its final configuration, with the coal moved by high-speed conveyor belts instead of hoppers moved by an endless cable. This photo shows the ship "High Adventure" docked at the pier for loading. This system was installed and operated by Coal and Allied Industries.
Photographed circa1990 by Robert Donnell.

Early Reactions

Like many major developments, the construction of the Balls Head Coal Loader and other works around Sydney Harbour received mixed reactions from Sydneysiders.

Sydney's Balls Head Coal Loader

A report in the Daily Telegraph in 1918 commenced with the description:

> *Eighteen months ago, Ball's Head was a place of sylvan beauty, whose steep sides were mirrored in the deepest depths of the Harbour.*[1]

And then went on:

> *Today that is changed, but not as changed as it will be eighteen months hence, when the greatest ships that ply to these shores will range alongside an immense jetty, and when the air will be filled with the rumbling and roaring of coal poured into hungry bunkers. No human agency will perform the task; almost entirely will it be done mechanically. The ocean leviathans will be fed as they never have in these climes been fed before and more expeditiously.*

The article then provided some detailed technical information on the coal loader (much more than the media of the 21st Century would ever do), and finished very positively with:

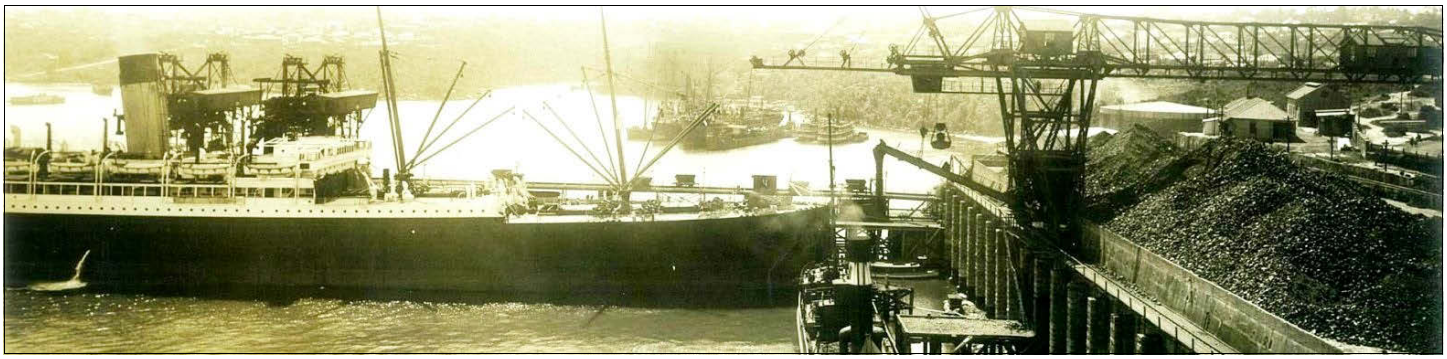
> *In this way has an enterprising company anticipated the needs of the future, so far as they can humanly be gauged, and at the same time has provided for such extensions as the growth of the port may demand.*

However, not everyone saw the development as desirable progress. One of Australia's most notable poets, Henry Lawson, wrote a poem in 1916, which he called *The Sacrifice of Balls Head.* The first verse includes:

They're taking it, the shipping push,
As all the rest must go -
The spirit of the past is dead
North Sydney has no soul -
The State is cutting down Ball's Head.
To make a wharf for coal.

So, in the early part of the 20th Century, "the shipping push" obviously held considerable sway in Sydney, which had, after all, a maritime economy where "coal was king".

Engineering Features



This 1934 photo shows a ship berthed at the coal loader pier while being loaded with coal. Five moving hoppers can be seen on the cable tramway beyond the ship's deck, and a small shed which was probably the winding house, driving the cable. At right a small ship lies against the land wharf while being unloaded. The big gantry crane can be rolled along the top of the seawall. Here it lifts a loaded grab bucket from the small ship to dump on the big piles of coal on the deck (far right). Source: Internet.

At the time of its construction, the Coal Loader had a radically different operational technology to other similar sites around the world, with only three loaders in the USA and Canada being as advanced.

The Coal Loader complex comprised the wharf along the excavated shoreline, lined by a substantial seawall, 13 metres high. 5.4 metres thick at the base and tapering to 2.3 metres at the top. This was the edge of the coal stacking deck, 450mm of mostly non-reinforced concrete, which covered an area of about 180m by 55 metres, or about 10,000 square metres, and was capable of storing around 50,000 tonnes of coal.

The incoming coal was unloaded from ships alongside the land wharf, by two massive travelling "Brownhoist" electric gantry cranes, equipped with automatic grabs (by 1942 only one of these cranes appears). The advanced technology (for the times) of these cranes can be judged by a few key factors. The grabs had a capacity of approximately 1.8 tonnes each, a hoisting speed of 150 metres per minute, and the trolleys carrying the grabs from ship to coal stacks had a travelling speed of 300 metres per minute.

1 Daily Telegraph (Sydney), Thursday 21 November 1918, p4.

Sydney's Balls Head Coal Loader

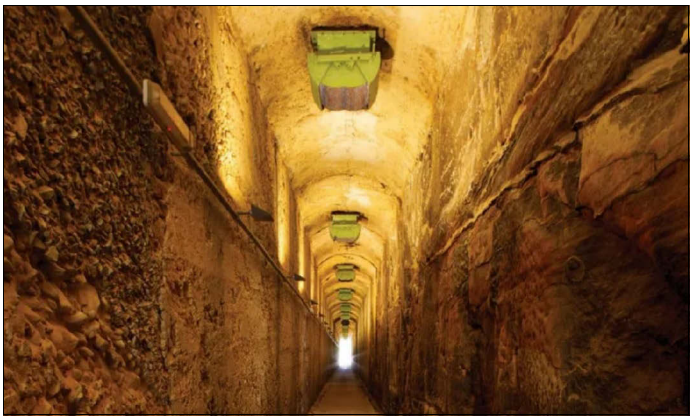
Part of a 1920 photo with a loaded grab bucket about to dump its coal on the stock pile, Source: Bonzle.

Under the coal stacking deck there were four tunnels, which were for the cable tramway to carry the coal, via the wheeled hoppers from the tunnels to the loading pier. The decision to construct four tunnels was a nod to "future proofing", as only two were ever used for transporting the coal via hoppers on the cable tramway, with the other two providing workshops and water storage space.

The coal in the stockpile was pushed (or poured) into chutes from holes in the deck down into "travelling feeders" which were driven along on side-rails high up in the tunnels, and paused under whichever deck chute was to be used.

Detail of photo showing a grab bucket releasing its coal onto the stockpile. This post WW2 gantry crane replaced the two originals. Photo, Patrick Trevor. Source: NSC

Part of a 1960s photo of the coal deck and the outloading pier. Shows (lower left) 2 of the holes in the deck above tunnel No.1 down which the coal is poured to the travelling feeder below. Top half of the photo shows the pier with the outloader structures and a number of hoppers lined along the cable tramway.
Photo Noel Mannering, Source: NSC.



The interior of one of the tunnels, showing the coal chutes in the roof, through which the coal was poured into the travelling feeders, running on rails mid-height on the side walls.. Photo: Landscape Architecture Australia. 2016

The travelling feeders automatically accepted 4 tons of coal. Each travelling feeder then moved along the tunnel, above an empty hopper car, and released its load to fill the hopper cars moving along the floor of the tunnels underneath them.

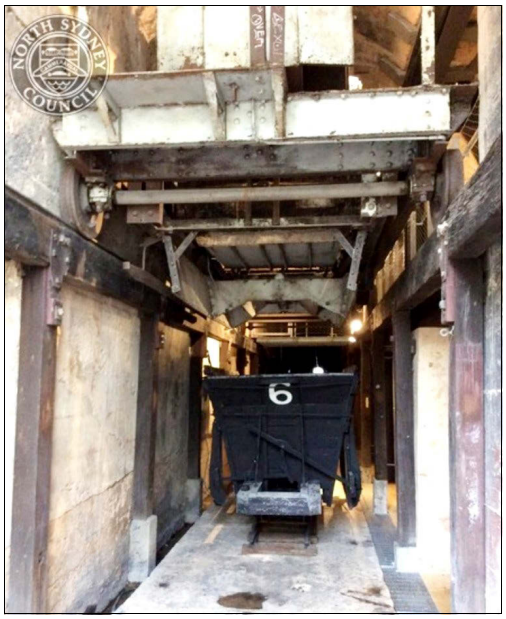


Image at Left: The base and underside of a surviving travelling feeder, perched under the roof of Tunnel No.1 on its wheels, ready to roll along the rails fixed to the sides of the tunnel. The hopper No.6 on the floor under the feeder, is one of only two surviving after the closure of the coal loader. It was restored by ICS some years ago. Photo: by David Banbury, 2018. Source: NSC.

The cable tramway was a continuous loop some 975 metres long, travelling from under the stockpiled coal and out along the pier where each hopper load of coal was "outloaded' into waiting ships. The empty hoppers continued their circuit to the end of the pier, around, and back to the tunnels to be refilled. The cable was operated (pulled along) by a winding house situated on the pier

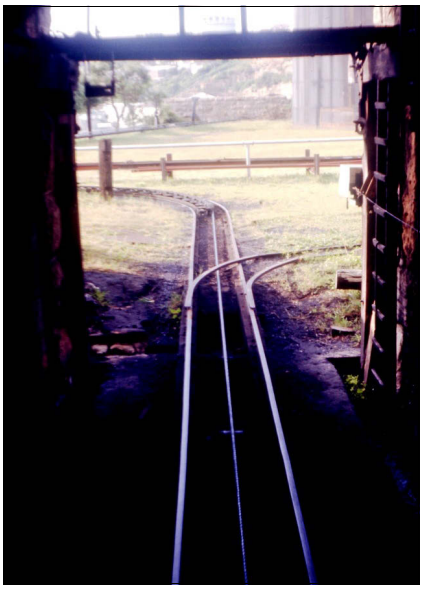
Two portable outloaders were installed on the pier, which was 18 metres wide and 164 metres long, taking it into deep water (about 45 metres) in Balls Head Bay, and thus allowing for sizeable shipping. The cable cars were hauled onto a steel trestle on the pier and automatically dumped into receiving hoppers carried by the outloaders. The latter were fitted with elevators which fed the shuttle conveyor loading booms, and then by means of telescopic gravity spouts, the coal was delivered into waiting ships from either outloader to two points simultaneously.

Looking back 100 years, the whole process gives the impression of a high-tech and well engineered approach, but it is worth looking at the tramway or cable car component in a little more detail.

Sydney's Balls Head Coal Loader

Cable Tramway

The cable tramway, one of the few outside of San Francisco, was designed and constructed by Mead Morrison of Chicago, U.S.A. Its track was laid to an unusual narrow gauge of 20 inches (508 millimetres), with light weight 35 lb/foot (17 kg/m) rails. While this was possibly the smallest commercial size available, the tramway hoppers were of substantial size with a capacity of 4 tons each. Initially 34 hoppers were provided but one was set aside to use if one of the others needed repairs. The 33 hoppers in use allowed ships to be loaded at a rate of about 900 tonnes per hour.



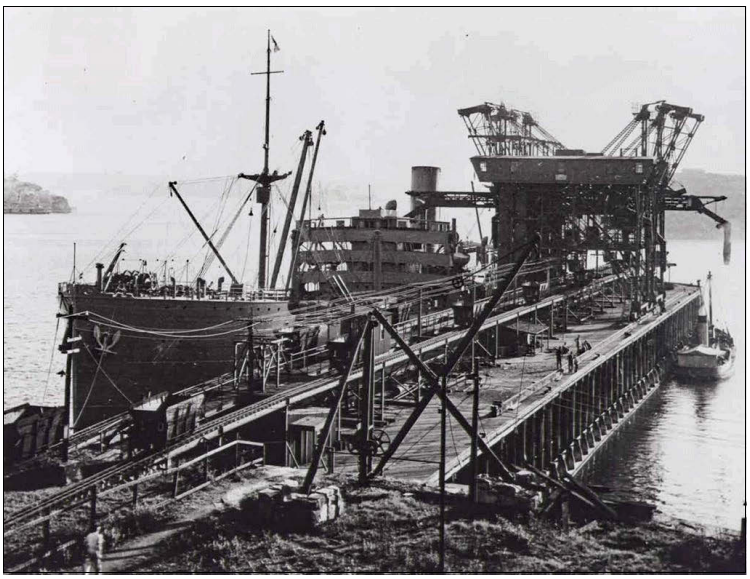
Cable tramway rails and cable emerging from a tunnel and turning left towards the pier. A maintenance siding curves off to the right.
Source: ARHS Collection no date.

Empty No.20 hopper car turning at the end of the pier to return to the tunnels for re-filling. Source ARHS Collection - no date.

The cable tramway was powered by a 125hp 450V General Electric motor, and each hopper car was equipped with a 'bottom grip', where two moving side jaws gripped the cable between the rails under the hopper. The process was automatic, although there was a manual grip lever on each car, for use in emergencies.

There were issues with the cables used for moving the hopper cars, with slippage in the grips causing cars to collide. The engineer for the Coal Loader in the 1950s - 1960s, Wilf Brogden, noted that he sought advice on this from the San Francisco cable tramway engineers, solving this problem.

Only one hopper car remains onsite at Balls Head (No.6), restored by North Sydney Council. Two of the hopper cars were donated for preservation to the Illawarra Light Railway Museum, and these are still on display and proudly featured on the Museum's website.



Above: A ship docked at Balls Head Coal Loader pier in the 1940s, being loaded with coal from the outloaders - here standing near the end of the pier. One wonders if the tiny ship (a ferry?) on the other side of the pier is also waiting to be loaded.
Photo: Robert Donnel. Source ARHS Collection. .

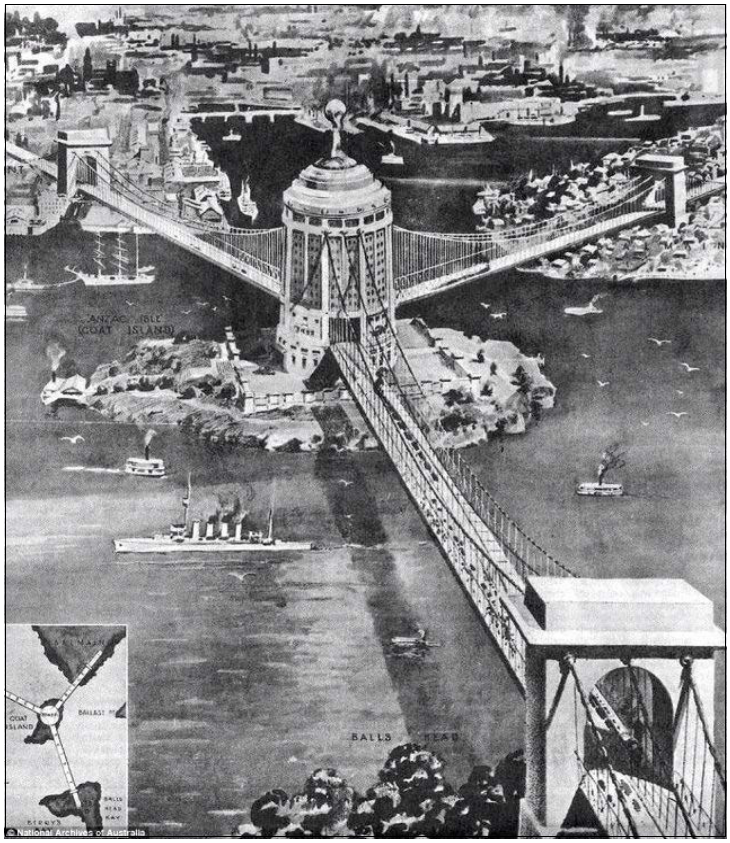
Image Left: A different view of the pier and outloaders, with a ship alongside being loaded with coal. It gives a clear view of the two cable tracks, with a walkway between them, and hoppers heading to and coming from the outloader. Photo taken in the 1970s shows the single gantry crane on the coal deck (right), which replaced the two original gantries, for taking incoming coal from local colliers onto the coal deck / coal stacks. Source: ARHS Collection.

Francis Ernest Stowe (1867 - 1936)

The story of Balls Head Coal Loader would not be complete without a further reference to its original engineer, Francis Ernest Stowe. However, Stowe was more than 'just an engineer' - he was a real polymath.

Sydney's Balls Head Coal Loader

Francis Ernest Stowe (1867 - 1936) – Cont.



Stowe's 1922 concept drawing for a Sydney Harbour Bridge. We are used to the map convention with North at the top of the page. Stowe has upended this convention, with Balls Head (north) at the bottom of the page, Goat Island in the centre, Millers Point top left, and Balmain top right. Perhaps Stowe invented a roundabout to solve the inevitable traffic congestion on Goat Island!
Source: NSW State Library.

An Irish immigrant, Stowe set up practice in Australia as a civil engineer and architect, establishing the Sydney Marine Engineers College. Stowe's interests were remarkably varied and included designing a counterweight tramway leading down to the Darling St Wharf in Balmain. He developed a concept for a harbour bridge in Sydney which had three arms, linking Millers Points, Balmain and Balls Head. Reportedly, this was only narrowly passed over by the Government in favour of the Bradfield proposal which was built.

Stowe was also in the Government's Technical Education Branch, as a teacher in 'Slide Rule', which perhaps should be an item of engineering heritage itself?

Beyond engineering and architecture, Stowe became a Lieutenant-Colonel in the Australian 7th Light Horse (the NSW Lancers). His interests ranged from philosophy, to writing books such as *Cancer and its Cause*, *Sunlight and Relativity* and *A New Universal Time System*. He was a prolific inventor, with many patents ranging from the prevention of corrugation in steel traction rails to a dust-proof picture rail.

With today's interest in the role of women in the professions, it is interesting that Stowe befriended one Florence Parsons, and employed her in his office. He encouraged her in her studies in architecture, and she later became well known as Florence Taylor, the first woman architect in Australia and the first female member of the Institution of Structural Engineers in the United Kingdom.

Stowe died in July 1936. When one looks at the extraordinary range of Stowe's experiences and achievements, it is no wonder that the Balls Head Coal Loader was such an innovative project.

Operation of the Coal Loader

Engineering Heritage generally focuses on the design and construction of engineering facilities, but equally important in my view is the aspect of operation. We are fortunate that aspects of the Coal Loader's operation were recorded in an oral history interview with Wilf Brogden, who was engineer and then manager of the facility from 1952 to 1982.[2]

When Wilf Brogden took on the role of engineer in 1952, he found that the Coal Loader was very run-down overall, with the wharf 'disreputable' and the machinery in very poor condition. There was only one crane operating and the daily output of some 800 to 900 tonnes was really very slow, despite there being hundreds of men on site. Work methods had not advanced since the loader commenced operations in 1919, as the coal loaded into ships had to be trimmed by hand, and by candlelight.

Brogden noted that he had problems with noise, as some ships arrived at 3am, and with dust. In addition, some ships discharged polluted water ballast into Balls Head Bay, which killed off mussels on the pier, forcing Brogden to complain to the Maritime Services Board. Brogden lived on site, and monitored the dust situation 24/7. Dust suppression water sprayers from the coal stockpiles were used to wash the accumulated coal dust from trees in the area, a system designed by Brogden and his staff.

2 Brogden, Wilf. – Balls Head Coal Loader (Waverton, N.S.W.) – Coal & Allied Pty. Ltd. – Park, Margaret, Sydney, 1999 (Stanton LH REF OH /212)

Sydney's Balls Head Coal Loader

End of the Line?

When the Balls Head Coal Loader ceased operations in 1992 , the terms of the lease required the dismantling of the site. Only the wharf, coal loading platform, tunnels and a few administrative buildings remained as evidence of its former operation. If Balls Head had been like so many other former industrial sites, this would have been 'the end of the line', with the site being left to deteriorate or handed over to developers. Fortunately, this did not occur and through community pressure and professional involvement, we now have an excellent example of heritage engineering.

Reconfiguration – Heritage Engineering

In the mid-1990s the local community became concerned about NSW State Government plans to sell off the former industrial sites in this area for housing. There was concerted lobbying and action, and in 1997 the then Premier, Bob Carr, finally dedicated the site as public open space.

The success of any project is very much dependent on the people involved and the reconfiguration of Balls Head Coal Loader is no exception. Three key professionals stand out here:

- David Banbury: Project Manager, North Sydney Council;
- Max Irvine: Structural Engineer, PMI Engineers;
- Steve Debello: Architect, Perform Architecture.

The work undertaken by these three was a classic case of success through collaboration, and shows what can be done by a dedicated team of professional engineers and architects.

David Banbury (left) and Max Irvine on site at the Coal Loader in 2021. Photo: Frank Johnson.

North Sydney Council had a Master Plan for the site prepared by Clouston in 1999, which was when David Banbury commenced his role as Project Manager. One of the reasons for the success of the project and a lesson for other heritage engineering works is that Banbury is still involved over 22 years later. Another key success factor was that of community backing, a long-standing aspect of the Balls Head site.

Detailed planning work started in 2005, when Council engaged the architecture firm Hassell to prepare the Development Application, which consent was approved in 2008. Site works commenced in 2009 and proceeded in four stages:

- Stage 1 (2009): adaptive reuse of the former Mess Hall and Powerhouse Building and immediate surrounds;
- Stage 2a (2009-10): lower terrace area and one of the tunnels, including a connection to Balls Head Reserve;
- Stage 2b (2010-11): adaptive reuse of the remaining upper terrace administration precinct and the curtilage to the aboriginal engraving;
- The final main stage (2016-2018): coal loader platform, including the three remaining tunnels.

When work started in 2005, the coal loader was almost 90 years old and site had been out of use for over 20 years, so this was a real challenge. There were parts that were failing and in a dangerous condition and had to be removed. Safety was always the first consideration, but an overriding objective was to demolish as little as possible, maintaining the heritage of the site. Works undertaken to restore and convert the coal loader included:

a) Keeping the water out as much as possible.

b) Investigating and overcoming the concrete cancer in the reinforced sections.

c) Determining how to merge the old structure with the new works, given the age-old problem of works not exactly conforming to design drawings. This necessitated a complete on-site measurement exercise, and in the design phase the whole structure was put into a 3D model. This innovative initiative allowed the project manager and designers to walk around in a virtual space and visualise the various proposed alterations.

d) Contending with uncertain ground conditions, for which ground penetrating radar provided real assistance.

e) Consideration of the current Building Code of Australia requirements, which required creating extra doorways, etc.

f) Where elements had to be replaced, e.g. timber supports, the new ones replicated the original as much as possible, even to the extent of 'dummy fixings' to look like the old style of construction.

g) Use of low maintenance materials, including concrete, hot-dipped galvanised steel and stainless steel, recycled hardwood timbers, and micaceous oxide paint.

Every effort was made to ensure that the new works did not overpower or detract from the heritage of the site. Due consideration was given by the structural engineer to avoid 'over-engineering', which is an important factor. For example, the coal stacking deck once supported 50,000 tons of coal but now only has pedestrians, a few lightweight structures and maintenance vehicles.

The work was undertaken in a staged program, as funding became available from Council. This was a key success factor, as there is usually a greater chance of obtaining relatively small parcels of funding, rather than a large amount up front. The periods of no funding also provided time to plan and design later stages. The ongoing program enabled the community commitment to be built up, as the locals came to use parts of the site and to appreciate its potential.

Current activity

The site now operates as the Coal Loader Centre for Sustainability, under the control of North Sydney Council. The Council pamphlet on the site describes it as:

> *The Coal Loader demonstrates the layering of human history, from the ancient culture of the Cammeraygal people, to an industrial coal bunkering facility, to a showcase for sustainability. Be inspired by innovative sustainable design technology, community gardens, native plant nursery, regenerated parklands and much more.*

The 'much more' includes the tramway tunnels, offices and workshops from its operational period, the visitor orientation deck with displays on the history and operation of the coal loader, and the promenade area over the coal loader platform. The wharf used for unloading is currently home to two vintage ships, MV Cape Don and MV Baragoola (a former Manly Ferry), which are both there for refurbishment.

The Coal Loader Deck in 2021. Photo: Frank Johnson.

The tramway tunnels are of much interest and can be accessed. No 1 Tunnel is used for art exhibitions, displays and small live music performances. In March 2021, there was an art exhibition, titled Homeward Bound, which provided a very esoteric contrast to the way the tunnels were used in times past.

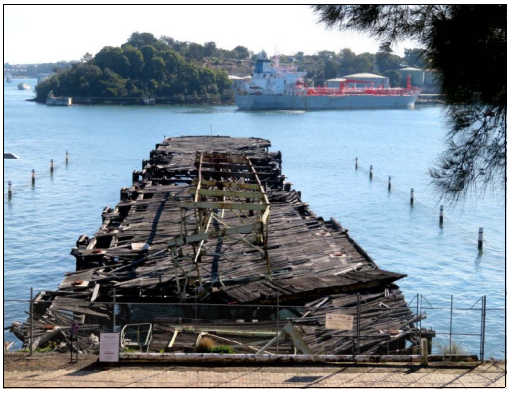
Overall, the site is very popular, with locals and tourists alike and is well worth a visit, as is the remainder of Balls Head. To make a visit even more pleasant, there is a great café on site, open Wednesdays to Sunday.

Image at Left: A ghostly art exhibition in one of the tunnels. Photo: Frank Johnson 2021.

The Pier

One element of the Balls Head Coal Loader that has not fared well is the pier, for it is rapidly deteriorating. While the rest of the Coal Loader is under the control and management of North Sydney Council, the pier is the property of the NSW State Government,

The pier was to be demolished, but this was put on hold after protests from the local community and intervention by the NSW Heritage Office. In July 2019, the then Roads and Maritime Services undertook safety work to erect piles and netting around the wharf to contain any fallen wharf elements, and navigation lights were installed to aid marine traffic. However, no work was done on the pier itself.



The dilapidated state of the Coal Loader Pier in 2021.
Photo: Frank Johnson.

More recently, some interest has been shown by Transport for NSW (TfNSW), the current custodians, who understand the significance of the maritime structure to the Coal Loader story. TfNSW and North Sydney Council are now working together on an appropriate reuse scheme which balances heritage and contemporary use objectives. Given the condition of the wharf, this certainly presents some significant engineering challenges.

And the Future?

Engineering structures are not fixed in time and the Balls Head Coal Loader is no exception. While the major structural re-purposing has been largely completed and is designed to be low maintenance, that is not the end of the story. Water penetration is still a major issue, and an ongoing inspection regime is in place. The key is to remain flexible, to be able to deal with whatever arises or is uncovered in the future.

The coal loader has recently been listed on the NSW State Heritage Register and a submission is being prepared for it to be included on the Engineers Australia Engineering Heritage Register. Such recognition is appropriate, for the Balls Head Coal Loader site is a prime example of what can be done with engineering heritage. Anyone can walk around the coal stacking area, look down on the wharf and pier, then stroll through the cable tramway tunnels. There are not many industrial engineering sites where this level of interaction is so accessible, so well developed and so popular.

Finally, one could conclude that Ernest Stowe, our polymath engineer, would have approved of the way in which his Balls Head Coal Loader has been re-purposed into a facility relevant to its current time, just as he was so keen to do 100 years ago.

Acknowledgements

Researching this article was made so much easier with the assistance of Max Irvine and David Banbury, both of whom were generous with their time for site visits and discussions. It was obvious that they shared a very high degree of professionalism and passion for the redevelopment of the Balls Head Coal Loader. Also, my thanks to Bill Phippen of the Australian Railway Historical Society for providing images of the cable tramway.

Dedication

On my first visit to the Balls Head Coal Loader, my good friend and fellow engineering heritage enthusiast, Bruce Yates, accompanied me. Bruce was very impressed with the history of the coal loader and its current re-purposing and enjoyed our time on site. Sadly, Bruce passed away very suddenly just a few days before this article was submitted, and only hours after I had spoken with him about the progress of my writing. So, this article is dedicated to Bruce Yates, a true friend and fellow traveller on the engineering heritage road.

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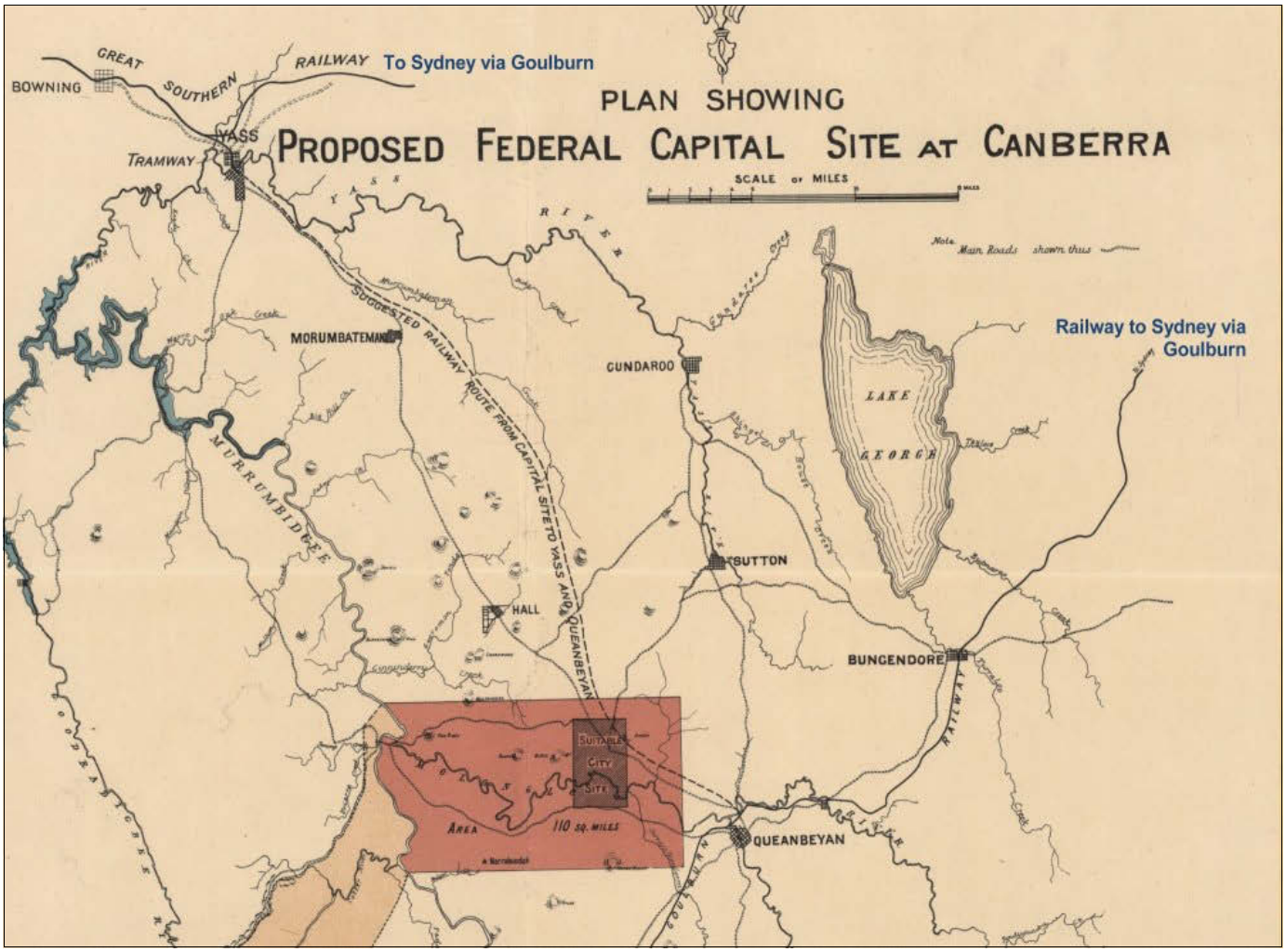
Canberra's ill-fated City Railway: a particularly sorry tale

By Mark Butz

Rail transport was fundamental to developing the new Australian Federal Capital at Canberra in the early 20th century. The site for the city was in something of a rural backwater, poorly served by both road and rail. American architect Walter Burley Griffin and his wife/partner Marion Mahony Griffin had prepared the prize winning design for the city, which included a planned railway to connect Canberra with two existing major railway lines in New South Wales (NSW). This was a potentially 'fairly easy' line through Canberra that would connect Yass on the Sydney to Melbourne Great Southern Railway, with Queanbeyan on the Goulburn to Cooma line.



Part of a drawing (dated 17th March 1908) showing, with a dotted line, the route of the 'fairly easy' railway line from Yass (top left) to Queanbeyan (at bottom) and passing through the 'Suitable City Site' which would become Canberra. Source: National Library of Australia (NLA).

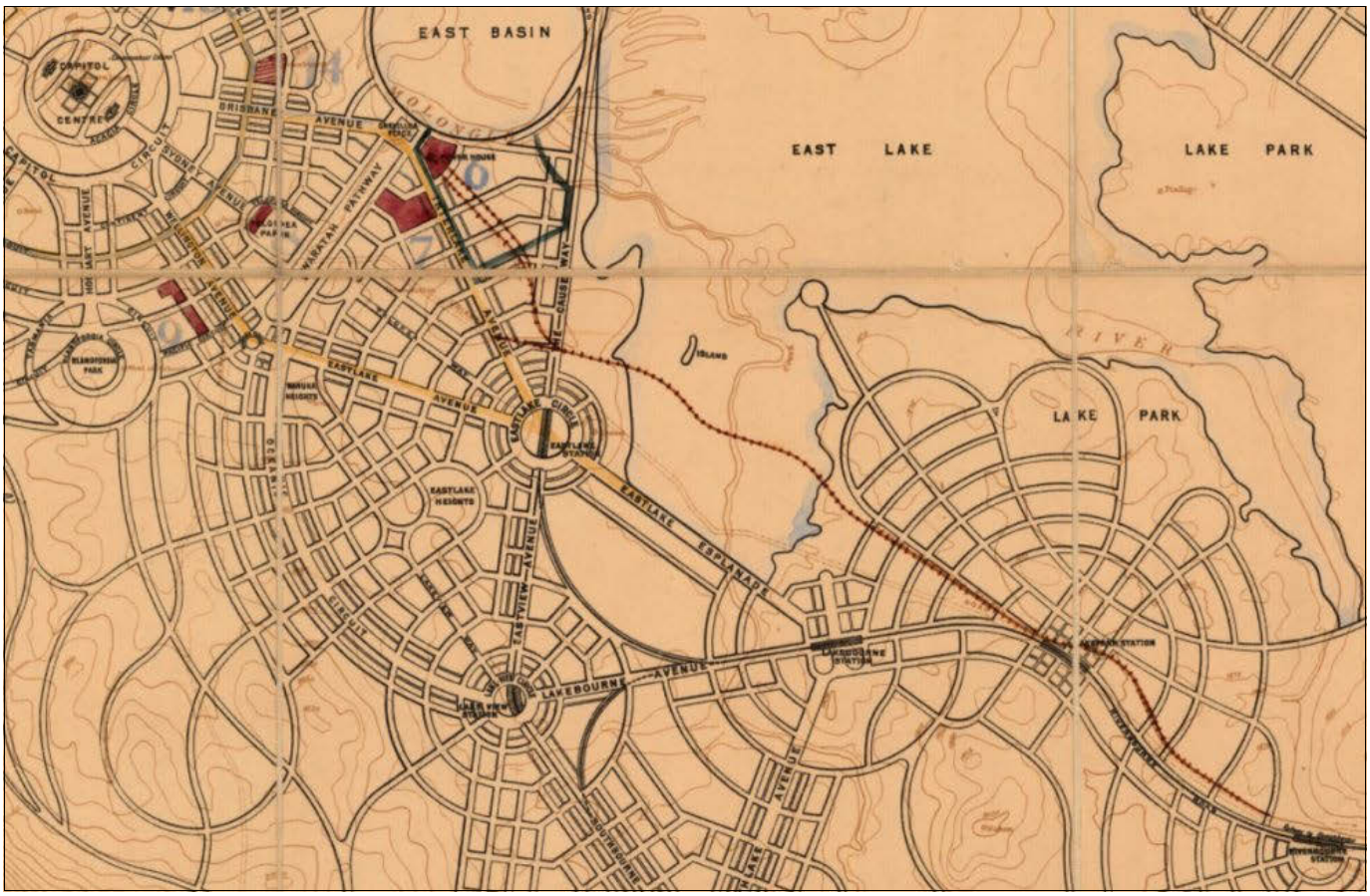
Work on the railway began even before the winning design plan could be put in place, and this set the tone for fractious relationships between the planner and administrators in the fledgling city. This City railway was a particularly sorry tale, shaped by professional animosities, wartime austerity, poor understanding of the local environment, and rapid change in the period from the 1910s to 1950s.

The new Federal Capital was to be built on the Molonglo River, a rather erratic stream with a broad floodplain. At the heart of the Griffins' 1912 design was a string of three formal sculpted central lake basins on the floodplain, flanked by two larger informal lakes (West Lake and East Lake). The design worked from the geometry of the landscape to define a series of radial axes from high points on both sides of the river, some named as the Land Axis, Water Axis and Municipal Axis. The enormous East Lake was separated from East Basin by a long 'weir bridge' that gave its name to the Causeway Axis of the plan. This embankment was to be about 6,000 feet (1,830m) long, rising 30ft (9m) above the central lake level. It was to be aesthetic, but also functional by protecting the central lake basins from silting up.

Canberra's ill-fated City Railway

The Causeway embankment was to carry a pedestrian promenade, two roadways, and a double railway line crowning the summit. In 1917 Griffin wrote proudly: *Coming in from the south, the traveller passes over a mile of causeway, between the water areas, so that the whole of the city is spread out with its vast foreground of waters and parks.*

When Griffin first visited the fledgling capital in August 1913 he found that the authorities had pre-empted his design by starting the 'Federal Territory Railway' linking Canberra to the railway line near Queanbeyan in NSW, 16 km to the east of Canberra, and terminating at the recently built Canberra Powerhouse. Queanbeyan is a station on the line between Goulburn, to the north, and Cooma, near the Snowy Mountains further south.



A small part of a 1918 'Plan of City and Environs' of Canberra, showing 'Works Constructed Or in Course of Construction', overlaid on an earlier Griffin plan of the City. The course of Griffin's proposed City Railway is a black line passing through several station from bottom right and onto the Causeway at Eastlake Circle. The line as built is shown as a dotted line coloured red. It ignores Griffin's route, charging through East Lake and across the Causeway, ending with a double (shunting) line at the Power House (coloured red with a blue No.6 printed next to it). One can understand Griffin's annoyance.
Source: NLA.

Griffin regarded this as *the preliminary railway line*, while the Powerhouse was *a decided disfigurement of the plan and of the city*. So began a tense relationship that would continue for the whole of Griffin's period of service in the capital. Work had begun on the railway from Queanbeyan in March 1913, the same month in which the city was officially named Canberra, and the first train carrying coal for the Powerhouse arrived in May 1914.

Arrival of the first train to Canberra carrying coal for the Powerhouse 1914 - a CG class loco later renumbered as 1210 - photo A D McDonald. Source: NLA.

In the other direction, even before Canberra's selection as the Federal Capital site, in 1906 an 'exploration' had been made of the 'fairly easy' line to connect Yass to Queanbeyan via Canberra. Under 1909 legislation to establish the Seat of (Australian) Government, the NSW Government was committed to meeting the costs of construction of this railway from the border of the Federal Territory to near Yass, about 60km to the north-west of the Capital City site.

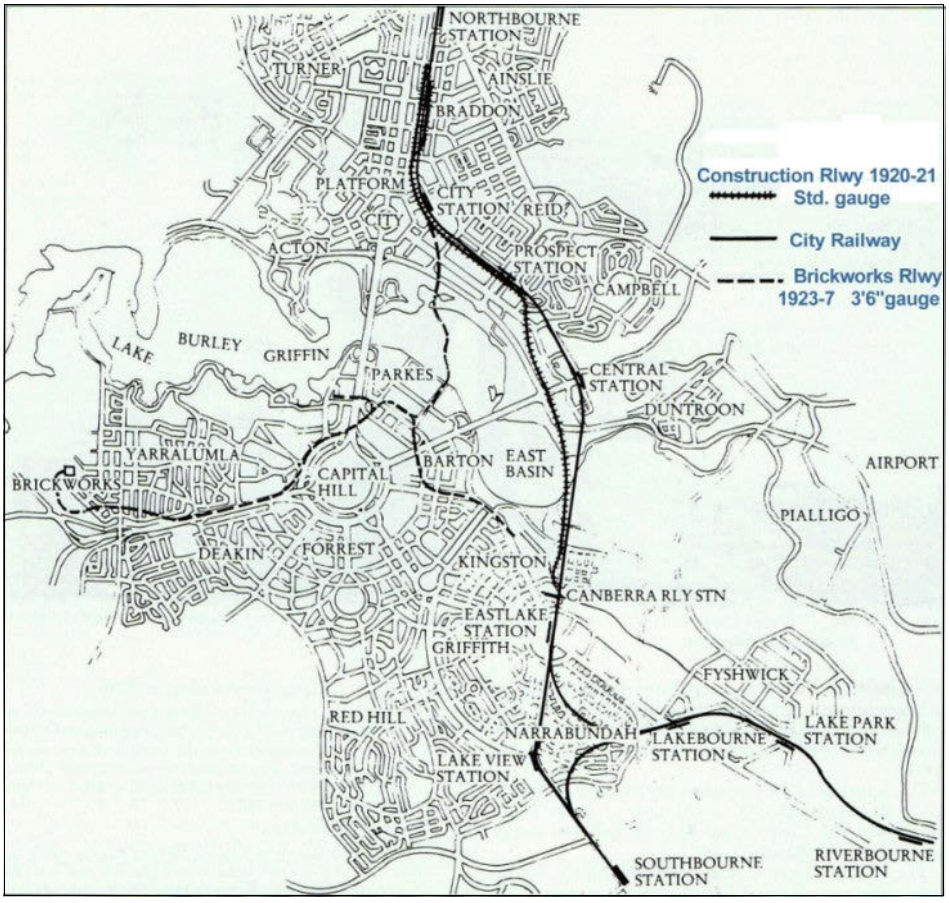
Griffin encouraged construction of this link at the earliest possible time, and both the Federal and NSW governments began surveys for a suitable route in 1916. The Seat of Government Act also provided for a rail connection between Canberra and the coast, specifically to the Commonwealth Territory at Jervis Bay. A route was explored in 1909 commencing at Civic centre, and a survey was completed in 1914.

Back in Canberra itself, after leaving Queanbeyan, Griffin's railway was to pass through six stations before terminating (initially) at City Station. It would have a very gentle grade of 1 in 200, and in the city area it would be sunken below ground level. Griffin had to work with and through a Departmental Board which did not agree with many of his ideas, considering them impractical and extravagant. The City railway was one of the earliest and most prominent of their clashes, being challenged as early as October 1913, and the Minister's intervention was required to confirm selection of his route.

Having been stalled by Departmental opposition, Griffin's ambitious plans had barely commenced when the Great War broke out in July 1914. Funds were withdrawn and nearly all works stopped, and any hopes of a strong start to developing the capital were dashed. By 1919 the Federal Territory population was smaller than it had been in 1913.

The 'Construction Tramway': a Modest Start

As Australia emerged from wartime constraints, an initial railway (the 'construction tramway') was built to the west of the alignment proposed for the permanent line (Griffin's City Railway). This too required a Ministerial decision. A timber trestle bridge (20 trestles and 68 piles) to carry the line across the Molonglo river was very conspicuous in the flat floodplain landscape, and it was tangible evidence that the capital was emerging from the retarding effect of the War.



Sketch showing the intended route of the Griffin's 'City Railway'. Close to and west of it, is the Standard Gauge Construction Railway (or Tramway) that was actually built in 1920-21. The narrow gauge Brickworks Railway (or tramway), used for moving construction materials, was built in 1923 from Yarralumla, past Capital Hill and the provisional Parliament House to the Power House at Kingston, with a branch from it travelling north and crossing the river to end at City Station.

Source: Canberra's Engineering Heritage, 2nd Ed., 1990, Ch.2, Railways, P.60.

Between the trestle bridge and branching off the 1913-14 railway line to the Powerhouse, an earthen embankment about 6ft (1.8m) high was built across the floodplain.

The standard gauge (4ft 8½ ins/1435mm) line to the Civic Centre was officially opened for goods traffic in 1921. This followed verification of the size of locomotive that could be used and the speeds that were permitted – not more than 6mph (10 kmh), and reduced to 4mph (6.4 kmh) over the Molonglo Bridge and for ¾ mile (1.2km) to and from the terminus at Civic Centre.

In addition to construction materials, the service was carrying labourers, with a long siding close to the temporary workers' camp at Russell Hill, which may also have served the Royal Military College at Duntroon. Another platform and three loop sidings about 800ft (240m) long were built in the Civic Centre. At the same time, in the second half of 1921, the rail connection to Yass was being actively pursued. These signs of progress were short-lived.

Image Above: Timber trestle bridge over the Molonglo River, to carry the 'Construction Railway' (or Tramway) from the Power House line to City Station (now Civic). Mt Pleasant can be seen at left rear. Photo c.1921, Source: NAA: A3560, 230.

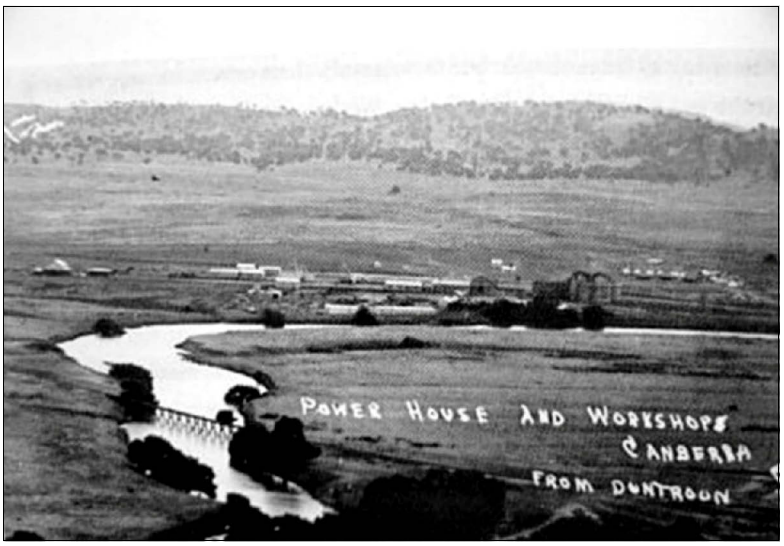


Image at Right: A postcard c.1920 shows the 'Construction Railway' trestle bridge over the Molonglo River. The Power House and Workshops are in the middle distance. Source: Sylvia Curley, "A Long Journey", pub. Canberra, 1998.

Floods ...

A view of the destroyed trestle bridge after the flood of July 1922. Source: NAA A3560, 228.

In July 1922 Canberra experienced its largest flood in 30 years, which severely damaged the new railway embankment and trestle bridge. Eight of the middle trestles were lost completely, and the foundations of several others were badly damaged. The main timbers and decking were swinging unsupported but held together by the rails. The flood badly scoured the rail embankment, washing out most of the ballast and displacing the track.

In the slowdown during the War, Griffin had held out against strident criticism to ensure that the railway embankment and bridge were built. Now they lay broken, with holes through the embankment and rails dipping into the river.

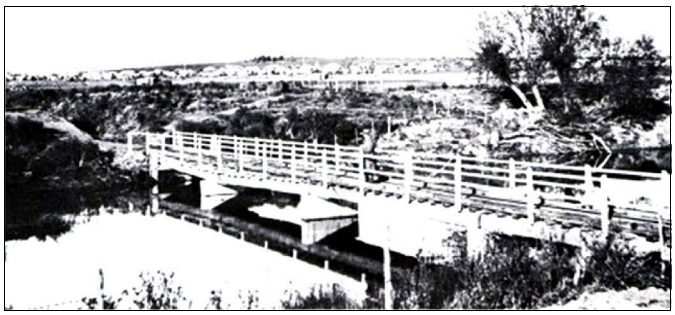
The temporary and downscaled version of the railway had provided savings, but it was poorly sited and constructed from an engineering point of view:

- Firstly, Jerrabomberra Creek had been diverted to avoid the need to construct an additional bridge. The swollen creek's contribution to the flood built up along the bank and discharged just upstream of the trestle bridge, also adding to pressure on the supporting piles. Then floodwaters punched holes through the bank, and the creek reclaimed its original course.
- Secondly, the trestles had been oriented at right angles to the line of the railway (aligned with the Causeway axis) but obliquely to the course of the river, presenting a series of large surfaces that resisted floodwaters and trapped large woody debris.
- Thirdly, it was later found that the piles had been poorly installed and were insecure at the base.

There was really no chance that the line could withstand such a flood event. The unthinkable was probably inevitable. And then, in May 1925 an even larger flood set a new record, inflicting further severe damage. The waters had gone high over the top of the railway embankment, depositing big logs and debris 3-4ft deep and washing it out completely in places. At the trestle bridge the flood tore apart the sagging railway line, and washed a mass of rails, sleepers and bridge timbers downstream.

Not everyone was aghast at the sweeping away of the damaged bridge, the Federal Capital Pioneer newspaper reporting that the flood: *has removed an object of ridicule and cutting cynicism from the gaze of anti-Canberra-ians* [sic].

Despite loss of the railway crossing, city construction work needed to continue, as inability to deliver materials put workers' jobs at risk. With road bridges also destroyed by the floods, a new light tramway connection to the north side of the river was added as an expedient, crossing from the Parliament House construction site via a low-level timber bridge. This was an offshoot of the narrow gauge (3'6") tramway that ran from 1923 between the Brickworks at Yarralumla and the Powerhouse.



This offshoot was linked to the stranded standard gauge City railway, with one rail moved inward on the existing sleepers. In this way the northern part of the City railway continued to serve, delivering bricks to build the city, until the whole Brickworks tramway was removed in 1927, to tidy up ahead of the opening of Parliament House.

Image Left: Low-level bridge over the Molonglo river, carrying the narrow gauge Brickworks railway link to the then disused City railway c.1926-27.

Source: Canberra's Engineering Heritage, 2nd Ed., 1990, p.62.

The End of the City railway ... and others

Numerous alternative schemes for the City railway were proposed but they all soon came to a halt in the face of a dismal sequence: drastic budget pruning for the Federal Capital; the Great Depression; cancellation of public service transfers from Melbourne; and notions of abandoning development of Canberra altogether. Significant flooding in 1931, 1934, 1945, 1947 and 1948 caused many to doubt the wisdom and expense of ever replacing a railway bridge over the fickle Molonglo. In 1950 it was decided to delete from the City Plan both East Lake and the City railway, while leaving open the possibility of a future rail link 'outside the city'. The remaining rails and sleepers were removed, most cuttings and embankments were filled or re-graded, and railway easements through the city were reallocated to other uses. The last bridge was removed in 1959.[1]

The City railway line was never rebuilt, complicating future rail links to Yass and Jervis Bay. As early as 1921, in the post-WW1 doldrums, the Jervis Bay railway appeared to be a distant dream, and it remained so. The link to Yass did remain a hope, until 1972 when the Bureau of Transport Economics determined that it would not be viable. Now it was official: after 50 years the City railway had been cut off at both ends and would be obliterated.

The Modern Traces

Some sections of the old track had simply been paved over, as evidenced by rails and a sleeper unearthed by excavations in 1989, by which time many residents had never known that the City railway had ever existed. This excavated track section clearly showed adjustment from standard gauge to narrow gauge.

The only tangible trace of the City railway remaining today is a truncated set of standard gauge rails and sleepers that run under the fence of the railway station and yards at Kingston. It dates from 1914 when the Queanbeyan-Canberra rail connection was established, with two short branch lines to the west serving Stores and the Powerhouse. A third branch was added, curving to the north-east to carry the ill-fated construction tramway to the embankment across the river and on to the City. This was cut after destruction of the railway trestle bridge in 1922. There are some physical indications of the route of the construction tramway and the planned City railway, despite extensive redevelopment of some areas. Enough spaces remain to get a sense of its path, ranging from gaps left between buildings, to streets that were once railway easements, to one remnant embankment.

Conclusion

Railway development has been a rather neglected aspect of Canberra's history, known mainly to a few enthusiasts. Engineering Heritage Canberra (EHC) recently operated a bus tour of Canberra's rail remnants as a prelude to release of a self-guided itinerary/brochure. This follows on from two previous self-guided engineering heritage tours developed by EHC within the 'Canberra Tracks' network. It brings largely-forgotten rail heritage to the attention of residents and visitors, taking in the original Queanbeyan-Canberra railway, the lost City railway (tramway), and iterations of Brickworks tramways that helped to build the city in the 1920s.

Acknowledgements

Research has been assisted by: ACT Heritage Library; ArchivesACT; Canberra & District Historical Society; National Archives of Australia (Canberra and Adelaide); National Library of Australia (including Trove); Army Museum-Duntroon; and the helpful staff and volunteers of those repositories.

Development of the rail remnant self-guided itinerary of Engineering Heritage Canberra has been assisted by the ACT Government under the ACT Heritage Grants Program.

1 However it was not all gloom. In the 1960s,with a new vision by the Menzies Government for making Canberra a fitting capital city, Lake Burley Griffin was constructed to a modified plan, with concrete road bridges across the lake defining the Parliamentary Triangle. Footnote – KB.

The Lake Canobolas Pump House, Orange, NSW

By Peter Brown.

Introduction

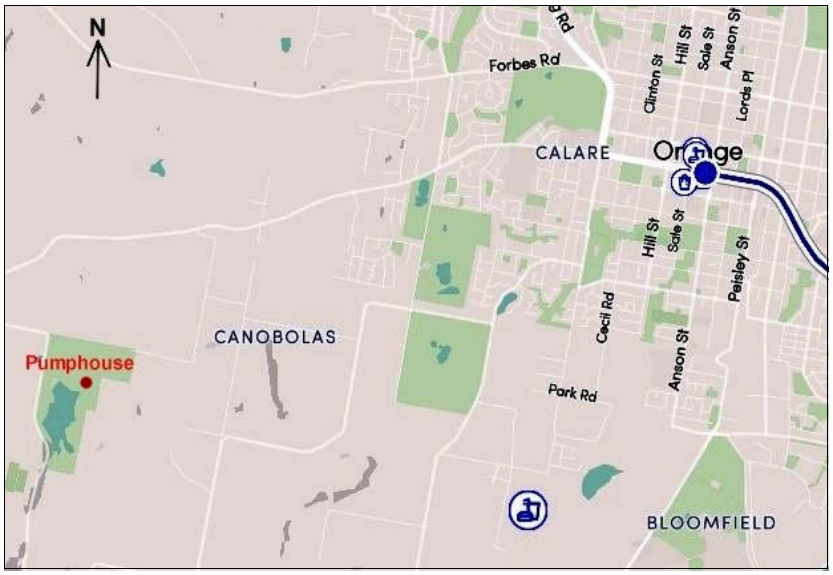
The Lake Canobolas Pump House pumping technology represents an extremely rare example of a "transition" technology – the internal combustion Producer Gas Engine (aka a Suction Gas Engine) – coming as it did between steam power and other forms of internal combustion engines and electricity as power sources.

This is an example of a large scale, complete and authentic installation, in (almost) working order apart from the gas producer. As such, it deserves to be recognised as an important example of a significant technical development and an opportunity to preserve knowledge.

Location

The City of Orange is situated in the Central West of New South Wales, approximately 260 kilometres west of Sydney. In 2018 it had a population of approximately 40,000. Growth in the past few years has largely been due to the opening of the Cadia gold mine, 20 km to the south of Orange, and the need for its support services. Cadia is currently the most productive gold mine in Australia .

In the past the district depended mainly on fruit growing and agriculture. Orange is a major centre for Health Services in Central Western New South Wales. Due to its high altitude, the Orange district is also becoming well known for the production of cool climate fine wines and food.



This map, adapted from an NRMA Touring Map (Sydney to Orange), shows the relative positions of the centre of the City of Orange (large blue dot) and the Pumphouse (red dot) in the Lake Canobolas Reserve & close to the Lake (dark green).
The Pumphouse is about 10 km from Orange.

Early History

European settlement of the area began in the 1820s, and the railway arrived in 1877. Orange is not situated on a river and so in the early days of the city every Orange home had its own well which tapped into an underground source of water which was hard (hard water is high in dissolved minerals). In addition, house drainage often contaminated it. Most residents used a windlass and bucket to access the supply. The more affluent had a small Douglas force pump. The coming of the railway led to development of the town and the need for a reticulated water supply. The first was a 400 ML reservoir constructed at Gosling Creek in 1889 and, on completion, this was stocked with 2,000 cod, perch, silver bream and yellow belly, a gift from Mr J.W. Smith of the Royal Hotel.

The then Governor of NSW, Lord Charles B Carrington, turned on the first town supply on the 8th October 1890. The total cost of this scheme, including reticulation, was £32,688 and it was anticipated it would cover the needs of the city for the next twenty years. In fact the storage, being of such a capacity, could cope without any inflows for two years. The residents were able to have lawns and gardens, though by 1911 an additional supply main had to be installed. A sewerage system for the city was contemplated in 1914 and as a result, surveys were carried out to find a suitable location for a second reservoir.

The Meadow Creek Water Supply Scheme

After an enquiry by the NSW Public Works Committee the decision was made to locate the additional supply on what was then known as Meadow Creek. Urgent preliminary works were approved and commenced on 4th January 1915. These included the laying of the rising and service mains and the erection of a Service Reservoir adjacent to the Cargo Road. In December of the same year the Orange Water Supply Act was passed by the NSW Parliament. This Act authorised the Minister for Public Works to complete the Meadow Creek water supply scheme at a cost of £49,160.

Lake Canobolas Pump House

The works included the Storage Reservoir (682 megalitres), a building to house the pumps and associated equipment, all of the necessary plant, the rising and service mains, the service reservoir on the Cargo Road and an extension of the reticulation system into the previously separate town of East Orange. A caretaker's cottage of five rooms was also constructed. This was built near the pump house and was constructed from brick, concrete and timber with a galvanised iron roof . These works were commenced during January 1916 and completed in October 1918. The completed cost was £50,668 and the storage reservoir became known as Lake Canobolas. The creek was later renamed Molong Creek.

This is the pumping station which is the subject of this article. The plant was used to pump water from Lake Canobolas for use in Orange from 1918 to 1932. However, the older (Gosling Creek) scheme was cheaper to operate, so the Lake Canobolas plant was not used continuously throughout that time. The town's water supply problems had not been solved by the 1918 scheme so a third and much larger scheme (4,680 ML) was built on Spring Creek. The Lake Canobolas plant continued to be maintained and in 1944 and 1945 and for a period in 1957 was used to supplement supply during droughts. Since 1962 water for the city has been supplied from Suma Park Reservoir on Summer Hill Creek (17,300 ML), Gosling Creek Reservoir and Spring Creek Reservoir, and from 1962 water from Lake Canobolas was no longer pumped to Orange, and the plant was abandoned.

Lake Canobolas and the Pump House. The location of the Pump House is marked by the red dot at top right. Source: Google Earth.

Since water from Lake Canobolas is no longer pumped to Orange the Lake has become a popular venue for family recreation including fishing, swimming and other activities. In July 1972 Council decided to drain Lake Canobolas in order to restore the lake bed, carry out foreshore improvements and attempt to reduce the number of redfin which are prolific breeders. They had all but taken over the lake with a population estimated at 100,000 and only about 200 of the preferable trout were left. It has since been restocked with trout fingerlings.

Much of the waste water from the city is treated and pumped to the Cadia gold mine. There it is used in the treatment of the ore from an open cut and underground mines. In 2009, due to a recent prolonged drought, the City Council constructed a storm water harvesting scheme, in order to supplement the City's water supply. This scheme was the first large scale storm water harvesting project in NSW. In the longer term the scheme should be able to supply up to 2,000 megalitres of water into Orange's water supply system. Council has also built a pipeline from the Macquarie River to the Suma Park Dam, so it is able to draw water from the Macquarie when flows in that river are above a certain volume. Consideration is also being given to the raising of the Suma Park Dam wall.

Description of the Site

The gravity dam holding the waters of Lake Canobolas is constructed of concrete with a central spillway. The wall is 39 feet high and 1,000 feet long. A large sluice valve is located at its base so that the lake can be drained. When built the lake held 150,000,000 gallons of water and the maximum depth of the lake was 40 feet. It's surface is 3,000 feet above sea level. The valley in which the Molong Creek flows is well known for its scenic beauty, with orchards covering the surrounding hills which rise up to Mount Canobolas 1395 metres above sea level, the highest point between the Blue Mountains in the east and the Indian Ocean, several thousand kilometres to the West.

Lake Canobolas Pump House

Description of the Plant

The Pump House where the Producer Gas plant, engine, pumps and other associated equipment is situated is below the dam wall and within the Lake Canobolas Reserve, ten kilometres west of Orange. The building is constructed with a timber frame and corrugated iron cladding and is 72 feet 6 inches long. Ram (piston) pumps were widely used in the nineteenth century for water supply as they were tried and tested technology, however, early in the twentieth century centrifugal pumps came into widespread use with electricity providing the power. The plant at Lake Canobolas probably had a relatively short life due to it soon becoming superseded technology, and also to maintenance issues with the Producer Gas plant.

The Lake Canobolas Pumphouse. This view is of the side of the building facing the dam wall. The Producer Gas Plant is behind the double doors at right.
Source: Orange Council.

The Gas Producer

It should be noted that the gas made by this process is correctly named Producer Gas. There are other technologies which produce combustible gas from coal, coke or wood – Coal Gas, Water Gas and others – but those are not Producer Gas. Sometimes, in other jurisdictions, notably in the UK, Producer Gas is known as Suction Gas, since the engine cycle provides the suction to drive the process.

There are two sections to the Pump House building. The first is 24 feet long. This houses the gas producer and coke store. It would appear that only coke was ever used for the production of gas here, and during the working life of the plant it is suggested that this fuel would have been readily available from the town gas works located adjacent to the railway line in Orange.

The producer gas plant consists essentially of three parts. The Generator where the gas is actually produced. The Vaporiser provides steam for enriching the gas. The Scrubber cleans and cools the gas prior to it being used in the engine. There is also a Reservoir Box where the gas is held prior to admission into the engine. To start the process, the Generator is filled with coke by means of a hopper on its top and a fire is lit. A hand blower mounted on the side of this unit is used to assist in commencing the reaction until the suction of the operating engine takes over. Gas is produced by drawing a mixture of air and steam through the incandescent fuel in the Generator. Water, which is first fed through the Vaporiser, is heated by the gases leaving the Generator and provides the necessary steam for the gas-making process. Before entering the Generator the air for the process is passed through the Vaporiser where it is saturated with the necessary amount of steam. After heating in the Vaporiser the gas passes into the Scrubber where it is passed through a column of coke, kept wet by a suitably arranged sprinkler. This cleans and cools the gas, which needs to be cleaned as the reactions create other less volatile hydrocarbons which would clog the engine if not removed.

Finally the gas passes into a Reservoir Box where it is held prior to entering the engine by means of pipe work. The suction provided by the engine on its intake stroke provides the necessary vacuum to sustain the reaction. From then on the process is automatic while the engine is running, providing the Generator is kept recharged with coke as necessary.

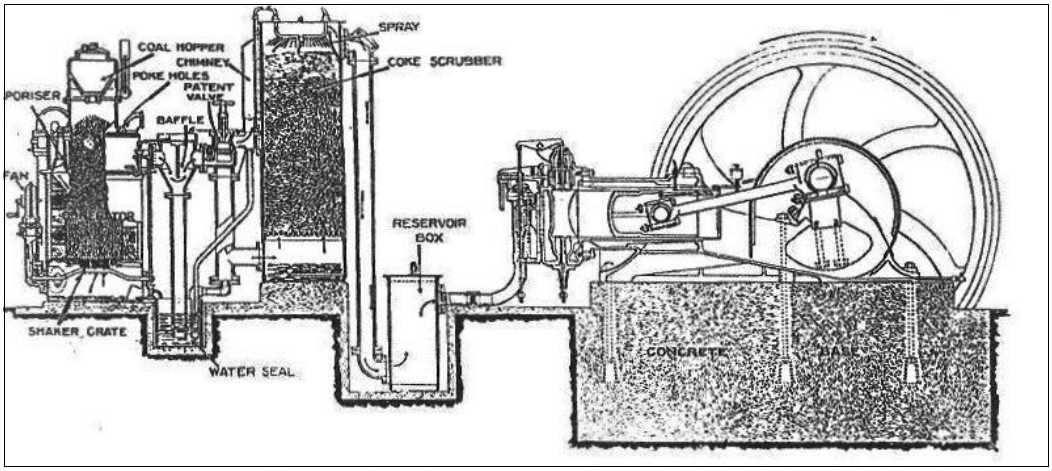
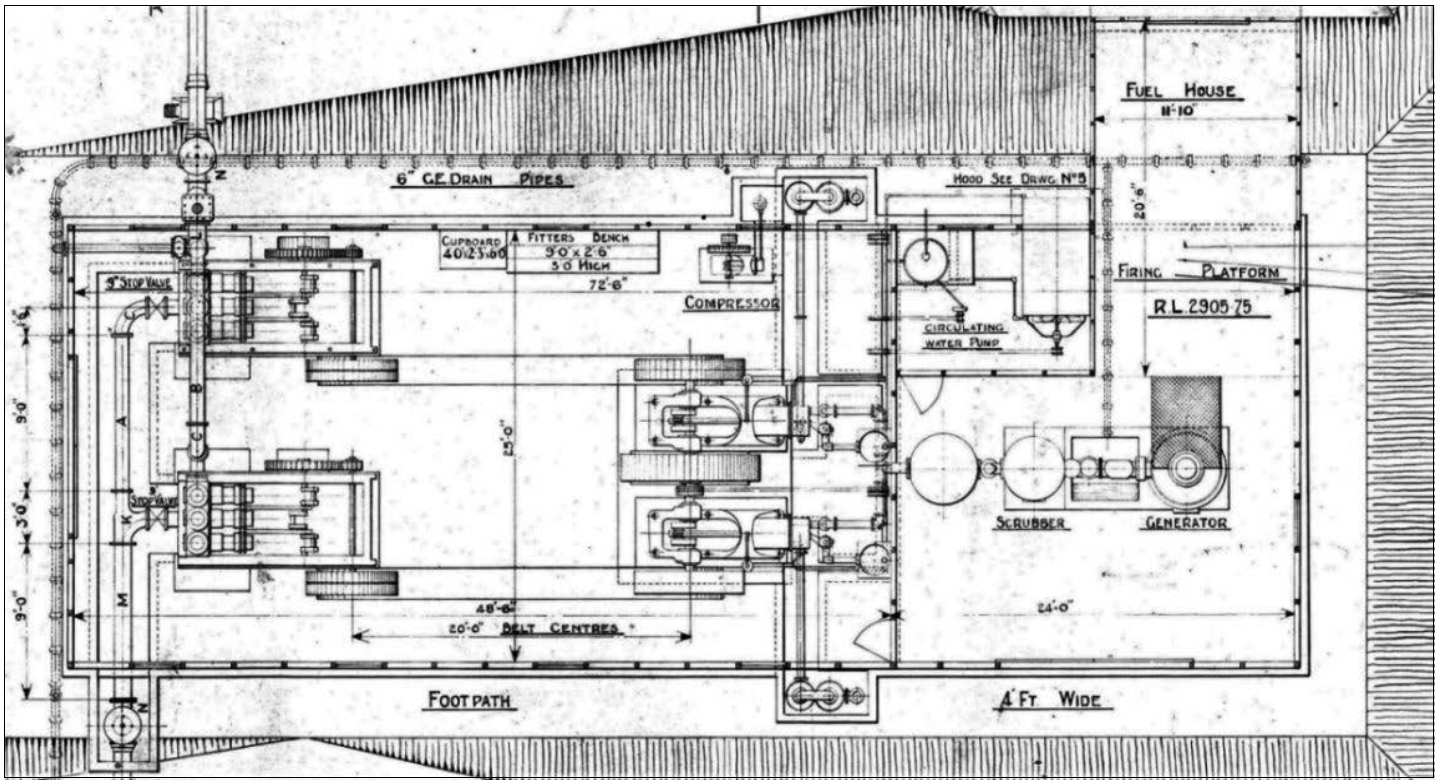


Diagram showing a section through a Hornsby Stockport Gas Engine (right) and Suction Gas Plant (left).
Source: Orange Council.



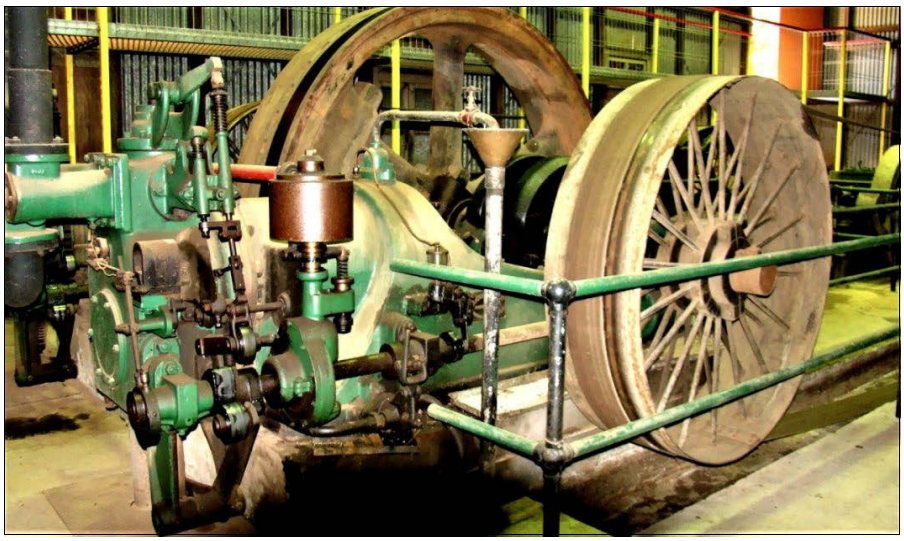
Plan view of the equipment layout in the Pump House. The producer gas plant is on the right, and the water pumps on the left. Source: Orange Council.

The process will stop when the engine is shut down. The gas produced by this process is generally known as Producer Gas and is similar to the gas used by many motor vehicles during the Second World War, when petrol was in short supply. Older people in the community will remember the ungainly gas producer units attached to taxis, cars and commercial vehicles, and the gas bags lying on the roofs of the vehicles..

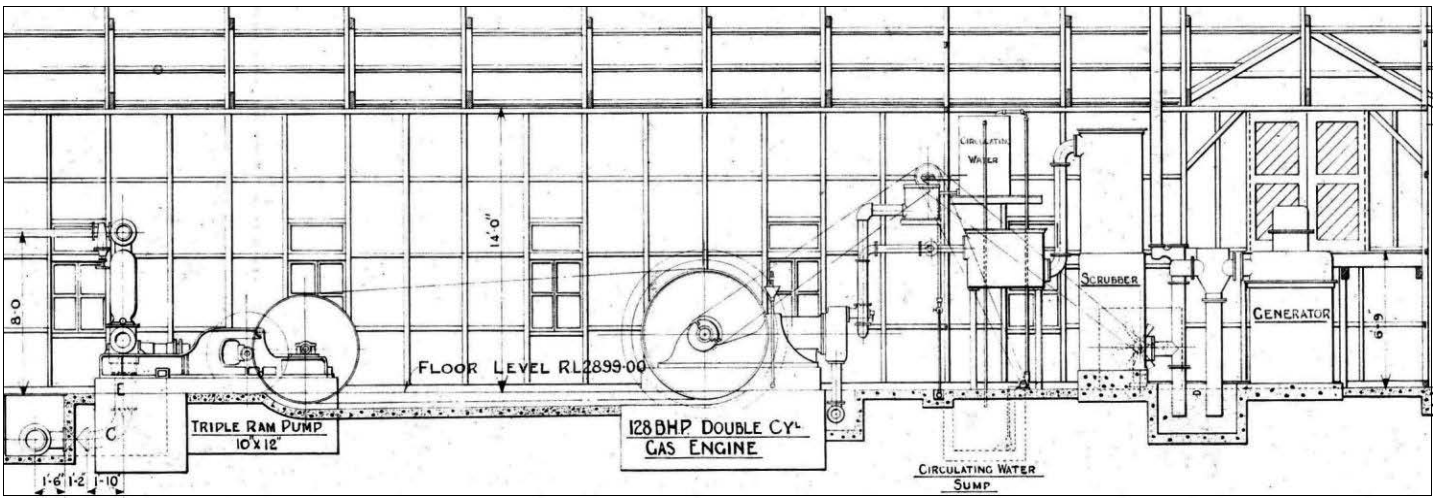
Producer Gas is a mixture of carbon monoxide, hydrogen, carbon dioxide and inert nitrogen. Richard Hornsby and Sons Ltd of Grantham and Stockport, England, the manufacturers of the plant, recommended that the Suction Gas Plant should be located in a well ventilated location or situated in the open air. Their primary concern was that the fuel gas produced contained carbon monoxide, a colourless, odourless and tasteless gas which is very toxic to human beings. A test cock was provided close to the engine to check when the gas was of sufficient quality to run the engine. The instructions said: *It should burn continuously with a good blue flame.*

The Engine

The second section of the building houses the Hornsby – Stockport Suction (or Producer) Gas Engine, which operated the pumps. This unit is a two cylinder engine, Works number 50137, rated at 128 brake horsepower with an operating speed of 230 rpm. It has the distinction of being the last engine manufactured by Richard Hornsby prior to the First World War and it was shipped to Melbourne, Australia on 24th February 1915. The Admiralty took over the Hornsby factory for the duration of the war. As a matter of interest, the first engine (No.52138) built by the Company after the war was also shipped to Melbourne, for installation at Mildura, on the 17th August 1920.



Side view of the Hornsby-Stockport Gas Engine. The flywheel is centre, one pulley operating a pump is at right, the other pulley operating the other pump is barely visible behind the flywheel. The gas plant is out of the picture to the left, and the two pumps are out of the picture to the right.
Source: Orange Council.



Longitudinal sectional drawing of the equipment layout of the Pump House – gas generator at right, gas engine at centre, pumps at left. Source: Orange Council.

The two engine cylinders were each equipped with a magneto and spark plug, and used a common flywheel, located between the cylinders. The flywheel has a diameter of 8 feet 2 inches and a width of 19 inches. The engine cylinders are 15 inches diameter driving onto a common crankshaft. On the outer ends of this crankshaft are keyed two pulleys each 5 feet 6 inches in diameter. The water pumps are driven by long flat belts from these pulleys.

Two methods were available for starting the pump engine. Detailed instructions for both methods were given in a manual provided with the engine. The method of starting the engine in the Pump House at Lake Canibolas was by use of compressed air. Richard Hornsby and Sons provided a small air compressor engine, number 38383 of 3 horsepower for this purpose. It is of a rare and unusual design with two cylinders. A power cylinder with magneto and spark plug is coupled to an air compressor cylinder on the same crankshaft, which charged an air receiver and so provided the necessary power for starting the main engine. The principle used here was that on stopping the engine at the end of a pumping session, the energy stored in the flywheel could generally be used to drive the engine as a pump to provide compressed air for the next start. Again detailed instructions are given for this method.

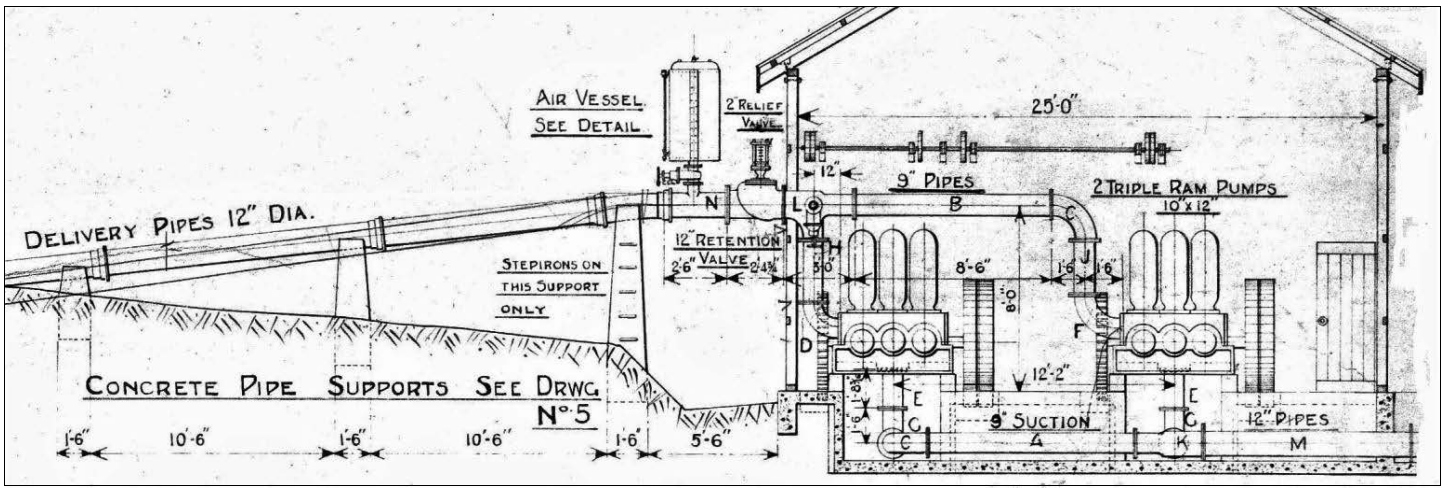
The Orange City Council still has the original *Instruction Book* for the engine. It makes quite interesting reading with a considerable emphasis on safety. At the beginning under the heading *Precautions* the instruction book says – *Never take out the piston or remove any part for examining the interior of the Engine without first disconnecting the wire from the Magneto to the sparking plug.*

The Pumps

One of the triple ram piston pumps. Note the massive crankshaft and (at right) the curved safety guard over the speed reduction gear wheel.
Source: Orange Council.

Also in the second part of the building are the two triple ram piston pumps. These were manufactured by R. Warner and Company (Engineers) of Walton on Naze, England. The centre distance between the engine pulleys and those on the pumps is 24 feet, the pump pulleys being 5 feet in diameter. The pulley shafts were coupled to the pump crankshafts by speed-reduction gearing. Each pump has three 10 inch diameter pistons with a stroke of 12 inches and had a total output of 60,000 gallon per hour. An original drawing (see next page) shows 3 air vessels (one per cylinder) above the output manifold /valve chamber of each pump. The purpose of the air vessels was to cushion the damaging effects of water hammer in the pipes. However, it will be noted, from two of the fairly recent photographs of the pumps, that at some stage the holes provided for fitting the 3 air vessels have been capped, and instead there is a single air vessel on each pump, connected into the start of its delivery pipe. It seems likely this design change was made during manufacture of the pumps or at least before installation of the pumps, as doing it later would have been very difficult.

Lake Canobolas Pump House



Cross section of the Pump House building showing the two triple ram pumps, the delivery pipes from each of them, and the 12" cast iron rising main to the service tank, with its concrete supports. The three air vessels shown on each pump (the original design) were replaced by a single, larger air vessel on each pump (as built).The rising main, its valves, and its concrete supports are all still in situ (see the photos below). Source: Orange Council.

Image Right: Shows the silver coloured single air vessel and delivery pipe from the right-hand pump (in the drawing above), the left-hand pump (green) and its single air vessel (black). Source: Orange Council.

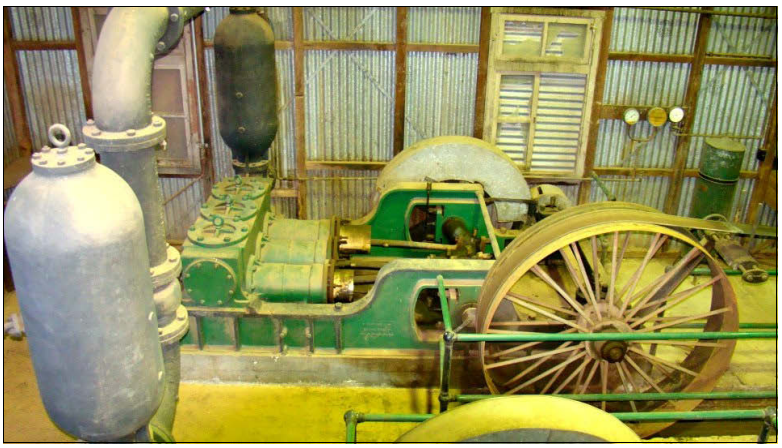


Image Left: Shows the delivery pipe from the left-hand pump in the drawing above, rising outside the shed wall, to join the delivery pipe from the other pump, and the start of the long 12" rising main on its concrete support.

Source: Peter Bell.

Water from the two pumps was fed into a common cast iron rising main, 12 inches in diameter, with 9/16" thick walls, and just under two miles long. The water flowed through this to a 500,000 gallon service tank, nearly 140 feet above the pumps, at an elevation of 3,036 feet on the Cargo Road near the outskirts of Orange. It was then reticulated by a 10 inch gravity main to the homes and businesses in the city.

Preservation

The plant operated for the last time in 1957. Thirty years later, and at the instigation of Mr R.N. (Bob) Copleston, Head Teacher of Fitting and Machining at the Orange College of TAFE, Orange City Council gave approval for restoration of the building and its equipment. Work commenced in March 1987. Taking part in the restoration work, with Mr Bob Copleston as Project Manager, were students from the Fitting and Machining, Carpentry and Joinery, Painting and Decorating, Plumbing and Welding disciplines of the TAFE College. Mr Dick Page and other staff at the College were also involved. The first priority was the removal of water, rust, also dry silt, mud and other debris. Externally the building was overgrown with trees and blackberries some of which had found their way into the interior of the structure.

The second stage of the project involved cleaning and dismantling the engine and pumps and removing seized pistons, cleaning and reassembly. Bearings were also dismantled, cleaned and lubricated before reassembly. After thirty years of inactivity the plant was finally able to turn over freely.

Lake Canobolas Pump House

The final stage of the project was the construction of a viewing platform and a drive so that the engine and pumps could be viewed in motion. The platform, of welded steel construction, is 72 feet 6 inches long, allowing visitors to walk the full length of the building and view the complete plant. The gas engine can now be run (for demonstration purposes) by means of a friction drive via a pneumatic-tyred wheel, pressing against the rim of the much larger engine flywheel. This pneumatic tyred wheel is driven by a small electric motor via a 200:1 reduction gearbox.

Image Right: Shows the elevated viewing platform/walkway (left). The camera looks down on the Hornsby Stockport Gas engine, with the two pumps seen in the distance. Source: Orange Council.

Statement of Significance

From The Lake Canobolas Pump House Conservation Management Plan:

Lake Canobolas Pump House is historically, aesthetically, and technologically significant as a rare surviving early twentieth century pumping station. The pumping station was built between 1915 and 1918 as part of the Meadow Creek Water Supply Scheme. The purpose of the Scheme was to augment the existing water supply for the growing town of Orange. The Lake Canobolas Pump House illustrates historical efforts to provide an adequate water supply for Orange which, unlike many other NSW towns, is not located on a river.

The Pump House demonstrates the effectiveness of the Country Towns Water Supply and Sewerage Act 1880 in the provision of water supply infrastructure for country towns in NSW.

The Pump House has a raw industrial aesthetic and illustrates working conditions in small industrial work places at the beginning of the twentieth century.

The Pump House includes a remarkably intact collection of pumping equipment, the purpose of which was to pump water from Meadow Creek reservoir (Lake Canobolas) to the Cargo Road service reservoir. The Pump House has the ability to provide further information about the history, technology, operation, and rarity of individual pieces of its equipment collection.

The Pump House demonstrates the reliance of Australia on British technology and manufacturing in the early twentieth century, and the use of technology common at this time.

Conclusion

The Lake Canobolas gas producer, suction gas engine, pumps and associated equipment are quite remarkable in their completeness. The only item missing is a large 112 pound spanner which was used on the large nuts of the engine flywheel boss. Given the necessary funding and expertise it should be possible to restore this historic and rare equipment to working order. As far as this writer knows, the only surviving similar engine in Australia is a smaller Hornsby Suction Gas Engine being run on Propane gas at a museum in Gatton, Queensland. Council has had experts survey the Lake Canobalas plant and prepare a Conservation Management Plan so that it can be properly conserved.

The writer wishes to acknowledge the valued assistance freely given to him by Bill Phippen and by the staff of the Orange City Council, especially Alison Russell. Bill is also hopeful that in due course, the Pump House and its equipment will be placed on the NSW Heritage Register and that an Engineers Australia Heritage Marker will be approved.

References

Records and Documents held by the Orange City Council.
Lake Canobolas (Meadow Creek) Pump House, by Mr R N Copleston, 1988.
Orange and District Illustrated, Orange City Council, 1989.
Lake Canobolas Conservation Management Plan by Kate Higgins and K & H Ainsworth Engineering Pty. Ltd.

Alfred Thomas Harman
& the Port Melbourne Engineering Works

by David Radcliffe

Introduction

From 1902 to 1975, the Port Melbourne Engineering Works, later Alfred T Harman & Sons Pty Ltd and Steel Castings Pty Ltd, was nestled amongst Victorian era cottages in Derham Street, Port Melbourne. Initially, they produced a variety of steam powered machinery before specialising in winches and winding gear used in maritime, mining and forestry operations. Their reputation for innovation and quality broadened as they diversified into designing and making a wide variety of excavation equipment used in infrastructure projects nationwide. Three generations of the Harman family led this evolving engineering business founded by Alfred Thomas Harman.

A 1939 aerial photo showing (in colour) the Port Melbourne Engineering Works (at left) and the Port Melbourne Engineering Machinery Stores (at right). The view is from North (bottom) to South (top). Williamstown Road runs across the width of the photo, Derham St runs off Williamstown Rd and between the coloured buildings. Part of Port Melbourne Cricket Ground is in the foreground with a match underway. Source: State Library Victoria

Background

Born in Peckham, Surrey in 1864, Alfred Thomas Harman came from a business background. His father, Alfred Hugh Harman, set up a small photographic printing company and patented a process to produce enlarged photographs with an artistic finish. In 1879, he began to manufacture gelatine plates for other photographers, a business that grew to become the Ilford photographic film company in 1900.[1] About the time A.H. Harman began making photographic plates, he left his wife and seven children, including Alfred Thomas, who was then in his teens. The fallout included Alfred Thomas and his brother Percy emigrating to Melbourne in the early 1880s.


HIGH CLASS PHOTOGRAPHS.
BY ALFRED HARMAN & CO.
CARTES DE VISITE, and every other style, taken daily; no appointment necessary. Photographs enlarged and painted in various styles, at prices to suit all classes.
ESTABLISHMENTS: 79, HIGH STREET, PECKHAM, OPEN EVERY DAY
EWELL ROAD, SURBITON HILL, OPEN ON WEDNESDAYS AND SATURDAYS ONLY.

Advertisement for Alfred Hugh Harman photography (1874) Source: Graces Guide

By some accounts, Alfred T Harman began to offer his engineering services in 1885. Aged 24, he married Margaret Chrimes in 1888 and while his trade was listed as engineer, he was employed as a lumper on the wharves. By 1891, they had purchased a house in Port Melbourne near the corner of Derham Street, and in 1893 he built a workshop in the backyard from which he operated his engineering business. He proudly advertised his services as an *engineer, blacksmith and brass-founder* offering *engines and machinery of every description made to order and repaired at lowest possible rates.*[2] In the early days of the business Alfred Harman also supplemented his income by working as a ferry-master. The story goes that his passion for steam extended to racing steam ferries and on one occasion he ran a ferry aground.[3]

Port Melbourne Engineering Works

In 1902, Alfred Harman purchased land on the south-east side of Derham Street, near the intersection with Williamstown Road, where he erected the Port Melbourne Engineering Works. A contemporary newspaper article described this new facility in glowing terms.

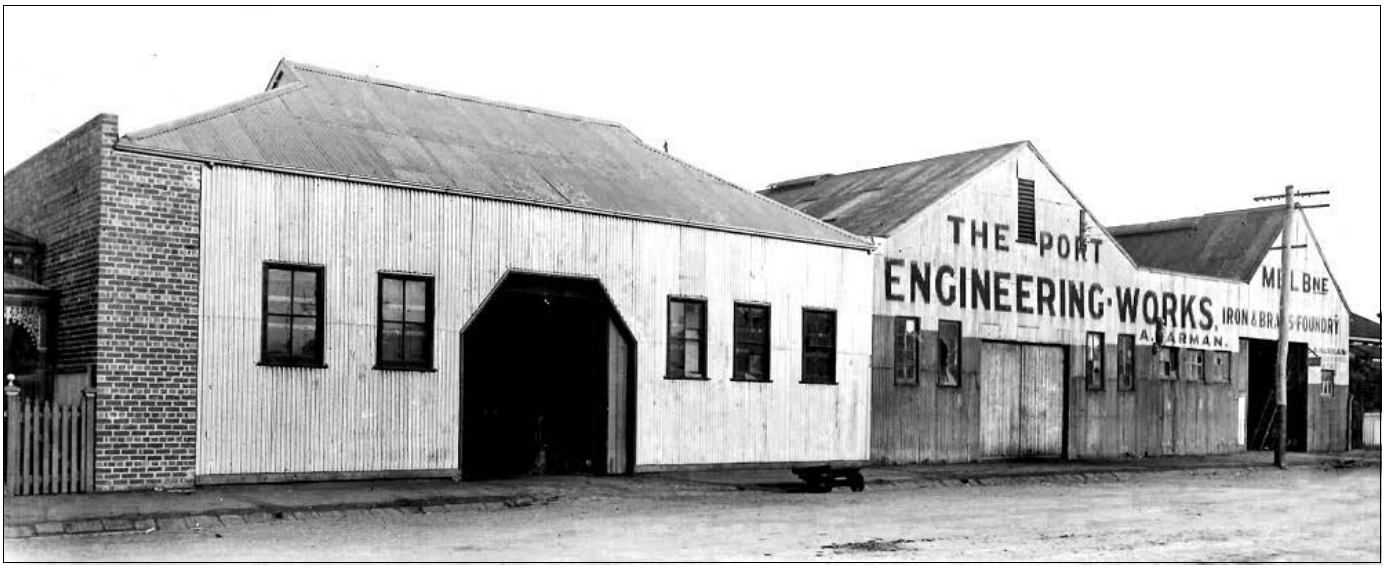
The engineering establishment of Mr. A. T. Harman is one of the most complete for its size of any about Melbourne, and some

1 Michael Pritchard, *The Development & Growth of British Photographic Manufacturing and Retailing 1839-1914*, PhD Thesis, De Montfort University, 2010.

2 Standard (Port Melbourne), 30 November, 1895, p. 2.

3 Jim West (2015), *A History of Steel Castings Pty Ltd,* Unpublished, 4 pages.

first-class work is turned out. The shop, which covers a good area, is fitted up in a most compact manner, and is a very comfortable place to work in. One of the features of the place is the floor, which is laid- down entirely of hard wood, forming a durable and pleasant walking foundation; it also gives the place a cleaner appearance than most engineering shops. The plant is a most replete one and contains the latest drilling and planing machines and lathes. There are also appliances for brass moulding and a smithy's forge. The pattern room is another feature of the establishment.[4]



The Port Melbourne Engineering Works, on the south-east side of Derham Street, c.1920. The Harman family lived in a cottage on the right for a decade.
Source: Port Melbourne Historical and Preservation Society (PMHPS) Collection.

The Machine Shop, Port Melbourne Engineering Works, c.1920. Source: PMHPS Collection.

By 1907, the firm employed 40 workmen and specialised in steam powered winches with 32 different models. They were also the only manufacturer in Australia of Pickering governors for steam engines.

There was a deep sense of pride in the engineering capabilities of this local manufacturer when they won the contract to supply a high-speed winding plant for the Sydney Harbour Collieries Company to haul coal from undersea deposits. It was reported that this was the largest machine of its kind in Australia, built entirely using local materials and workmanship.[5]

4 *Local Industries: Mr Harman's Engineering Establishment*, Standard (Port Melbourne), 10 June 1905, p. 3.

5 *Mammoth winding plant: An Example of Local Skill*, The Age (Melbourne), 19 November 1907, p. 7.

Machinery Store

Alfred Harman not only manufactured machinery but was also an agent for a variety of engineering equipment made by others. In 1911, he built the Port Melbourne Machinery Stores opposite the Engineering Works in Derham Street. They sold new and second-hand equipment manufactured by them and by others. This included petrol and suction gas engines (horizontal, vertical and compound), mining and sluicing plants, boilers (multi-tubular, vertical, jackass, colonial and Cornish), mining, dredge and ships winches, steam driven gravel pumps, wood working equipment (saw benches, mortising, moulding and planing machines), brick making plants of all-kinds, nozzles, piping, wire ropes, shafting, pulleys and plummer blocks.[6]

Port Melbourne Machinery Stores, on the north-west side of Derham Street with a cottage on the right, c.1920. Source: PMHPS Collection.

Family Business

Alfred and Margaret Harman and their growing family of five children moved into Derham Street, next door to the factory in 1905. The business was profitable, and this was reflected in the upward mobility of the Harman family. In 1910, Alfred accompanied his eldest daughter, Margaret, aged 18, on a six-month trip to the 'old country' to visit family. On the eve of the trip, all 50 employees attended an 'at home' to bid them 'au revoir' and present the travellers with gifts, a beautiful travelling rug from the journeymen and tobacco pouch and pipe from the apprentices. There was a musical program performed by the guests and several spoke in eulogistic terms of Mr. Harman and he responded 'in his usual good-humoured way'.[7]

Then in 1913, following the death of his father, Mr and Mrs Harman and their second daughter, Clara, visited England. By 1914, the Harman family had moved from Port Melbourne to live in the more salubrious Canterbury, home of the well-to-do in Melbourne's leafy east. The following year, Margaret married an engineer from the company, Fred Dehais. However, tragically, she died during childbirth in 1916. Clara and their third daughter, Hazel, each married in 1923, with both weddings being featured in Table Talk, a weekly social magazine of the time.

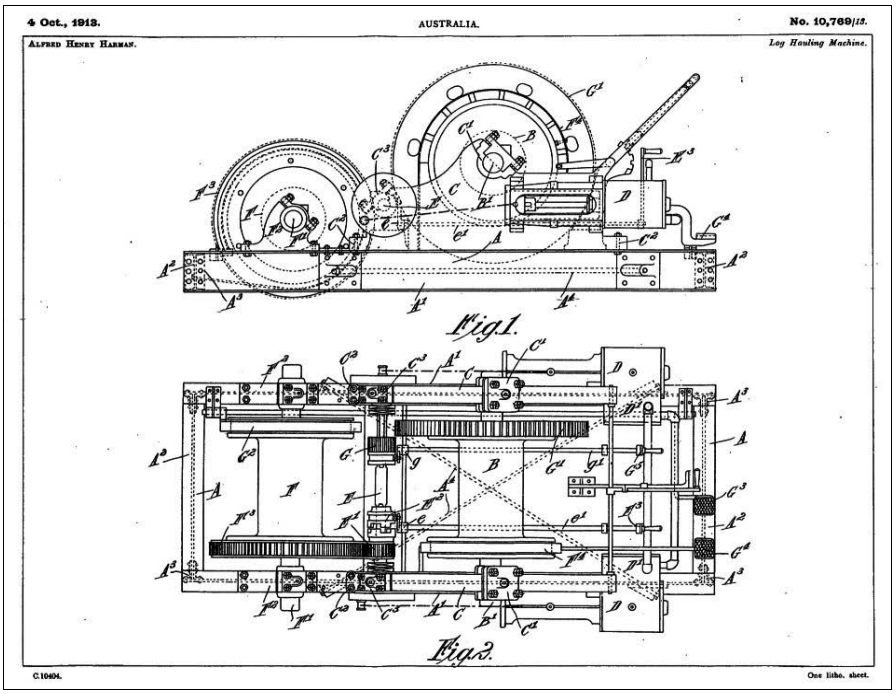
Image at left: The Harman Family – Left to right – Clara, Alfred Thomas (seated), Alfred Henry, Harold Rowland (seated), Hazel (early 1920s).
Source: PMHPS Collection

6 The Age (Melbourne), 16 August 1913, p. 1.

7 *'Au Revoir' to Mr A T Harman*, Standard (Port Melbourne), 19 March 1910, p. 2.

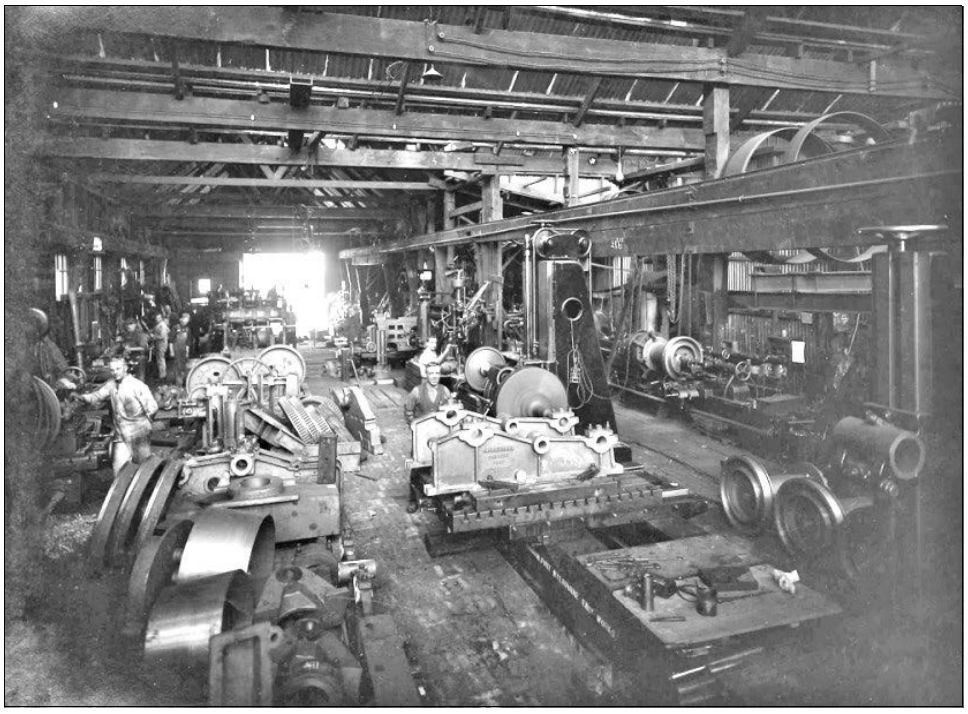
Log Haulers & Other Innovations

In 1913, Harman's eldest son, Alfred Henry, aged 24, applied successfully to patent an improved log-hauling machine. Log-haulers were a specialised form of steam powered winch used in forestry, especially where the terrain was not suitable for bullock teams. Log-haulers were developed in the US in the 1880s and were being imported into Australia in the early 1900s. Alfred Henry's innovation centred on using a stronger frame and having a pair of winding drums capable of being operated and reversed independently or together. Due to its superior quality, the Harman log hauler came to dominate the market in Victoria,[8] and they were used across Australia.



Patent by Alfred Henry Harman for An Improved Log-Hauling Machine (1913).
Source: Australian Patent Office

The Harman's were awarded patents for several other innovations related to winches and winding machines. These patents related to friction clutches for the drums of hoists (Alfred Henry Harman, 1913), self-lubricating snatch blocks (Alfred Thomas Harman and Jethro Fryer, 1919), friction clutches for the drums of hoists, cranes, and winches (Alfred Henry Harman, 1922), and a composite gear wheel (Alfred Thomas Harman and Herbert Bailey, 1925).



Harman winches being machined and assembled at the Port Melbourne Engineering Works, c.1920.
Source: PMHPS Collection.

By the late 1930s, they offered diesel powered log-haulers and their wide range of winches used in ships and mining were available in electric, diesel, petrol, and steam powered models. Eventually crawler tractors displaced log-haulers for forestry work. Nevertheless, Harman winches continued to be used as an attachment on tractors made by International Harvester.

Harman Excavators

A second product line that grew out of Alfred Harman's core expertise in the design and manufacture of powered winches and winding systems was excavators. In 1920, they sold their first, a rail-mounted, crane excavator with 1.5 cu.yard grab bucket, to the Metropolitan Water Supply and Sewerage Board (MWSS) in Brisbane. It was assembled on-site and used in the construction of the Tarragindi reservoir.[9] The following year the Brisbane MWSS Board purchased a 1.5 cu.yard Harman steam shovel, reported to be the first of its type manufactured in Australia.[10]

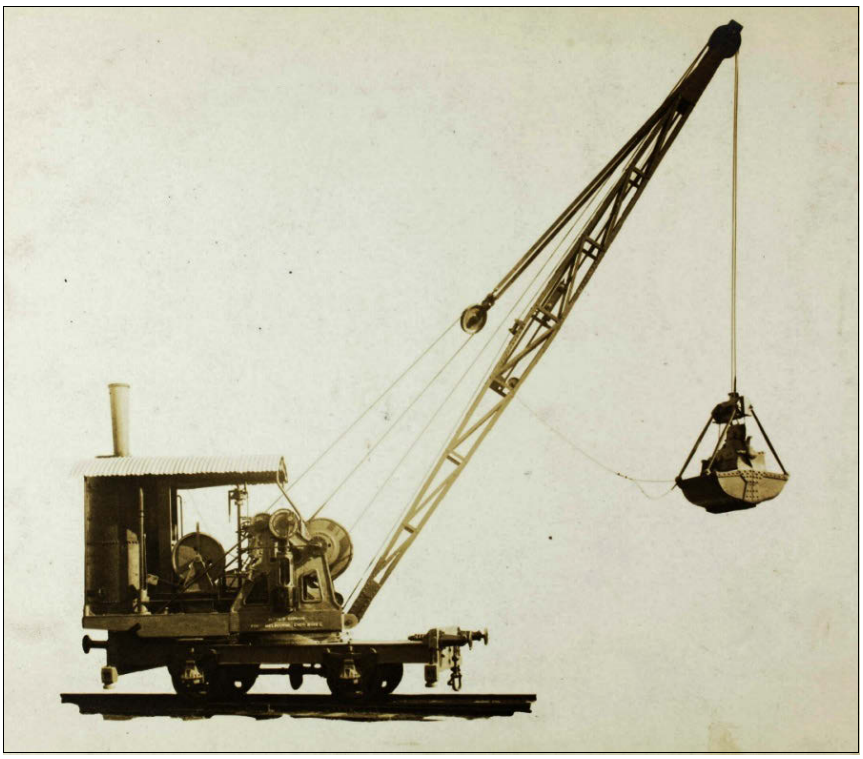
8 Peter Evans, *The Harman steam logging winch*, Australian Forest History Society, Newsletter No. 77, May 2019, pp. 12-13.

9 *Water and sewerage*, Telegraph (Brisbane), 5 May 1920, p. 4. *On Tarragindi hill*, Telegraph (Brisbane), 4 November 1921, p. 5.

10 *Industrial News and Notes*, Daily Commercial News and Shipping List (Sydney), 14 September, 1921, p.9.

The success of these early machines led to orders from government agencies in Victoria. In 1923, the River Murray Commission purchased a track mounted, 2 cu.yd. Harman dragline weighing 60 tons with a working radius of 60 ft. It was for the excavation of the lock canal at the weir at Mildura. Virtually all the components for these steam excavators were created in their Port Melbourne factory. The only manufacturing operation performed outside the premises was gear cutting.[11]

Other contracts included a shovel of 0.88 cu.yd. capacity weighing 25 tons, built for the Victorian Railways Construction Board in 1927, and a 2.25 cu.yd. shovel which weighed 70 tons was built for the Melbourne and Metropolitan Board of Works for use in construction of the Sylvan Dam in 1928. By now their excavators were mounted on caterpillar tracks.



Steam powered, rail-mounted Harman grab bucket excavator of the type purchased by the Brisbane Metropolitan Water Supply & Sewerage Board in 1920. Source: Museums Victoria.

Harman steam shovel excavator used by Victorian Railways, c.1930. Source: Public Record Office, Victoria.

Over the next decade they developed a series of excavator models that could be configured as shovels, ditchers, skimmers, scoops, draglines, or grab buckets. The capacity ranged from 1/3 cu.yd. up to 3 cu.yd. Initially steam powered, the motive power progressively changed to diesel, petrol or electric depending on the application. Eventually there were four model types: B, C, D and E.

The early Harman excavators were fabricated using rivets. In 1933 they built their first all-welded machine.[12] Australian industry was a relatively early adopter of arc-welding technology, with the pioneering work by Harry Grove, who headed the construction department at the Melbourne Metropolitan Gas Company.[13] During the late 1920s, the arc-welding technology was adopted by Harman's engineering neighbour across Williamstown Road, Malcolm Moore Ltd, who began making all-welded grab-bucket cranes.[14]

11 Jim West (2015), *A History of Steel Castings Pty Ltd*, Unpublished, pp. 4.

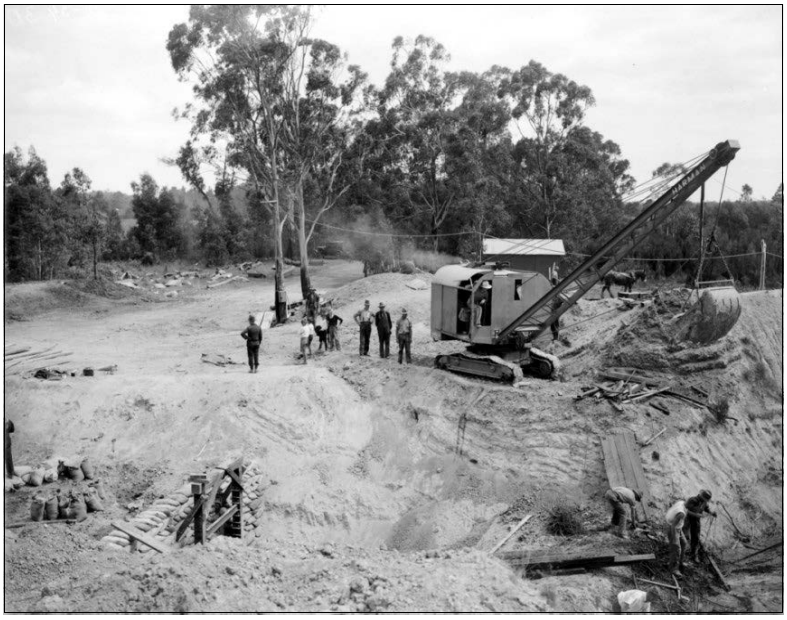
12 The Age (Melbourne), 26 September 1933, p. 14.

13 Paul Savage, *With Enthusiasm Burning: The Story of Welding and Associated Industries in Australia*, 1974.

14 David Radcliffe (2021), *Malcolm Moore & Albert Longoni: A Tale of Two Innovative Engineers*, EHA Magazine, Vol 3 No. 7, Jan. 2021, pp. 23-30.

Locally made versus imported equipment

Throughout his business career, Alfred Harman was active in the debate over protecting local manufacturing industry through tariffs and he frequently challenged those who seemed to prefer imported engineering equipment over locally made. Users of such equipment wanted tariffs lowered while newspapers often argued that local manufacturers could supply quality equipment if they were given the chance. In 1907, the winding plant Alfred Harman built for the Sydney Harbour Collieries Company was seen as a clear demonstration of what Australian foundries and engineering establishments could deliver.[15] Thirty years later, towards the end of his career, the first diesel powered Harman dragline, built for the State Rivers and Water Supply Commission, was described as a tribute to Australian industry, and equal to, if not better than, imported excavators.[16]



Flood reclamation works on a drainage channel using a Harman dragline (1934). Source: State Library Victoria.

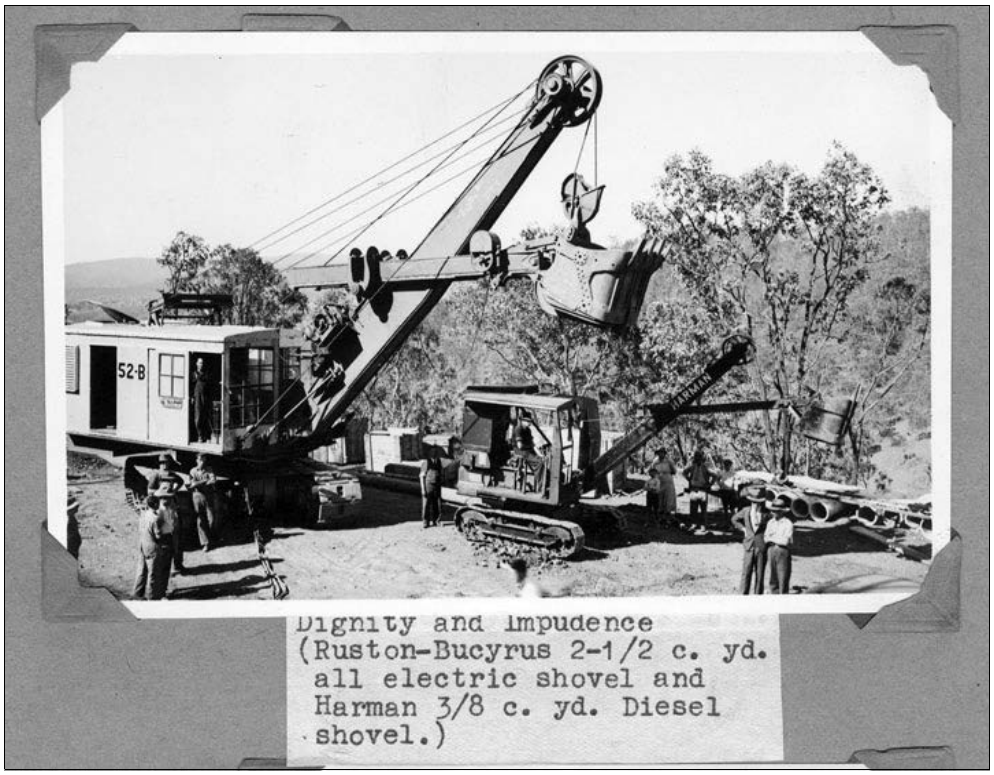


Image at Left:
Entitled "Dignity and Impudence", this photograph, taken at Somerset Dam in Queensland in 1937, is a visual metaphor for the imported versus local machines debate. It contrasts a large, imported Ruston-Bucyrus all electric shovel and a small Harman diesel shovel. Source: Qld State Archives.

In 1921, the State Electricity Commission of Victoria (SECV) chose to source from overseas an excavator for the Morwell development, and Sir John Monash wrote a newspaper column dismissing the Australian Industry Protection League as the "clamour of small sections". He also pointed out the inadequacy of the small Harman steam shovel recently delivered to Brisbane.[17] Alfred Harman shot back with a letter to the editor pointing out that the small shovel was made to specification for a particular purpose and that he could have made a shovel with the capacity and reach required by the SECV and for a lower price than that of the imported one.[18] Based on the experience of his company, in 1934, Alfred Harman put the case for continued protection for local manufacturers to a meeting of the Tariff Board.[19] The preference by some government bodies for imported excavators over locally made ones divided opinion and upset local representatives.[20]

15 *Mammoth winding plant: An Example of Local Skill*, The Age (Melbourne), 19 November 1907, p. 7.

16 *New excavator: Local machine challenges imported*, The Age (Melbourne), 15 May 1936, p. 13.

17 *Sir John Monash comments*, Herald (Melbourne), 3 September 1921, p. 7.

18 *Australian-made shovel*, Herald (Melbourne), 7 September 1921, p. 7.

19 *Power shovels: Tariff on excavator machinery*. The Age (Melbourne), 21 June 1934, p. 13.

20 *Made-in-Australia*, Record (Emerald Hill), 13 Oct 1928, p2. *Attitude of MMBW over excavators*, Record (Emerald Hill), 1 Nov 1941, p.2.

Other Ventures

While winches and excavators were the core product lines that endured, Alfred Harman also embarked on other ventures with mixed results. In 1902, before the winch business was fully established, Harman constructed an "agricultural locomotive". Weighing 8½ tons, it consisted of fore and aft hollow steel rollers, 7ft diameter and 10ft wide, mounted on a steel frame and powered by a 200hp compound steam engine geared 24 to 1. Invented by Constable Thomas Fennessy of Port Melbourne, this machine was conceived to compact and plough swampy country.[21] Initial trials were conducted on the rough and sandy land in Fishermans Bend near the Harman factory. While these trials were reported to be satisfactory, major alterations had to be made to the machine and the matter ended up in court in 1903.[22]

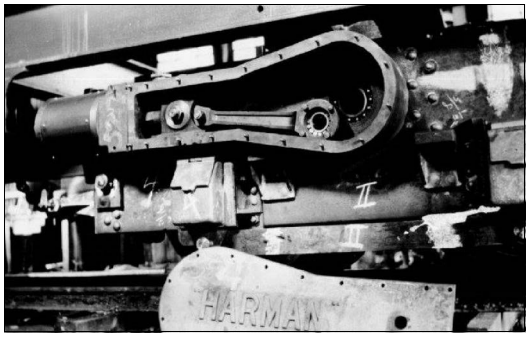
Alfred Harman built a narrow-gauge locomotive for the Victorian State Rivers and Water Supply Commission in 1923, and a few years later, Harman embarked on another bespoke machine, this time a specialised geared locomotive for the Forestry Commission. This geared locomotive came with many engineering challenges.

Delivered in November 1927, early trials of the Forestry Commission locomotive revealed underlying design flaws. Although Harman's fitters, with the support of local saw-millers, worked in the field to overcome these issues, the locomotive was never able to achieve the required haulage capacity.

The contract was cancelled in June 1928 although further trials continued for a couple of years.[23] Harman applied for a patent related to the geared locomotive but was unsuccessful.

The Harman geared locomotive was fitted with a "turbine furnace", claimed to double the efficiency of the boiler. The name is misleading as there is no turbine involved just a redesigned fire grate to inject steam to improve the combustion of lignite and other low-grade fuels. Invented by British engineer Verner Chadwick, Alfred Harman became the sole Australian agent of the turbine furnace. In 1923, Harman installed one in the Williamstown to Port Melbourne ferry, the *SS Rosny*,[24] and the following year he registered the Turbine Patent Furnace (Australasia) Pty Ltd with a capital of £50,000.

Above: Harman geared locomotive with 'Made in Australia' proudly chalked on the side (1927).



Left: Drive mechanism on the Harman geared locomotive 1927.

Source for both images: Wikimedia Commons.

Other "turbine furnace" installations included one on the dredge *Matthew Flinders* and one for the SA Fruit Growers Society. Turbine Patent Furnace (Australasia) was deregistered in 1940, then registered again in 1946 by his sons, Alfred Henry and Harold Harman who promoted the technology in the sugar industry.[25]

Image at Right: Turbine Furnace name plate, c.1925.

Source: Harman family tree Ancestry.

21 *A constable as inventor*, Bendigo Independent, 19 August 1902, p.4.

22 *Agricultural Locomotive: Harman v Fennessy*, Standard (Port Melbourne), 5 September 1903, p.2.

23 *The Harman Geared Locomotive*, Light Railways, No.42, Summer 1972-73, pp.13-19.

24 Williamstown Chronicle (Vic), 3 November 1923, p.1

25 *New companies*, Herald (Melbourne), 2 October 1946, p.16.

Alfred Thomas Harman & the Port Melbourne Engineering Works

In the early 1920s, there was a major debate about the most effective mechanical method to unload coal from ships in Victorian ports. The authorities favoured grab cranes while local engineer George Chadwick advocated his patented bucket elevator system.[26] Alfred Harman won a tender to build a demonstration plant to allow interested parties to see the Chadwick elevator system in action.[27] One wonders if, when Alfred Harman worked as a lumper in the 1880s, this included unloading sacks of coal.

Changing of the Guard

As might be expected, the company experienced difficulties during the depression of the 1930s and nearly went under. Between 1931 and 1934, Harman had orders for only three excavators,[28] and they relied heavily on the second-hand machinery side of the business. Alfred Henry Harman took over the reins in 1934. He partnered with James Robertson to purchase the foundry part of the business from his father, forming J.V. Robertson Pty Ltd. Then, following the death of Alfred Thomas Harman in 1937, the remainder of the original Port Melbourne Engineering Works was registered as Alfred T Harman & Sons Pty Ltd in 1938, with directors Alfred Henry Harman, Harold Rowland Harman and Margaret Harman.

During the Second World War, J.V. Robertson Pty Ltd shifted production away from brass and iron to focus on steel castings with their wide application in defence equipment. They purchased new casting furnaces and in 1943, the company changed its name to Steel Castings Pty Ltd. In the post-war period, it continued making castings for many clients including the Victorian Railways and Malcolm Moore Industries. In 1955, Alfred Henry's son, Bruce Harman, became the managing director of Steel Castings.[29]

Image at Right: War-time inspired Harman excavator advertisement (1944).
Source: Sands and McDougall Directory.

Opportunities and Challenges

Meanwhile, Alfred T Harman & Sons continued to make excavators to meet the demands of post-war construction and development projects. They exported some machines, principally through the Columbo Plan. Following the death of Alfred Henry Harman in 1958, the younger son of Alfred T Harman, Harold Rowland Harman, aged 54, took over the family business. However, the world was changing.

Harman Excavator being loaded at Melbourne for shipment to Cambodia as part of Columbo Plan (1955).
Source: Overseas Trading Magazine.

In 1962, Alfred T. Harman & Sons was sold to Swedish company Kockum. Operating as Harman-Kockum Landsverk Australia Pty Ltd, they continued to make Harman excavators as well as the Kockum KL 225 face shovel and the KL 250 dragline at the Port Melbourne factory, with a goal of developing export markets in SE Asia, New Zealand and the Pacific.[30] However, after Kockum changed its business direction in the mid-1970s, the name Harman was dropped and production in Port Melbourne ceased. Meanwhile, Steel Castings Pty Ltd moved from Derham Street in 1972 but continued to operate from premises in Bertie Street, Port Melbourne before they eventually closed their doors in 2004.[31]

26 *Grab or bucket: How to handle coal*, Herald (Melbourne), 28 June 1921, p.9.

27 *Port efficiency and the Chadwick rapid discharge system*, Daily Commercial News and Shipping List (Sydney), 22 February 1922, p.16.

28 *Power shovels: Tariff on excavator machinery*. The Age (Melbourne), 21 June 1934, p. 13.

29 Jim West (2015), *A History of Steel Castings Pty Ltd*, Unpublished, pp.4.

30 *New Australian-Swedish firm's export plan*, Overseas Trading, Vol.17 No.6, p.139.

31 Jim West (2015), *A History of Steel Castings Pty Ltd*, Unpublished, 4 pages.

Alfred Thomas Harman & the Port Melbourne Engineering Works

Thus, the enterprise that Alfred Thomas Harman founded in the late 19th century, continued in one form or another, for nearly 120 years. Harman's avowed basis for doing business was "quality before price" and "efficient service before and after sales". His story illustrates the interplay between ingenuity, enterprise, and industry policy, specifically tariff protection. It is a microcosm of the history of manufacturing in Australia through the 20th century.

Image at Right: The premises of Steel Castings Pty Ltd in Derham St in 1972. The only external change since these facilities were built as the Port Melbourne Engineering Works in 1902 is the addition of the tall chimney. Source: PMHPS.

Remainders

As is the case with all manufacturers of construction equipment, the legacy of Alfred Harman is manifest in numerous rusting machines scattered across the country. Many of these are photographed where they rest, then posted online while some are painstakingly restored by enthusiasts.

Left: The Port Melbourne Machinery Stores building in Derham Street, Port Melbourne (2021). Photo: David Radcliffe.

The Port Melbourne Machinery Stores building still stands in Derham Street, Port Melbourne. While the delightful lettering on the façade, inspired by the arts and crafts movement, has been thoughtlessly removed, a ghostly 'A Harman' can still just be made out.

Above: Harman log-hauler in the high country of Victoria, photographed in 2015. Source: Australianimage.com.au.

Tasmania Division Archives & Library Go Digital

Bob Taaffe, Chair, Engineering Heritage Tasmania.

In 2014 the Tasmania Division of Engineers Australia moved office from the Royal Engineers building in Hobart to the Commonwealth Office Building. The new premises had far less room to hold the archives and library. Engineering Heritage Tasmania was allocated a small amount of space and the rest of the collections were consigned to archive boxes and placed in storage. A general box list was created.

The Division was keen to reduce the cost of storage and having nearly all of the collection in storage made it hard to assess exactly what was in the boxes, plus access took around a week for each request. The author volunteered to look at digitising the contents, starting with four boxes as a sample.

As there was the desire to eliminate or reduce the storage costs, the questions became what do we do with documents after scanning and how were they to be scanned? Taking the second question first. Scanning bound documents produces a less than ideal result. It is better to be able to feed the sheets through the scanner. To do that meant taking documents apart. That was a philosophical question - what is more important, the information or the media? For us the answer was the information. Now back to the first question – what to do with the documents after scanning? It was decided to retain only those printed items that were created by the Division.

The first items chosen for scanning were the Journals of the Institution of Engineers Australia. The Division had a reasonably complete set from 1920 through to the 1960's. They were scanned both in colour and black and white. Colour is usually better to preserve photo details. But as the paper and the photos were poor it was no advantage to continue colour scans. The optical character recognition (OCR) engine was run through the journals and then the result was assembled so that a single search reviewed every issue in very quick time.

Much of the material is typed, handwritten or photocopied, or books. These items were supposed to comprise 48 boxes but ended up closer to 60 boxes. Much of the scanned material still requires proper indexing and filing.

Tasmania Division Archives & Library Go Digital

Digital files will be placed into several functional areas if they cover more than one area – to make searching easier. The books were often scanned in colour to provide a good result with respect to illustrations. They will have the OCR engine run through them, plus a manual index will be created, along with keywords to aid searching. This work is underway.

Several precious books were found, namely, the original Division Minute Book and the Membership Register. After colour scanning they have been transferred to an existing Engineers Australia deposit in State Archives of Tasmania so that they cannot be mislaid, lost or thrown out.

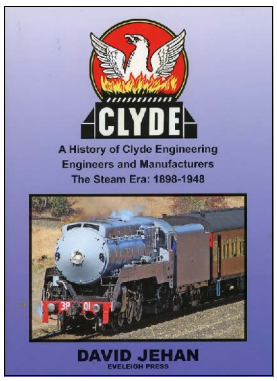
For the technical details: Scanners – two different scanners were used, being Fujitsu (ScanSnap) iX600 and iX500. The iX600 was used for pages larger than A4 size. The iX500 had a document feeder that scans both sides of the page at once, so the iX500 was used for most of the work. Scanning resolution of 600dpi was decided upon, as the better the quality of the scan, the more efficient the text recognition. All files were saved as PDF files. These are open sourced, and widely used. Quality control is important and every page needed to be viewed post scanning before the file was saved.

Some work still needs to be done: finish the sorting of the general files and scan two boxes of photographic prints, slides and negatives; and backing up – the digital files will be kept in several locations including on the Division main drive. If anyone needs material it is now a lot easier to access and it makes research easier and, if the scanning had been done commercially, it would have cost many thousands of dollars.

Review – A History of Clyde Engineering,

Engineers & Manufacturers – The Steam Era: 1898–1948. By David Jehan, MIEAust, CPEng.

Review by Bill Phippen, OAM,FIEAust.



David Jehan's latest contribution to the record of engineering and manufacturing in Australia is another excellent piece of work, as we have come to expect from him. It takes up where his previous book on Hudson Brothers left off and carries the story through to 1948. This year is chosen as it is the date of the contract between Clyde and American Electro-Motive Diesel (EMD) to manufacture diesel locomotives, but the narrative extends into the early 1950s as the last steam contracts were finalised. David hints at another tome covering the later half century of diesel manufacture in his introduction where he states: *Suffice it to say that the Clyde-EMD history and the products built in the last five decades of the company's operations are not covered here and are worthy of a separate volume.*

At 336 pages of typically high-quality Eveleigh Press production, with a hard cover, *A History of Clyde Engineering, 1898 to 1948* is a 'must have' for anyone interested in engineering or railways. Of course, the cover sports an image of the iconic locomotive 3801, but Clyde is about so much more than one locomotive or locomotives in general. A list of the types of things they built could be made here but that would be just to copy the book's contents page. Rather the better question might be – what didn't they manufacture? The book is a product-based history, rather than a corporate one, and as such is lavishly illustrated with photos and pages from Clyde catalogues. The images alone justify the addition of the book to any collection.

There is a deeper and unstated sub-plot to the book, hinted at by Engineers Australia heritage leader Neil Hogg in his foreword: *David Jehan has produced a fascinating history of how a great Australian manufacturing company contributed immensely to creating and sustaining our society. It reminds us of what our predecessors achieved and what we have given away.* Perhaps words to ponder on, especially in NSW, as debate is carried on about the near universal sourcing of trains, trams and ferries from overseas manufacturers.

Such is the scope of Clyde's manufacturing that a single person, even David, could not master it all. He has called on many other practitioners in the field, including this reviewer, to advise and check sections of the work and these people are acknowledged. This is a courtesy but also emphasises the thoroughness of his work. The availability of information about Clyde can be strongly credited to Ronald James Drummond who not only worked for the company, but as a man appreciative of history, collected and saved records as the company moved locations and eventually closed. His was the garage to which colleagues took otherwise to-be-discarded volumes when offices were emptied. At the time of writing this review there were only two hard copies of the book in Australia, the bulk in transit at sea. One is with this reviewer, and the other has been given to Ron who is in his 90th year.

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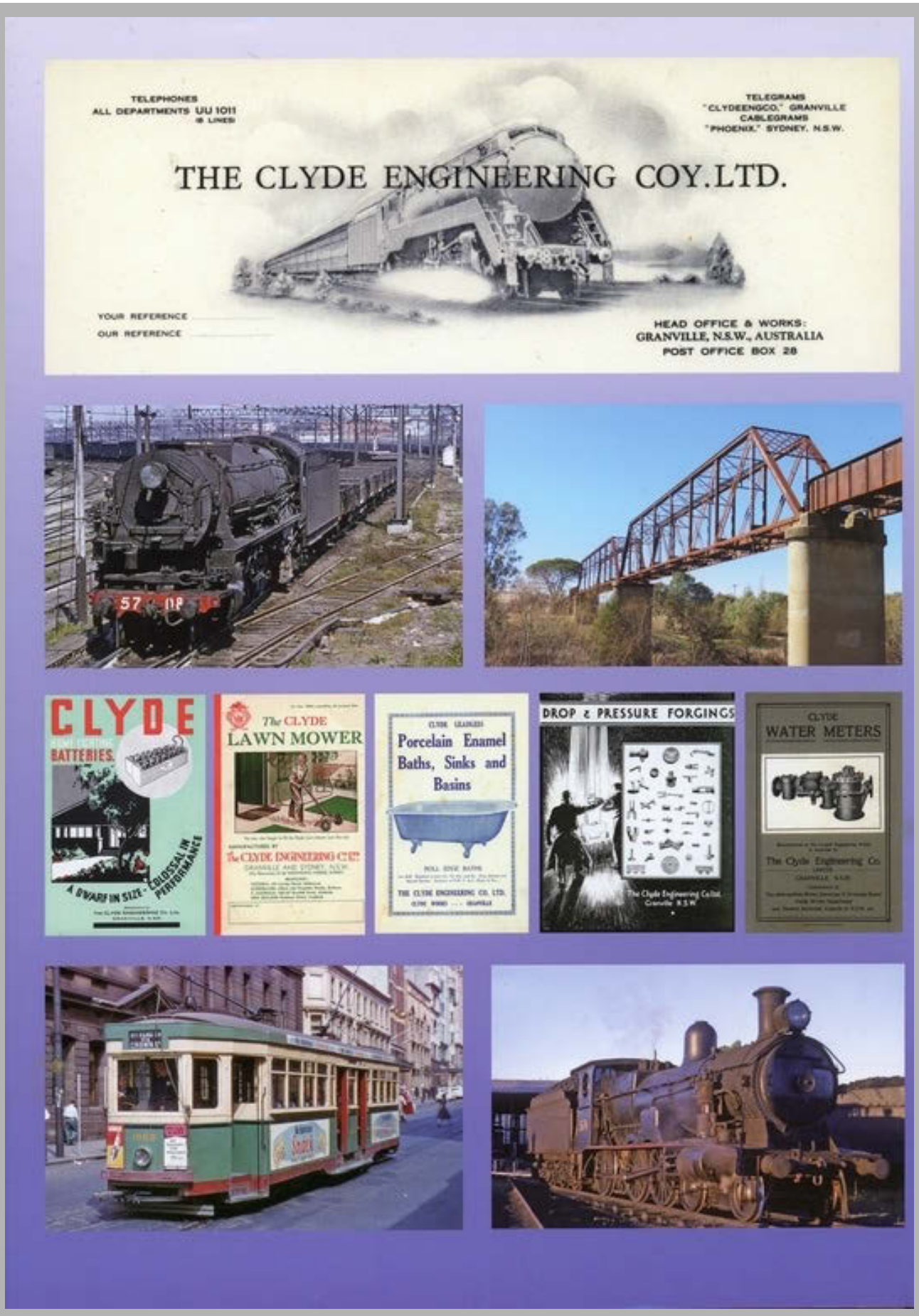

The back cover of David Jehan's book "A History of Clyde Engineering – 1898 to 1948" showing a variety of the products manufactured by the Company,

Continued from Page 35

Bill Phippen tells us – As both a rail historian and deputy chair of the Engineering Heritage Sydney committee, I can commend this book to anyone interested in the history of technology in Australia.

The book is now available from the Australian Railway Historical Society (NSW) Bookshop, 5 Henderson Rd, Alexandria, NSW or via sales@arhsnsw.com.au