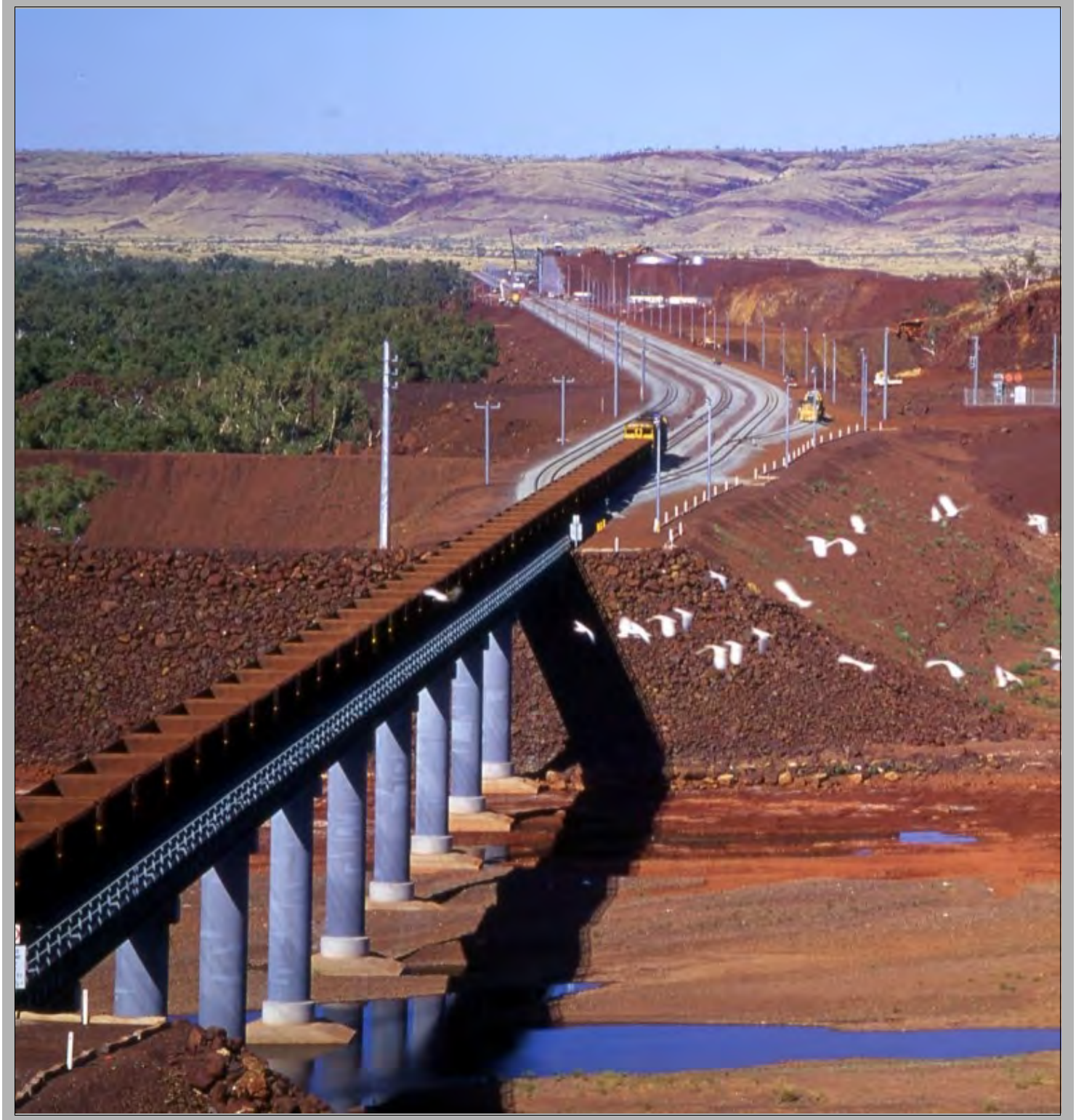
ENGINEERS AUSTRALIA

EHA MAGAZINE



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Cover Images:

Front: A bridge on the Robe River railway line in the Pilbara, Western Australia, carrying an ore train returning empty to be refilled at the mine seen in the distance. The red soil is typical of this iron ore country.

Photo: Rio Tinto, about 1995.

Back: From: The Recovery of 134-year-old "Edison Street Tubes" from William St, Brisbane. (Page 8). Part of the 1992 excavation – looking south-east along William Street from the corner of Stephens Lane. There is a more complete description of this photograph on page 11.

Photo: Courtesy of Energex.

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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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EVENT NOTICE

Go to page 29 of the Magazine to find a flyer for:

ENGINEERS' COUNTRY WEEKEND

16th, 17th, & 18th November 2018

at GEELONG, VICTORIA.

Details of the Program, Accommodation, Registration and the Cost are on the flyer.

Editorial

We have a good variety of stories in this issue of the Magazine, including two very different stories about two different Murray River pumping stations. Owen Peake goes back to Psyche Bend near Mildura to record the occasion of the UK Institution of Mechanical Engineers recognising the Chaffey Brothers steam pumping station, previously, in 2017, recognised by the American Society of Civil Engineers and Engineering Heritage Australia. Then Owen went down the river a bit to attend the steaming of another pumping station – not as old as Psyche Bend. Millewa A was converted to electric pumps many years ago but, amazingly, all the original machinery was left untouched, and is now in the process of being restored to working order by the local Regional Engineers Group. Great work!

Going back to my story (October 2016) about the 80th birthday of the TE20 Ferguson Tractor, Keith Baker came across a story about how a whole lot of those tractors saved the town of Wentworth (on the Murray River) from a giant flood in 1956, when they were used to built levee banks using scoops operated by the hydraulic 3-point linkage which Harry Ferguson developed. So much faster than scoops operated by horse teams. Great work again. Keith also entertains us with a story about a railway spiral (where the line crosses over itself) in the mountainous areas of New Zealand. An ingenious means of raising the elevation of the line rapidly over a short distance without resorting to a rack railway. The story reminded me that we have spirals in NSW – on the main south line at Picton (is that one still in use? I remember checking it out about 50 years ago) and at Bethungra further south. There's a youtube description of it at https://www.youtube.com/watch?v=LMApgO01d9k Good fun! I found it very difficult to work out what was happening when looking from the old Hume Highway (which I travelled frequently), and I gather that sitting in the train, no-one notices the spirals. There's another famous one on the Darjeeling Railway, climbing the Himalaya Range. One of my sons rode it years ago, and knowing I'd be interested, sent me a postcard of a cute little steam train on the spiral. I still have it somewhere. That line has zigzags also – see https://www.youtube.com/watch?v=nzgBMBPumVI – go youtube!

The link to *Victoria's Living Heritage Grants Program* (page 5) was a surprise to me. All varieties of heritage items in (I think) every State, have been receiving Government grants for 40 or more years now, for various works – conservation management plans, recording, rehabilitation, structural stabilisation, interpretation, whatever was needed to save our heritage. But never before have I been able to find out, simply and directly, who got how much money for doing what. And each item listed is even complete with a small photograph of the object concerned. Maybe Heritage Victoria has been doing this for years, but it has never been brought to my attention previously. Do the other States have similar publicity for their grants? If so, I'd like to see it.

I was pleased to see two items of the industrial/engineering heritage that received Living Heritage Grants have previously been featured in EHA Magazine stories – and here they are:

Psyche Bend Pumping Station, near Mildura, Psyche Bend Historic Site Reserve Committee

A grant of $50,000 has been awarded to undertake urgent reconstruction and repair works to the timber beam and support structure and two suction pipelines. The works will ensure that this element of the site, which has been in operation since the 1890s, can continue to function. Psyche Bend, built in the 1890s to irrigate more than 100,000 hectares around Mildura, is integral to the region's irrigation heritage, and is the oldest pump of its type in the world. Psyche Bend is open to the public three times a week, and for special events and excursions.

Murtoa Grain Store
Murtoa Stick Shed Committee of Management, Murtoa.

A grant of $70,000 has been awarded to fund urgent repairs to the windows and doors of Murtoa Grain Store (known as the Stick Shed). Murtoa Grain Store was built in 1941 as a war-time emergency grain storage. Similar structures were erected around Southern and Western Australia during World War 2 for the temporary storage of wheat. Murtoa Grain Store is the only one of its kind still standing. Due to the poor condition of the building, it has only had limited public access. The grant will enable this nationally significant site to be opened to the public, as a witness to an important part of Australian history.

And last, but not least, Brian Becconsall & Stuart Wallace of Engineering Heritage Queensland bring us their account of the recovery of 134-year-old **"Edison Street Tubes"** (and tube connection boxes) from under the roadway at William Street, Brisbane (page 8). We think these rare survivors from the earliest days of underground urban electric power supply are of international heritage significance. Sample specimens have been distributed to several museums in UK and USA and, of course, Australia. Their recovery and distribution are a tribute to the heritage awareness and co-operative spirit of all involved, and give us an excellent model for how other relics of our industrial and engineering heritage should be respectfully dealt with.

IMechE recognises Psyche Bend Pumping Station

By Owen Peake.

The Psyche Bend Boiler in operation on the day of the ceremony. Photo: Owen Peake.

Quite a large group converged on Mildura, Victoria over the June 2018 Queen's Birthday Weekend, to celebrate recognition of the Chaffey Brothers steam pumping station at Psyche Bend by the British Institution of Mechanical Engineers. The recognition ceremony was held on Sunday 10th June. The pumping station was the main 'first lift' irrigation pumping station for the Mildura Irrigation Area in the Age of Steam. The Psyche Pumps are operated and maintained very competently by the Sunraysia Steam Preservation Society.

The Psyche Bend Pumps have now been recognized by Engineering Heritage Australia (EHA), the American Society of Civil Engineers (ASCE) and the Institution of Mechanical Engineers (IMechE) – the first site in Australia to be recognised by these three key institutions. An account of the EHA and ASCE ceremonies appeared in the January 2018 issue of EHA Magzine.

Brian Carter of IMechE holding the IMechE marker at the ceremony. Photo: Owen Peake.

There was a short ceremony. The IMechE representatives present were Andrew Lezala, Chair of the IMechE Australian Branch, Ian Nash, Chair, IMechE Oceania Region, Brian Carter, Past Chair of IMechE Australian Branch and a member of the Victorian Panel of IMechE. Others who spoke at the ceremony were Ian Kellett, Chair, Sunraysia Steam Preservation Society, Mark Eckel, Mayor of Mildura Rural City Council and Scott Barnes of the Sunraysia Group of Engineers Australia.

L to R: Mark Eckel, the Mayor of Mildura, Ian Kellett, Chair of Sunraysia Steam Preservation Society and Ian Nash of IMechE in the pump house after the ceremony. Photo: Owen Peake.

A round bronze Engineering Heritage Award marker was unveiled and will later be erected inside the pump house. The text on the marker reads: *Designed by George Chaffey MIMechE and built by Tangyes of Birmingham, England. Psyche Bend was a key part of the pioneering Mildura Irrigation scheme. The 1000 ihp triple expansion steam engine driving four 42" centrifugal pumps was in operation from 1890 to 1959.*

Right: The Psyche Bend Pumping Engine in operation on the day of the ceremony. Photo: Owen Peake.

Victoria's Living Heritage Grants Program

A recent email from Heritage Victoria, received via the Victorian Heritage Chat Group, alerted me that: *The full list of successful projects under the 2018/Round 3 competitive stream of the Living Heritage Grants program is now published at*:

https://www.heritage.vic.gov.au/grants/living-heritage-program

Scroll down to 'View successful grants' and select the document for Round 3 - a copy of the pdf is also attached. Stay tuned for new web content on completed projects coming soon! I checked the attached PDF and found some very interesting stuff. Then I went to the website (link above) and discovered that Round 3 was only part of the story. There are five separate PDFs in which you can *View successful grants*, each one with a list of monetary grants given to various heritage projects around the State, from 2016 to 2018. The PDFs are labelled: Round 1 Community Heritage Grants Stream Successful Projects (PDF, 640.9 KB)
Round 2 Community Heritage Grants Stream Successful Projects (PDF, 1.2 MB)
Final Round 3 Successful Projects Summary 2018-19 (PDF, 1.1 MB)
Major Building Program Projects (2016-17 to 2017-18) (PDF, 406.4 KB)
Major Building Program Projects (2017-18 to 2018-19) (PDF, 313.9 KB)

They are fascinating, describing a grand total of 82 grants awarded over the period, ranging from $10 million for major conservation works to the Melbourne Trades Hall, down to $20,000 for a CMP on an early farm homestead. There would be at least 17 grants for items of interest in the fields of engineering or industrial heritage among them. Only room here for a small taste.

Barmah Punt, near Echuca – Moira Shire Council

A grant of $200,000 has been awarded to undertake urgent conservation works, including the excavation and lifting of the punt from its current location, its removal to a new cradle structure, and prioritised stabilisation repairs. The Barmah Punt is the oldest surviving cable punt ferry on the Murray River, and was integral to intercolonial trade and communication between Victoria and New South Wales. The punt is located in Jack Edwards park and is readily accessible to the public.

Healesville Railway Water Tower – Yarra Valley Water Inc.

A grant of $200,000 has been awarded to support the conservation of the water tower and water crane at the 1889 Healesville Railway Station. The water tower is a local landmark and urgently requires rust mitigation treatment and structural repairs to ensure that its functionality is not lost. After being inactive for several decades, the works will return the tower and crane to service, allowing the reintroduction of steam trains to the Yarra Valley region, a popular tourist destination.

Wollaston Bridge, Warrnambool City Council

A grant of $195,000 has been awarded to Warrnambool City Council to undertake urgent conservation works to the failing timber elements of the Wollaston Bridge. The suspension bridge was erected across the Merri River in 1890 as an entrance to the Wollaston Estate. Today, the bridge is one of the oldest surviving cable suspension bridges in Victoria and a local landmark. The bridge provides a key link for pedestrians over the Merri River and is frequently used for birdwatching, cycling, and other recreational activities.

Day's Flour Mill Complex, Murchison – Parks Victoria

A grant of $500,000 will support urgently required conservation works at Day's Flour Mill in Murchison. The site was included in the 2015 Living Heritage Audit and was found to be in very poor condition, owing to ongoing vandalism, loss of windows and doors, damage by birds to soft timber joinery, structural stability of the chimneys and salt damage to handmade bricks. The site was owned and run by the Day Family from 1865 until 1986, and is highly intact with a significant collection of machinery and associated artefacts. Now managed by Parks Victoria, the mill site is closed to the public due to safety concerns.

Paddle Steamer Gem, Swan Hill Rural City Council

A grant of $500,000 will support complex conservation repairs to the Paddle Steamer Gem in Swan Hill to prevent water ingress. The vessel was first launched in Moama, NSW in 1876 and is a rare survivor of the steam boat era of trading along the Murray-Darling river system. The Gem was built in red gum planking over iron frames for a local Echuca shipowner. The Gem was originally fitted with a 40 horsepower steam engine and wood fired boilers and carried both freight and passengers, mainly in the lower reaches of the Murray River below Mildura. The grant will ensure the Gem continues to float and will enhance the visitor experience aboard the vessel.

The Headlie Taylor Sculpture Unveiled

The Headlie Taylor Sculpture, unveiled beside the Olympic Highway in Henty, NSW on 12 September 2018, recognises one of our greatest agricultural inventions. In the Spring of 1914, an eager young inventor, Headlie Shipard Taylor displayed his new harvesting machine at the Henty Show. All the town were talking about his new machine, the third prototype constructed on his Emerald Hill Farm and patented in 1913.

Photo - Bruce Ferguson.

Up to this point wheat farmers had been enthusiastically using the Stripper Harvester invented in 1884, which combined the process of stripping, winnowing and bagging. Wheat farmers were increasing production through greater acreages and higher yields but required advanced harvesters that could economically collect all the grain, even when weather conditions knocked over and tangled the crops or weeds made harvesting difficult.

The dramatic answer to this problem came in 1914 with Headlie Taylor's Header Harvester, which could cut the heads from the standingor fallen crop, where two spirals transferred the material to the elevator and thrashing drum, with the comb remaining level when raised or depressed with no loss of grain. The air draught was simply provided by two vanes, one on either end of the threshing drum and the main drives distributed to even the load and reduce wear. The design could handle all presentations of the crop, standing or fallen. This machine swept Australia and the world and the principles are still the basis of modern harvesting machines.

Bruce Taylor, Tim Fischer, the Sculptor Paul Smits, & Headlie Taylor's son John at the unveiling of the statue. Photo supplied by Bruce Taylor.

The Headlie Taylor Sculpture recognises this contribution to the Australian Grains Industry over 100 years ago and now brings large scale public art, through sculptor and artist Paul Smits of Melbourne, to country NSW.

The Unveiling was attended by hundreds of Donors, Supporters and Taylor Family members who witnessed a moving tribute by both Henty Schools and speakers including Former Deputy Prime Minister, local farmer and now Chair of the Crop Trust with Global Seed Vault, Tim Fischer AC, who along with Headlie Taylor's last remaining son, John Taylor now in his 92nd year, unveiled this spectacular bronze sculpture.

The Headlie Taylor Header Museum is proud to display this iconic sculpture in Henty, Home of the Header.

From Bruce Taylor, Great-Nephew of Headlie Taylor.

Readers of EHA Magazine may remember a story in the December 2014 issue, about Headlie Taylor, his career, the Sunshine Header Harvester invented by him, and the Blacksmith's Shop on Headlie's father's farm, *Emerald Hill*, where he built the prototype machines. In the year 2000, we were engaged to record the Blacksmith's Shop, and its contents. We were pleased that our report was able to be of use later, when the Blacksmith's Shop and its contents had to be removed from the farm and the building was carefully taken to pieces and reconstructed inside a purpose built display shed in Henty – the Headlie Taylor Header Museum – just in time to celebrate the centenary of the Header Harvester in 2014.

Margret Doring
The Editor, EHA Magazine.

Notes & Queries — Fergie, the Tractor that Saved a Town.

by Keith Baker

Readers of EHA Magazine may recall the story in the October 2016 issue about the 80th birthday of the Ferguson TE20 (the Fergie) – *The Tractor that Changed the World.* Some of those same readers would have visited the town of Wentworth in New South Wales during the Engineering Heritage Conference held at Mildura in October 2017, and gained a feel for the esteem in which the Fergie tractor is held there.

A Fergie Tractor in the Wentworth Museum, NSW. Photo: J. Baker

Wentworth was built at the confluence of the Darling and Murray Rivers as an historic river port from the paddle steamer days. Twentieth century irrigation brought new life into the district with the pastoral properties being divided into smaller allotments or blocks for the production of citrus fruits, vegetables and grape vines. The soldier settler farmers, referred to as blockies, employed small manoeuvrable tractors, for which the Ferguson TE 20, with its three point linkage for attaching implements, was ideal.

A garden variety Fergie tractor, poised on the side of a levee bank. Photo: K. Baker.

Wentworth has endured many floods from one or other river since its settlement in 1859, but never like the flood of 1956 when the Murray and the Darling were simultaneously in flood. As the flood peaks approached from two directions, the blockies worked day and night with the help of the Army and Navy to avert disaster by filling sandbags and building and patching levees around the town. The Fergies came into their own during this work, where heavier tractors could not cope with the wet slippery conditions and were likely to break the banks with their weight. The levee banks held back the flood which peaked at 9.8 metres and lasted for months, while downstream South Australia bore the brunt of the massive volumes of water.

Etched Fergie on the glass door of the "Fergie Bar", Crown Hotel, Wentworth, NSW. Photo: K. Baker.

The heroic work of 1956 with Fergie tractors has not been forgotten by the locals, or unnoticed by visitors. Not only was there a full sized Fergie in the Wentworth Pioneer Museum, visited by the conference accompanying persons' tour, but another in the Fergie Bar of the Crown Hotel, surrounded by photos from the 1950s. And a "baby" scale model Fergie, presented to Wentworth by the Managing Director of Massey Ferguson, graced the main street, recognising *the major part played by Ferguson Tractors and implements in saving the town from complete inundation*, while in the nearby Junction Park, the levee bank protecting the town is adorned with a living Fergie Sculpture.

The social significance of the grey Fergie tractor has remained ingrained in the consciousness of the Wentworth community and celebrated in its periodic Great Australian Fergie Tractor Rally.

References: Interpretive panels in the Wentworth Museum, the Crown Hotel, Junction Park & Adelaide St.

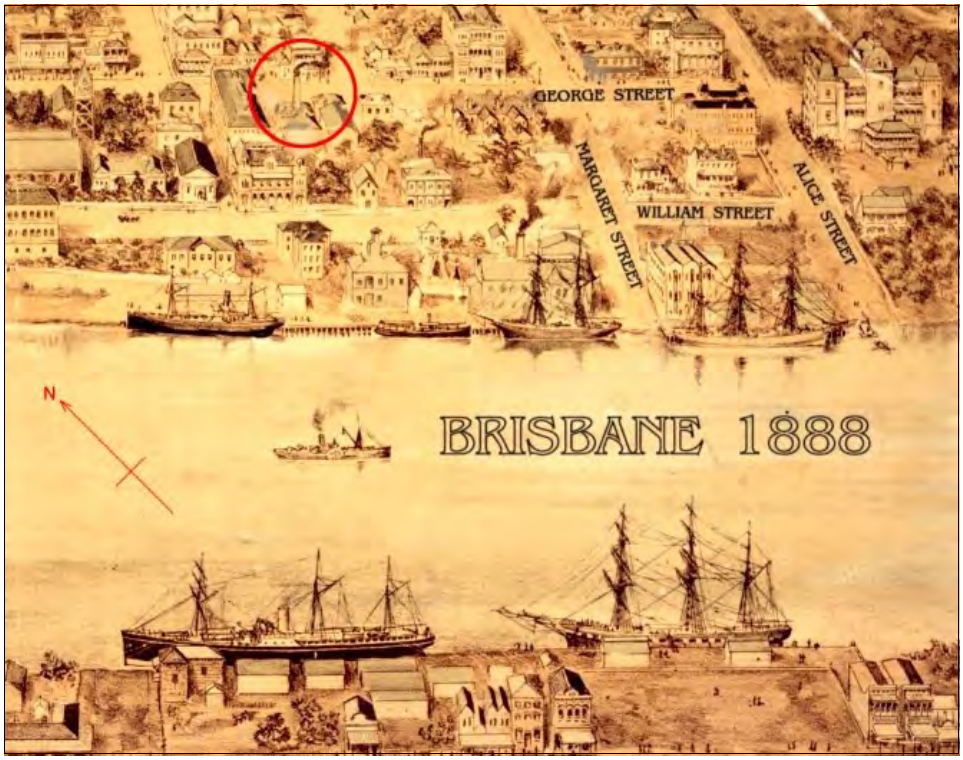
Image Right:
The scale model Fergie, with its 3-point linkage scoop for building levee banks, seated on a stone plinth in the main street.
Photo: K. Baker

The Recovery of 134-year-old "Edison Street Tubes" from William Street, Brisbane.

Queensland Parliament House Electric Lighting 1886

In February 2018, a recovery operation in William Street, Brisbane, of long abandoned underground electric mains called "Edison Street Tubes" was completed, some 134 years after they were first laid in 1884. The story starts in 1883 following a demonstration of new incandescent electric lighting in the Government Printing Office by the Edison Electric Company.

The colonial Queensland Government was so impressed by this invention by noted American inventor Thomas Edison, they immediately decided to place an order with his company for permanent electric light to the Government Printing Office in William Street and to Parliament House. This involved building a new Power Station behind the Printing Office, operating at 110v DC, and installing 1350ft (410m) of underground two-core electric mains along William Street to Parliament House.



1888 lithograph of the Brisbane Government sector. The new Government Printery Power Station, with smoking chimney, is in the red circle. The Gov't. Printery buildings are to left of the Power Station and run from George St to William St. Parliament House is at top right of the picture - later extended down Alice St.

An 1898 view looking south-east along William Street. In the distance is the recent extension to the Parliament buildings. The Edison Tubes are buried under the roadway at left. Photo: John Oxley Library.

The new incandescent lighting was made up of 400 new "cool" electric lights of 16 candle power (200 lumens) each, to replace the hot and odorous gas lighting. 150 of the new electric lights were for the Legislative Assembly, 50 for the Legislative Council, and 200 for the Printery. The dynamos, street tubes, lighting, wiring and fittings were all supplied by the Edison Electric Company of USA, using local agents Alfred Shaw and Company.

Progress was slow with the Edison Company. Their appointed American electrician, J.W. Snow, was responsible for route selection, installation and jointing – but he died in Sept 1884 and was replaced by J. Matheson.

However, by March 1886, with still no completion in sight and unsatisfactory wiring work being condemned by the Edison Company's NSW agent, the Edison Company replaced him with a local Australian consulting engineer Edward Barton to complete the work. Some 40 months after the initial contract, the supply was commissioned by Barton in July 1886 and handed over to the Government Electrician, J. Tomlinson. Shortly afterwards, a serious fault caused a fire in the Assembly with Tomlinson held responsible, and he was replaced by Barton as Government Electrician in November 1886.

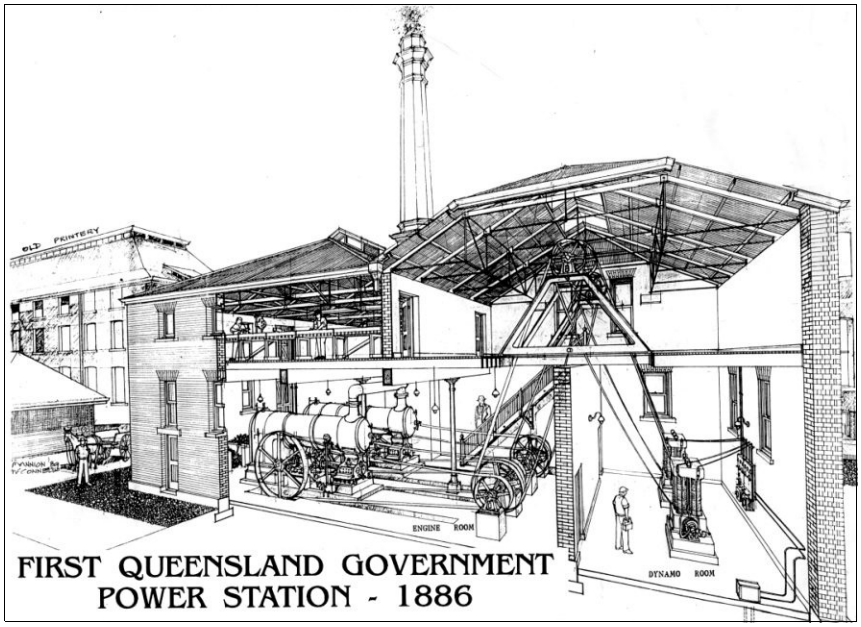
Google Map adapted to show the path of the Edison Street Tubes from the Govt. Printery, along William Street to the Parliament Buildings.

The Recovery of 134-year-old "Edison Street Tubes"

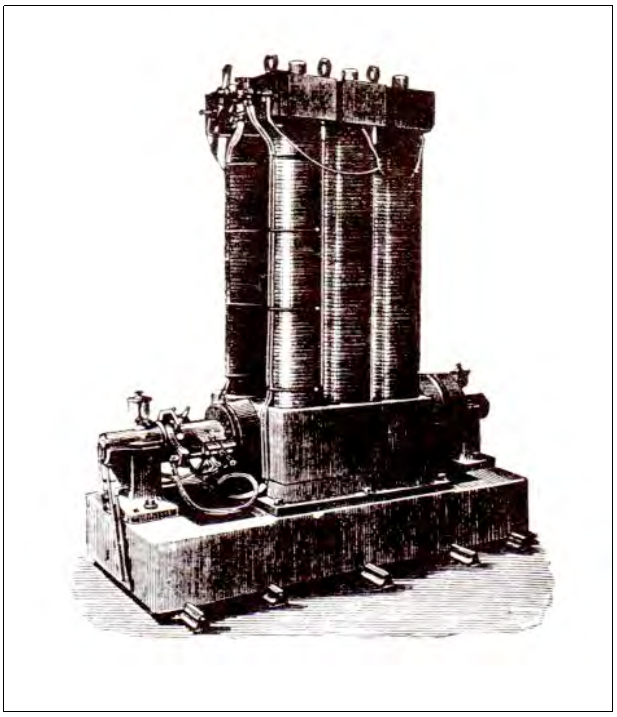
Government Printery Power Station.

The new Government Power Station comprised two 30 kW 110 volt DC Edison H dynamos driven by belts from two Robey & Company compound steam engines with locomotive type boilers supplied by Smellie & Co. These powered a total of 400 lights of 16 candle power each. The building was constructed by Andrew Petrie, and the overall project cost was estimated at £19,275, showing a very high value placed on replacing gas with electric lighting.

Difficulties in governing the loading on the Robey steam engines meant that all lights had to be switched on at dusk during Parliamentary sitting sessions and the station plant had to run at full load until sitting was complete. Operating the first central generating station was a steep learning curve for the colony, and Barton himself had to act as shift engineer at all operating times.



A recent cutaway drawing shows the Engine Room at left and Dynamo Room at right.
Image: source not provided.



A typical early Edison Dynamo. Image: source not provided.

The Government Power Station was decommissioned once the Parliament load was transferred to other sources in 1906 and the Printery load in 1909. The building survived for other uses but was subsequently completely removed in July 1986, while the underground Edison Street Tubes in William Street were abandoned and forgotten about.

Improvements & major reinforcements by Edward Barton

The new incandescent lights installed in 1886 were to replace each of the gaslight jets, which were only operated at night in winter sittings, but because of the unknown reliability of the new electric system, all the gas installations were retained. The early electrical installations had Edison light fittings attached to the wall gas fittings and the gas chandeliers, and new electroliers were fitted in halls and entrances. These were mostly replaced in the 1892 extensions with locally made fittings by electrical contractors Trackson Brothers.

After making improvements to the lighting in 1887 and 1888, Barton resigned as Government Electrician but retained a part time position as consultant and entered into a partnership with F. White to form a new company, Barton and White, to supply the General Post Office and the general public from their new Edison Lane Power Station.[1] While the Printery Power Station was exclusively used for the Government Printery and Parliament House, Edison Lane was the first central power station to supply the general public.

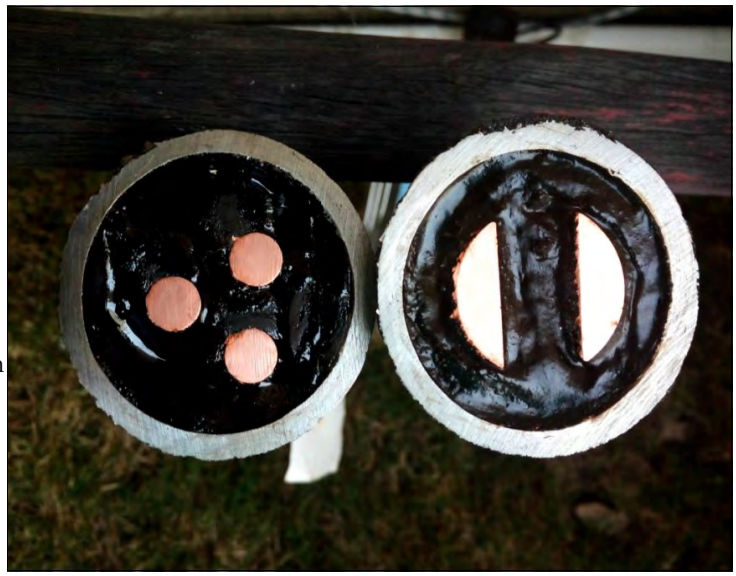
The Edison Tubes

The Edison Street Tubes were patented in 1881 for the two-core design by Thomas Edison, as the first commercial underground electric mains in the world, and were manufactured in New York, USA by one of his companies, Edison Electric Tube Company. They were first used in January 1882 in London, England, for the Holborn Viaduct installation, the world's first public electric lighting network designed by Edison to run from a central steam powered station and later, in September that year were used in Manhattan New York, for the Pearl Street installation. In 1884, just two years later, Brisbane was the first city in the southern hemisphere to install the Edison tubes, and was one of a few cities, outside major world capitals, to have received its supply of Edison Tubes from surplus stock from the Holborn installation in London.

1 A story about this Barton & White Power Station appeared in the Dec 2013 issue of EHA Magazine. – Ed.

The Recovery of 134-year-old "Edison Street Tubes"

In 1892, the addition of the Alice Street wing to the Parliamentary Buildings gave consultant Barton the opportunity to resolve an excessive voltage drop and improve the supply. He did this by laying a new three-core Edison tube alongside the existing two core Edison tube, using each of the 3 cores to supply a different part of the parliamentary buildings. The two cores of the original tubes were bonded together to form the return conductor. These reinforced mains provided supply for another 14 years and were taken out of service in 1906 when a larger capacity supply replaced them. This was a 220/110 volt DC three wire operation from the Barton and White Co. successor organisation, the City Electric Light Co. in George Street, supplied from their more efficient [circa 1898] Ann Street Power Station.

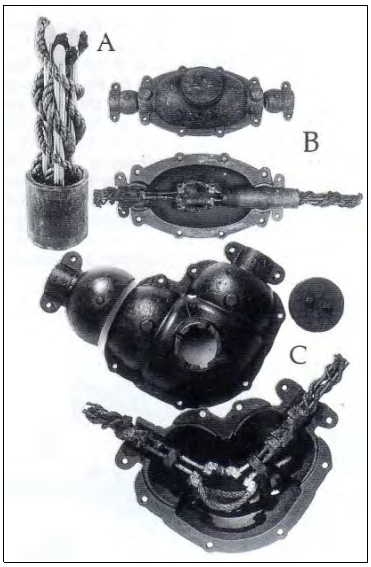


Freshly sawn cross-section cut through a 3-core Edison Tube (left) and a 2-core Tube (right). Shows the solid copper rod cores in each, the black insulating compound, and the silver coloured wrought iron outer tubes.
Photo: B Becconsall, 2018.

Cut-away examples of the 3-core (1892) and 2-core (1884) Edison Street Tubes recovered in 1992, showing the internal construction as described at right.
Image: Adapted from a Queensland Museum photograph.

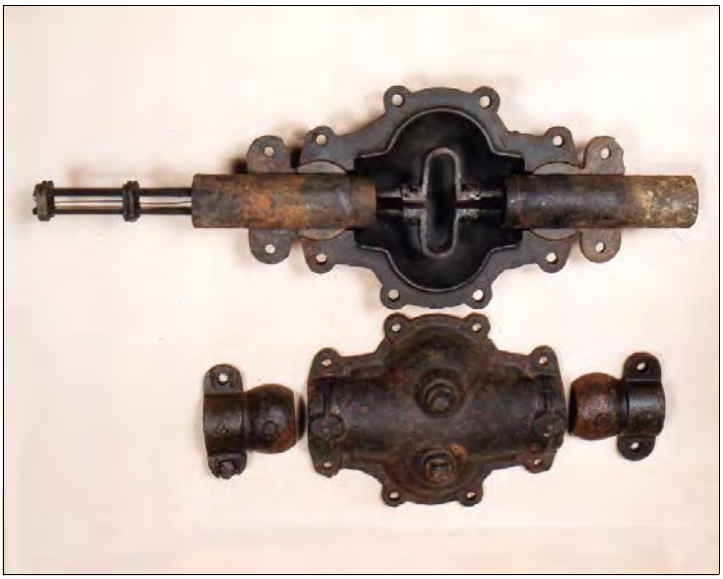
The Edison Street Tubes were each 20 feet in length (6.1m) with conductor sizes of 2 x 0.206 sq. inch (2 x 133sq mm) for the two-core and 3 x 0.12 sq. inch (3 x 77 sq mm) for the three-core. They consist of solid copper rods insulated by millboard diaphragms tied by cords in the case of the two-core and twisted rope in the three-core, and slid into the long wrought iron tubes of outer diameter 2¼ inch (57mm) for two-core and 2⅜ inch (61mm) for three-core (see at left). After filling by vacuum pump with insulating compound made from a combination of refined Trinidad pitch, linseed oil, beeswax and paraffin wax, they were permanently sealed with rubber plugs at each end for transport, with 3 inches (75mm) of copper rod protruding to enable continuous connections.

Following installation in the trench, they were joined by cast iron bolted egg shaped "boxes" filled with the same insulation and with flexible connectors to allow for expansion (see below). The trenches were only 300mm deep under the roadway, with the two mains running parallel to each other and well away from any other underground services.



Right:: 2-core in-line joint "box" laid 1884 and recovered from William Street in 1992.
Photo: Qld Museum.

Left: 3-core in-line (B) and right angle (C) joint "boxes" laid 1892 and recovered from William Street in 1992. Image: Qld Museum.



Later Discoveries from 1986 to 1992

Small sections of the tubes were re-discovered in colonial era buildings in Brisbane in 1986 and 1989 and the street mains were extensively re-discovered in 1992 by the South East Queensland Electricity Board (SEQEB, now trading as Energex) and by the Queensland Museum (QM). The research was conducted by QM staff researcher Don McKenzie and retired University of Queensland Emeritus Professor Syd Prentice, resulting in a paper[2] that became the seminal work on the use of these tubes in Brisbane. Only two lengths (12m) were cut up and recovered with joint boxes for display by QM – the location of the rest was identified by using then state-of-the-art underground cable detection equipment, but not disturbed.

Electricity industry engineers Brian Becconsall from Queensland Electricity Commission (QEC), Jim Simmers from SEQEB, and technical officer Mick Purcell, also from SEQEB, supervised the 1992 excavation. Engineering Heritage Queensland (EHQ) organised an EA heritage plaque to be installed at the old Government Power Station site and Becconsall & Simmers presented a joint paper in 1992 to EA on *Electric Lighting in Brisbane – The First Decade 1882-1892*,[3] combined with a QM display of recovered artefacts at the old Printery.

Right: Part of the 1992 excavation – looking south-east along William Street from the corner of Stephens Lane. This is a similar view to the earlier 1898 photo, with the pyramid shaped roof of the Parliament buildings extension on Alice Street in the distance. Note the shallow depth of the excavation below the road surface, and the right-angle joint "boxes" for the 2-core and 3-core Tubes. Photo: Courtesy of Energex.

Left: The 2018 dig in William Street. Recovered Edison Street Tubes being cut and sealed for removal. Photo: Brian Becconsall, February 2018.

The 2018 Recovery

In 2016, Energex alerted EHQ of the proposed Queens Wharf Brisbane integrated casino & resort development between William Street and the Brisbane River. The Destination Brisbane Consortium (DBC) who are developing the project had advised that 150m of William St was to be completely excavated for a large underground car park, which would remove over 50% of the buried remaining tubes. This provided an excellent opportunity to recover intact full 20 ft lengths of Tubes with joints just as they were manufactured by Edison in New York, and to demonstrate manufacturing methods at the birth of the Electricity Industry some 134 years ago.

QM advised they had sufficient samples for their needs, and now-retired engineers Brian Becconsall and Stuart Wallace, on behalf of EHQ, embarked on an extensive investigation worldwide to see which museums might want to obtain full length samples.

2 McKenzie, E.D. & Prentice, S.A. 1994-06-01; *The first underground mains for electricity supply in Brisbane. Memoirs of the Queensland Museum 35(1)*; 181-192. Brisbane. ISSN 0079-8835

3 Becconsall, B.J. & Simmers, J.M. April 1992; *Electric lighting in Brisbane – The First Decade 1882-1892. Power Supply and Lighting.* EA Qld Division Technical Papers Vol 33.

The Recovery of 134-year-old "Edison Street Tubes"

Left: The 2018 dig in William Street.
Careful removal of full 20 feet lengths of Edison Street Tubes from the excavation.
Photo: Brian Becconsall, February 2018.

By the end of 2017, specific requests had been received from the Science Museum in London UK, and from IEEE History Museum and Edison Historic Park, both in New Jersey, USA. Local requests were received from the Museum of Applied Arts and Sciences in Sydney, Highfields Energy Centre in Toowoomba, the Royal Historical Society of Queensland in Brisbane and importantly, through the Speaker, by Queensland Parliament House. Late requests were also received from the Smithsonian Institute in Washington DC, USA, and from Tamworth Museum in NSW.

The current owners, Energex, established a working group consisting of representatives of Energex, Department of State Development (and successor departments), the developer, Destination Brisbane Consortium (DBC), Probuild (Project Managers to DBC), Urbis (Heritage consultants to DBC) and EHQ to coordinate the recovery of 150m of the tubes. In the 2018 recovery process, (see previous page and above) the two- and three-core tubes were exposed, cut so full 6.1m sections with joint boxes at each end were removed intact, and strapped onto 7.7m purpose-built metal transport frames. They were then brush cleaned, sprayed with protective fish oil and transported to one of Energex's stores for onward shipment to the interested museums.

Above: Recovered Edison Tube lengths with joint "boxes" in special frames ready for transport.
Photo: Brian Becconsall, March 2018.

Below: Details of in-line joint "boxes" after preservation treatment.
Photo: Brian Becconsall, February 2018.

Legacy of the 2018 Recovery

After 134 years underground in shallow trenches, the tubes have remained remarkably intact, and the internal conductors and insulation are still in pristine condition for display. The prolific inventor and entrepreneur, Thomas Edison, was able to make use of readily available industrial products to provide the first commercial underground mains in the 1880's, and these underground electric mains were an instant success. Having the full 20 ft (6.1m) lengths available will show for future generations the ingenuity and care taken to make these in pioneering workshops at the start of the Electricity Network age in the 1880's.

The Recovery of 134-year-old "Edison Street Tubes"

Above: Sections of 2-core (bottom) and 3-core (top) conductors and separators removed from pieces of Edison Street Tubes to prepare for display.

Right: Copper conductors and separators/insulation disassembled and cleaned in preparation for making up a display like the one below.

Both photos by Brian Becconsall, March 2018

Overseas and Australian museums are particularly excited by the opportunity to obtain full lengths of the tubes, as there are few examples left world-wide. Samples of these tubes in full lengths with joint boxes will now be preserved for posterity, both here and overseas. Small shelf displays have been prepared as well by the authors and volunteers, and work in progress is shown in the three images on this page.

Below: Typical shelf display of the Tubes recovered in 2018, prepared by the authors and volunteers for display. Photo: Brian Becconsall, July 2018.

In Brisbane, an important historical project is underway in Parliament House where the Speaker and the Clerk of Parliament have agreed to provide a display of the Edison Street Tube technology in the Parliamentary Annexe. This will show to student groups and visitors how our Parliament House was first lit by electricity in 1886, and give a rare glimpse into the innovations and manufacturing techniques used in the 1880's at the start of the Electricity Industry here in Queensland.

by

Brian J Becconsall & Stuart Wallace
Engineering Heritage Queensland
May 2018

References:

1. McKenzie, E.D. & Prentice, S.A. 1994-06-01; The first underground mains for electricity supply in Brisbane. Memoirs of the Queensland Museum 35(1); 181-192. Brisbane. ISSN 0079-8835
2. Becconsall, B.J. & Simmers, J.M. April 1992; Electric lighting in Brisbane – The First Decade 1882-1892. Power Supply and Lighting. EA Qld Division Technical Papers Vol 33.
3. Becconsall, B.J. and Wallace, S.; EA Electrical College Newsletter – March 2018.

On 21 Nov 2018, in Brisbane, Brian Becconsall and Stuart Wallace will be presenting a paper on the Edison Street Tubes. Details at: https://www.engineersaustralia.org.au/Event/edison-street-tubes-william-st-brisbane-worlds-first-commercial-underground-electricity

Some New Zealand Railway Heritage

By Keith Baker.

Holidaying in New Zealand provides an opportunity for Aussies to see some spectacular mountain scenery, cultural differences and history, without travelling further than they might in their own country. It also gives an opportunity to see some of the engineering heritage that our colleagues in Engineering New Zealand (IPENZ) have recognised on their Heritage Register.[1] Being based in the centre of the North Island, we quickly became engrossed in some spectacular features of the railway infrastructure passing around steep mountains, through an alpine plateau and across deep river valleys on the North Island Main Trunk Line.[2] The first clue to its history was a sign indicating *The Last Spike*.

Sign & monument for the placing of the "Last Spike". The railway line is out of sight on the other side of the road behind the sign.
Photo: Keith Baker.

The rail linking Wellington and Auckland had been planned across the central plateau of the North Island from 1870 and construction commenced in 1885, but because of the difficult terrain it was not completed until 1908 when the last spike was officially driven.

The ASCE and IPENZ marker for the North Island Main Trunk Railway.
Photo: Keith Baker

Recognised as New Zealand's most significant land route, the achievement was commemorated in 1997 by IPENZ and the American Society of Civil Engineers near the point of connection from north and south as an International Historical Civil Engineering Landmark. Two major works in the vicinity had enabled the link to be finally made, a viaduct nearby and a spiral some kilometres further north.

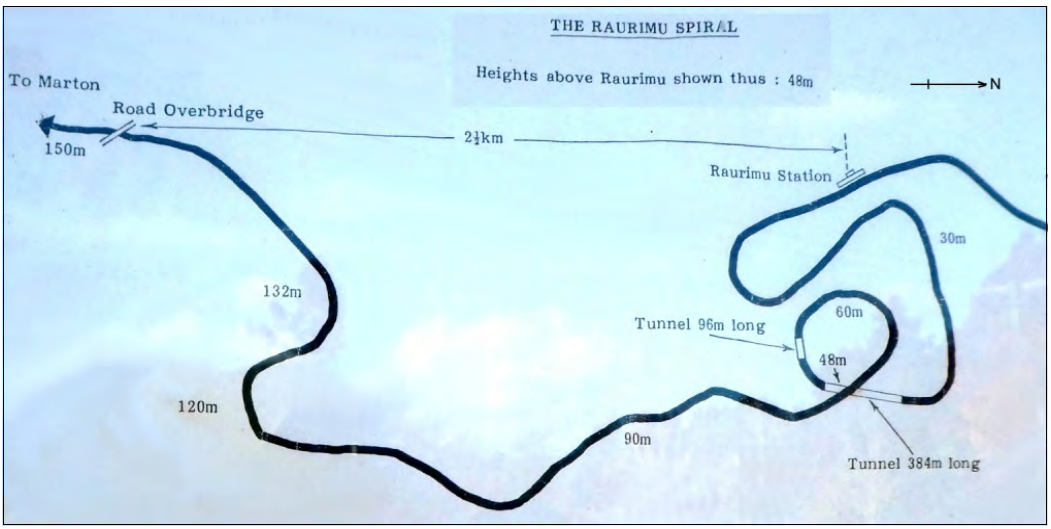
The Makatote Viaduct was built as a steel trestle bridge across a deeply entrenched river and was the last and highest of a family of structures that had a series of towers supporting Pratt trusses spanning up to 30 metres each. Makatote is 262 metres long and 79 metres high. Built in two years in difficult terrain by Christchurch contractors J&A Anderson, with an on-site fabrication workshop, it has remained relatively unchanged in spite of some progressive upgrading to carry heavier locomotives and accommodate electrification of the line.

Image Right: The Makatote Viaduct, showing reinforcing of one tower foundation.
Photo: Keith Baker.

1 See The Institution of Professional Engineers New Zealand (IPENZ) site http://www.ipenz.org.nz/heritage/DBSearch.cfm

2 The IPENZ Register entry for the North Island Main Trunk Railway - see http://www.ipenz.org.nz/heritage/itemdetail.cfm?itemid=71

The Raurimu Spiral[3] is an ingenious design that enabled the line to be economically completed from Auckland as far as the Makatote Viaduct. The Spiral includes two tunnels which allow the track to overlap and wind around in a circle, before exiting through two quarter turns and a horseshoe bend just south of the present day disused Raurimu Station. In 1898 Engineer Robert West Holmes was credited with conceiving and developing a spiral configuration that artificially increased the distance between the present road overbridge and Raurimi Station from 2.5 to 8.5km. This allowed the drop of 150m from the Central Plateau to be traversed on a manageable gradient of 1 in 50, and completely eliminated the nine viaducts required by the previously proposed route.



A Diagram of the Raurimu Spiral, photographed from a notice board near Raurimu Station. Photo: Keith Baker. The photograph has had the top trimmed and the notice board title moved down. A North Point has been added.

This Google Earth view of the Raurimu Spiral has been turned to match the notice board drawing above and a North point added.

Together these achievements allowed the trunk route to open up the Central Plateau and vastly improve travel time and commerce between Wellington and Auckland, a fitting end to this chapter in engineering heritage. But an unexpected twist in the story occurred when we met up with Kiwi friends Harvey and Chris in Auckland and talked about what we had seen. It turned out Christine's grandfather was Peter Keller, who as an 18 year old surveyor/trainee engineer had worked with Robert Homes on the survey of the rail route. According to the Keller version of history, during a sleepless night pondering on how to descend the plateau escarpment, Peter had the inspiration of using a spiral incorporating tunnelling into the escarpment. He dashed to his boss's tent to wake him and tell him he had solved their dilemma, only to be told to go back to bed and talk in the morning.

Christine Keller Smith holding a 1904 photo of her grandfather Peter Keller (on the left). Photo: Keith Baker.

A 3D model of the spiral at a lookout point between the highway and the railway line. Photo: Keith Baker.

On checking I found that The IPENZ Register entry for Raurimu Spiral credits *up-and-coming Public Works Department (PWD) engineer, Peter Keller (1880-1961), with refining Holmes' design slightly using the newly instigated PWD policy of transition curves.* This goes some way to substantiating the association, if not the claim, along with the photo of the survey party Chris showed me from the Alexander Turnbull Library. There is no way of proving that Ms Keller Smith's grandfather Peter was deprived of shared glory by his superior, but it is a different human interest conclusion to the story.

Keith Baker.

3 http://www.ipenz.org.nz/heritage/documents/Raurimu%20Spiral%20Registration%20Report%202012%20(600%20KB).pdf

Millewa 'A' Steam Pumping Station,
on the Murray River, north- west Victoria.

By Owen Peake

I had been waiting to get to see Millewa 'A' pumping station for decades and on the Queen's Birthday Weekend on 10 June 2018 I finally made it to one of the most atmospheric and remote steam pumping stations imaginable. Millewa 'A' is competently operated and maintained by the Sunraysia Group of Engineers Australia.[1] It is traditional for the Sunraysia Group to run both Millewa 'A' and Psyche Bend Pumping Station (in Mildura) sites over the Queen's Birthday Holiday Weekend. Millewa 'A' is about 9km north of the township of Cullulleraine and about 60 km by road west of Mildura (downriver) and the irrigation areas of Mildura and Cullulleraine are not connected. At Millewa 'A' there is a navigation lock (Lock 9) and weir on the Murray River and the Station pumps from the weir pool behind the Lock 9 weir.

Millewa 'A' Pumping Station. Photo: Owen Peake.

History of Millewa 'A' and the Millewa Irrigation Area.

Millewa 'A' Pumping Station was the last operational wood fired steam driven pumping station built in Victoria on the Murray River. The pumping station was constructed by the State Rivers and Water Supply Commission (SRWSC) and was put into operation on 20 October 1926. It formed part of an irrigation scheme, originally providing a supply of stock and domestic water to 462 'Soldier Settler' farm storages in the Millewa area, between the Murray River and the 'Sunset Country', west of Mildura.

The Soldier Settler program was instituted after the First World War to provide farming opportunities for returned servicemen from the war in Europe and the Middle East. Soldier Settlers were responsible for opening up large tracts of land in the Mallee Region of north-west Victoria. The irrigation scheme comprised a large water storage at Lake Cullulleraine, re-lift pumping stations at Lake Cullulleraine and Yarrara, 620 km of SRWSC owned earthen (unlined) channels, and a further 400 km of private earthen channels. Not surprisingly, little of the water pumped from the river actually got through to the farmers, in fact more than 95% was lost due to evaporation and seepage. Pumping was carried out during the winter months to minimise these losses.

Image above: The front of the Thompson Colonial Boiler, with the two fire doors open. Photo: Miles Pierce.

The plant at Millewa 'A' was second hand when installed and engineering drawings indicate it came from Cohuna, some 380 km south-east where it also served for irrigation pumping from the Murray River. The boiler is a 300 HP (224 kW) multi-tubular, under fired, two-pass Colonial type fire-tube boiler. The boiler is designed to produce steam for the engine at 160 psi. It has two fireboxes of very generous proportions and, like most steam plant in this part of the country, is designed to burn wood.

The engine is a 300 HP non-reversing, triple expansion, totally enclosed, inverted, vertical reciprocating steam engine, delivering its rated output at 250 RPM. The cylinder diameters are 12, 18 and 28 inches with a stroke of 12 inches. Thompson's of Castlemaine built both the boiler and engine at their main works at Castlemaine in 1908. The engine exhausts into a jet condenser originally designed to take water from the delivery side of the main pumps and return the condensate and cooling water to the river. A condenser bypass valve is fitted and is currently open, exhausting the engine to atmosphere. The engine is also equipped with a lubricating oil pump, a governor driven from the non-drive end of the crank shaft, plus a displacement type steam lubricator and a revolution counter.

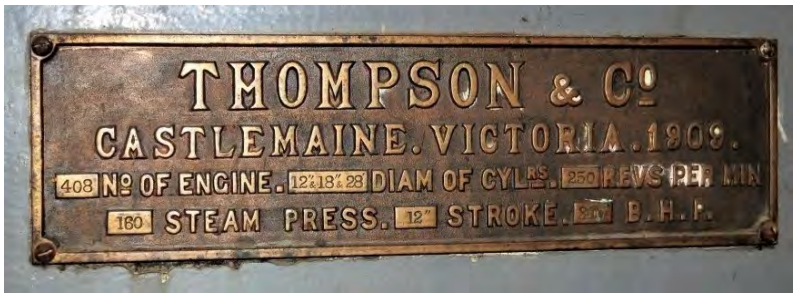
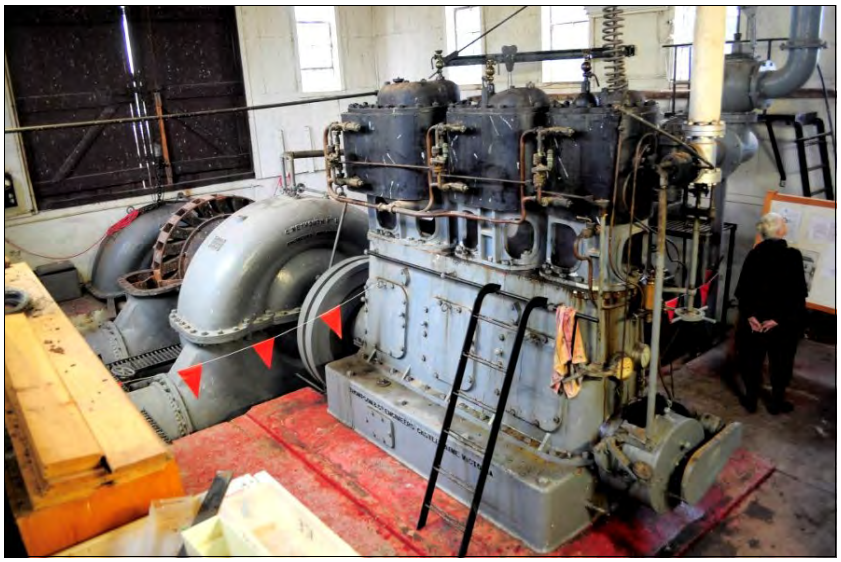


Image right: Thompson & Co. nameplate on the steam engine. Photo: Owen Peake.

1 Engineers Australia. Millewa 'A' Steam Pump Station – Demonstration. https://www.engineersaustralia.org.au/portal/event/millewa-steam-pump-station-demonstration downloaded 11 June 2018.



Thompsons of Castlemaine triple expansion pumping engine and two Weymouth centrifugal pumps. Photo: Owen Peake.

George Andrew Philip Weymouth started his business in City Road South Melbourne in 1898. The company primarily built electrical machinery including motors, dynamos, x-ray apparatus and electrical instruments, according to a contemporary advertisement. The company also claimed to be able to undertake *repairs to every class of electrical work*. Weymouth's timing was excellent. Reticulated electricity was becoming readily available in Melbourne and many classes of small manufacturers *raced to embrace the clean and convenient new power source*. The company moved premises several times as the business grew.[3]

It seems that Weymouth often supplied complete pump sets (electric motor and pump) and generating sets (steam engine and electric generator), particularly to mining companies. Apparently, in the case of the machinery now at Millewa 'A', the company also manufactured the pumps in-house.[4]

The two pumps are 39-inch (approximately 1 metre) diameter centrifugal type based on a design by well-known Australian mechanical engineer Anthony George Michell.[2] The design was unusual as both the inlet and the outlet pipes are in line. Normally water is admitted to a centrifugal pump parallel to the drive shaft, that is, at right angles to the outlet or delivery pipe. The advantage of the Michell pump is the simplification of the 'plumbing' of the inlet pipes while retaining efficiency. George Weymouth Pty Ltd, Electrical Engineers, Richmond, Victoria built the pumps, also in 1908.

Image above: A Weymouth centrifugal pump with the top removed. Photo: Owen Peake.

Image left: Jet condenser for the steam engine, and associated valves (see previous page). Photo: Owen Peake.

The two pumps together delivered 100 cubic feet of water per second (2800 litres per second) against a 10 foot (3.05 metre) lift from the Murray River. The delivery was into an earthen channel feeding Lake Cullulleraine, some 9 miles (14.4 km) south of the river.

2 See the Australian Dictionary of Biography entry at: http://adb.anu.edu.au/biography/michell-anthony-george-maldon-7567

3 Matthew Churchward, Museums Victoria. Geo. Weymouth Pty Ltd, Electrical Engineers, Richmond, Victoria. https://collections.museumvictoria.com.au/articles/3075 downloaded 14 June 2018.

4 Ibid.

Millewa 'A' Steam Pumping Station

The steam pumping station burnt about 1000 tonnes of wood annually when operating 24 hours per day for three months each year. This required three boiler attendants/engine drivers on each shift and further men were employed to gather firewood for the boiler. This eventually led to the steam pumping station being shut down and replaced by an electric pump fed from the grid.

Pumping routines have now changed with a longer pumping season and more water delivered for larger irrigated acreage. On the other side of the ledger, apart from the channel to Lake Cullulleraine, all of the formerly open channel network that supplied the Millewa Irrigation Area has now been replaced by pipes, thus reducing evaporation and seepage losses enormously.

A bank of two Weir feed pumps, used to feed the Thompson boiler. The pumps take unpurified river water straight from the channel. On the day the author visited the site, only the right hand pump was operating. Photo: Owen Peake.

The Pumping Machinery

At present the steam pumps are disconnected. However the Sunraysia Group of Engineers Australia has plans to re-commission the pump closest to the steam engine for demonstration purposes, and to use the second pump, with its impeller removed, for a return flow to the suction side. Water can then be circulated in a closed loop from a new pit to be built just outside the pump house to the original delivery structure which used to lead to the channel. The delivery structure has long since been isolated from the channel. This proposal is considered more feasible than reinstating the suction pipes from the river side which have been completely removed. This work is planned to be completed and in operation before the centenary of the pumping station in 2026.

On the day of my visit the engine was ticking over at 120 RPM on a steam pressure of 50 PSI. The engine is almost completely silent at this leisurely pace with the valve gear of the nearby Weir feed pump (one of a bank of two of different sizes) providing most of the machinery noise in what was overall a very relaxing and tranquil environment.

Blowing down the boiler to make sure the bottom spaces are clear of sludge (from the unpurified river water). Photo: Owen Peake.

Recent Maintenance

Various repairs and upgrades have been carried out over recent years. The largest project successfully completed is replacement of the thinner-walled boiler fire-tubes. These have a wall thickness of 1/8 inch (3.2 mm) and so many had been plugged that the boiler eventually became inoperable until it was re-tubed. All the tubes, except the stay tubes which have ¼ inch (6.3 mm) wall thickness and did not require replacement, have been replaced. This work was carried out by the volunteers and the boiler is now fully functional.

Closed top left boiler door.
Part of photo on page 16.

After many funding applications over about 10 years, funding was granted in 2007 for the purchase of boiler tube to restore the boiler to operating condition. Other restoration works have included replacement of the boilerhouse roof structure due to termite infestation. This project was funded jointly by Engineers Australia Sunraysia Regional Group, Lower Murray Water and Mildura Rural City Council. Some other modifications have been carried out on the boiler to keep the boiler inspector happy. Future work, other than getting the pumps pumping water, will consist of reconditioning the feed pumps, replacing boiler brickwork where required and reconditioning the main pumps.

Fire tube nest with 42 tubes, behind the top left boiler door. The thin-walled fire tubes (but not the 10 thick-walled stay tubes) in each nest were replaced recently. Photo: Owen Peake.

Peter Stone, one of the key people in the Millewa 'A' project, at the boiler front. Photo: Owen Peake.

A view of the Millewa 'A' Pumping Station, showing the pump delivery pit in the foreground. Photo: Owen Peake.

Strong Impressions

The result of the care and attention provided by the volunteer group over many years has given us a very impressive result. The pumping station is very little changed since it was built nearly 100 years ago. Although it is not steamed often, the events are very iconic with a strong sense of longevity and unhurried steadiness in every aspect of the station's operation. While the station no longer delivers water to the channel, in almost every other way little has changed since the scheme started operation in 1926.

From Pit to Port – The Pilbara Heavy Haul Railways.

By Bob Morrison

The Region

The Pilbara region in the north-west of Western Australia extends from the Indian Ocean to the Northern Territory border. The 3-billion-year-old landscape includes a coastal plain, inland ranges and desert. The first inhabitants were the Australian Aboriginals, whose history of occupation goes back some 30-40,000 years.

European settlement in the area began after an expedition led by Francis Gregory in 1862. The main early activities were pastoralism and pearling, and by 1869 there were more than 39,000 sheep in the region. Exploration inland continued and gold was discovered in 1887. Early coastal towns were established at Cossack, Roebourne and Onslow, with the inland town of Marble Bar becoming the centre for gold mining. Port Hedland was established in the 1890s, initially as a wool port.

Iron ore was first reported by Gregory, and later confirmed by the government geologist HP Woodward in 1890. Woodward noted that *iron ore occurs in immense lodes* in the inland Pilbara, and *there is enough to supply the whole world should present supplies run out . . . but as iron ores are of no value it is useless to trouble about them.*[1] Now in the twenty-first century iron ore is Australia's largest export by tonnage and value. Port Hedland is the country's biggest port by tonnages shipped, and Port Hedland, Cape Lambert and Dampier together handle approximately 50% of the world's seaborne iron ore exports. From the ground-breaking Pilbara beginnings of the 1960s, in 2017 BHP had a total production of 231 million tonnes of iron ore,[2] while Rio Tinto produced 330 million tonnes.[3]

The mining of iron ore in the Pilbara started in the 1960s, following the lifting of the Commonwealth Government's ban on its export, and the removal of the State Government's ban on the pegging of iron ore claims. Servicing the mines and the new communities that developed required the construction of new towns, ports and railways. The railways have grown into extensive private railway networks, carrying the world's longest and heaviest regularly-scheduled trains.

1 Robe River Iron Associates, *Reflections*, RRIA, undated (about 1992)

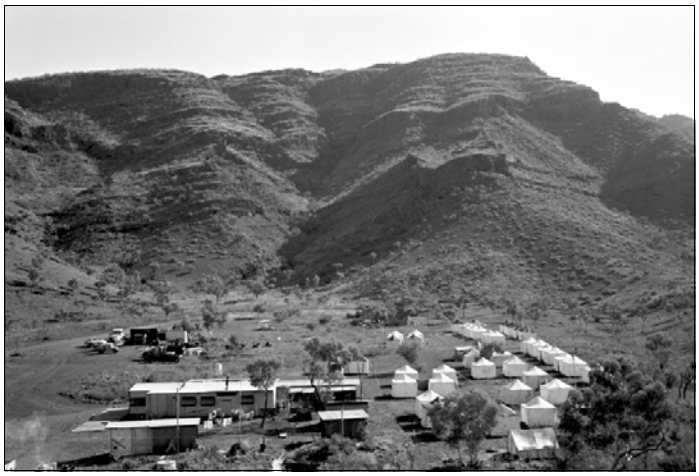
2 BHP Annual Report 2017

3 2017 Full Year Results, Rio Tinto, February 2018

Making Tracks

The first long railway in the region was the 3ft 6in (1067mm) gauge railway from Marble Bar to Port Hedland, which carried the train known unofficially as the Spinifex Express. The line was 183km in length and was opened in 1911 to serve the goldfields and pastoral stations. With the subsequent development of major mines in the eastern goldfields around Kalgoorlie the importance of Marble Bar declined and this railway was eventually closed.

Official opening of the Spinifex Railway in July 1911. Note the Black Swan banner on the front of the locomotive. Photo: WA State Library.



Construction camp on the Hamersley Railway, 1965/66. Image - Rio Tinto.

The original heavy haul iron ore railways dating from the 1960s and 1970s are the Goldsworthy and Mount Newman railways, now operated by BHP, and the Hamersley and Robe River railways, now operated by Rio Tinto.

The BHP systems terminate at Port Hedland, while the Rio Tinto systems connect to Dampier and Cape Lambert ports. They have been upgraded over time, and various branches and extensions have been added to serve new mines as they were established. All the Pilbara iron ore railways are standard gauge, i.e. 4ft 8½ in (1435mm).

Rail Handling, 1965/66. Image - Rio Tinto.

Construction of the Goldsworthy Railway commenced in 1965 and it opened in May 1966. It was built to link the Mt Goldsworthy mine to Finucane Island, where a port was built on the western side of Port Hedland Harbour. The port is connected to the mainland by a 5.6km causeway. The original line was 112km long. It was extended to Shay Gap in 1972 and Yarrie mine in 1993 for a total length of 208m. Flows from heavy cyclonic rains during the 1966-67 wet season overtopped the railway and damaged the track, causing excessive delays to traffic. Embankments were replaced with additional bridges to minimise recurrences.

Left: Typical Pilbara iron ore country.

The photo date of 1965/66 indicates that this photo shows the very beginning of the development of the Mt Tom price mine.

Image - Rio Tinto.

Smoko for workers at Mt Tom Price mine, 1966. Image- Rio Tinto.

The first Hamersley train about to leave Mt Tom Price on 1st June 1966.
Image - Rio Tinto.

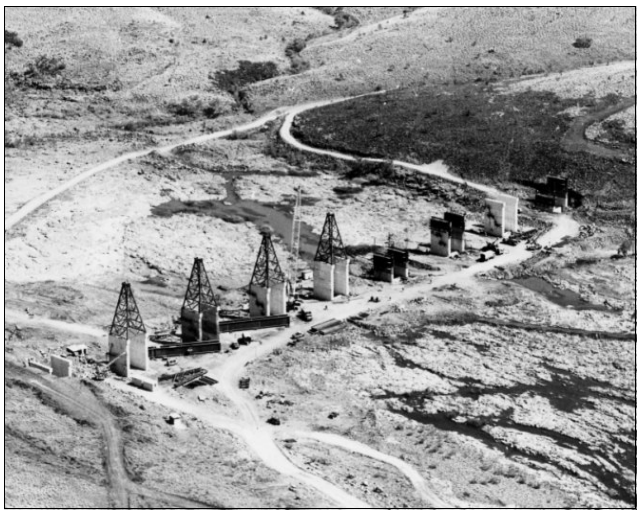
The first section of the Hamersley Railway system was built linking Mt Tom Price with a stockpile area and wharf at Parker Point, Dampier, a distance of 292 km. This was begun in September 1965. The first ore train ran in June 1966 and the railway was officially opened by Charles (later Sir Charles) Court, then Minister for Industrial Development and later Premier of WA, on 1 July 1966. A 94km extension from Mt Tom Price to Paraburdoo was completed in March 1972.

With Mt Tom Price in the background, Charles Court (later Sir Charles, Premier of WA) opened the Mt Tom Price to Dampier Railway on 1st July 1966.
Image - Rio Tinto.

The Mount Newman Railway connected the Mount Whaleback mine with the port at Nelson Point, Port Hedland. Construction began in October 1967 and the 426km line was officially opened on 22 January 1969. A significant role in the construction of the original heavy haul railways was played by workers from Thursday Island and other Torres Strait islands. Residents of these islands had been engaged on the national standard gauge railway from Fremantle to Kalgoorlie and on various narrow-gauge railways in Queensland, and had proved to be highly skilled and productive track-laying workers. In May 1968 on the Mount Newman project, workers contracted to Morrison-Knudsen-Mannix-Oman (MKMO) broke the world track-laying record. In one day they laid, anchored and spiked 4.35 miles (about 7km) of track. The feat was attributed to the talents of MKMO's engineers in developing specialised machinery and techniques, and the skills of the crew, many of whom were islanders. In September 2012 a statue was unveiled in Port Hedland to recognise the record and honour the Torres Strait Islanders who took part.

Above left & right: Thursday Islanders laying track, 1965/66. Images - Rio Tito.

From Pit to Port – The Pilbara Heavy Haul Railways.



The Robe River Railway Bridge over the Fortescue River, under construction in November 1971. Image - Rio Tinto.

Following approval for the Robe River mine development on 1 July 1970, a contract was awarded to construct the Robe River Railway from Cape Lambert to Pannawonica. The railway was 168 km long and was completed in May 1972. A test train hauling ore ran to Cape Lambert on 6 July 1972 and the first official production ore train ran on 8 August. In line with an ancient German mining tradition the first car travelled with a tree planted in the ore. This is said to signify the gladness of miners at the opening of a new mine.

Construction of the first railways here was undertaken largely by American and Australian contracting companies. There was initially a lack of Australian contractors experienced in track laying, given that most of the existing railway tracks to that time had been constructed by governments using their own personnel and equipment. Planning and design were carried out by the mining companies and local and international engineering companies. Steel rails were supplied from Port Kembla (NSW) and Japanese steel mills, while several hundred thousand hardwood sleepers were provided from Western Australia's southern forests.

The first ore train from Pannawonica to Cape Lambert on 8th August 1972 with a tree "planted" in a wagon laden with ore in accordance with old German mining tradition. Image - Rio Tinto.

Locomotives were diesel-electric, mostly built in Australia, as were the ore cars and other rolling stock. The first two locomotives for the Robe River Railway were reconditioned units, built in Canada and previously used on the NSW Government Railways. One had earlier served as part of the Royal Train during the 1954 royal visit to NSW. A singular import was the Pendennis Castle, a British steam locomotive, stablemate of the famous Flying Scotsman. This was purchased in 1977 by Hamersley Iron and presented to the Pilbara Railways Historical Society. It was used for several years to haul excursion trains before eventually ending up back in the UK.

All the original railways have been upgraded and extended over the years. Trains more than 3.5 km long now routinely haul more than 200-300 cars and 20-30,000 tonnes of iron ore. In 2001 a BHP train set a world record for the heaviest train by hauling a total of 99,734 tonnes for 275km between Yandicoogina and Port Hedland. The train consisted of 682 wagons and 8 locomotives and was 7.3km long.

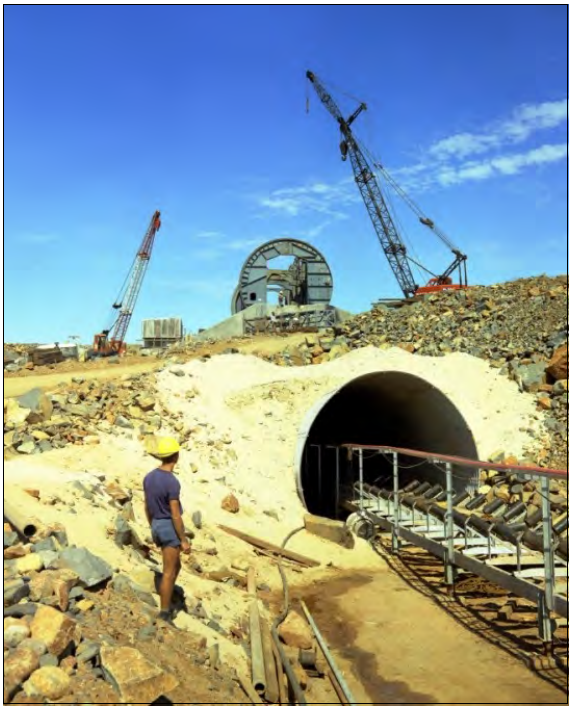
With the entry of other Pilbara iron ore mining companies in recent years several new railways have been constructed or planned. In 2007-08 a new 280 km railway was developed by Fortescue Metals Group (FMG) from its Cloudbreak mine to Herb Elliott Port at Port Hedland. This was later extended by 50 km to Christmas Creek mine. A 129 km branch from the main line to Firetail and King's Valley mines at FMG's Solomon hub was opened in 2012. In 2014-15 a new independent railway 344 km long from Port Hedland to the Roy Hill mine was constructed by the Hancock Prospecting group. Forward planning has been carried out by Aquila Resources for a separate railway 245km long to a proposed new port at Anketell near Dampier.

Right:
A Hamersley train on the causeway at Parker Point, Dampier, probably in the late 1960s. The sea with a jetty and a ship are just visible at left.
Image - Rio Tinto.

Engineering Achievement

At the time of planning the first heavy haul railways in the Pilbara, trains operating on Australian railway systems weighing more than 2,000 tonnes were rare. Most systems were owned and operated by state governments and much of their design and construction work was done in house. Opening up the major iron ore mining province in Australia's remote north-west required action to obtain and develop expertise and knowledge in heavy haul railway engineering, and in the safe and economical operation of long, heavy trains. The remote area, hostile climate including cyclonic rains and high temperature range, and lack of prior experience in designing and constructing major engineering works in this region meant that many difficulties had to be overcome in the early days. Worldwide there was little experience in the design and operation of such long, heavy ore trains.

A significant problem was that the early years experienced marked expansions in terms of tonnages hauled, to levels well beyond the original design criteria. Between 1966 and 1975 annual traffic on the Hamersley railway increased from 9 million gross tonnes to 56 million, while on the Mt Newman railway between 1969 and 1975 the traffic increased from 11 million gross tonnes to 52 million. These loadings led to track and vehicle deterioration at much higher rates than predicted by extrapolation from the experience of other railways operating at lower axle loads and annual tonnages.



Rail-car dumper under construction at Parker Point, Dampier in 1966. The dumper (top centre) would tip the ore from Mt Tom Price (see image previous page) into the conveyor emerging from the tunnel at right. Image - Rio Tinto.

The end of the line. Not Dampier – this is where the ore from Robe River railway is carried by conveyor out to the ships at Cape Lambert port. Image - Rio Tinto.

These and other issues led Mount Newman Mining and Hamersley Iron in 1973 to embark on a collaborative research programme. The work was mainly carried out by BHP's Melbourne Research Laboratories and the University of Western Australia, and later by ACE-T Pty Ltd, a company formed by members of the UWA group working on heavy haul train dynamics. The research was notable for its integration of laboratory studies and field investigations, and the involvement and cooperation of company engineers and operating field staff. The programme accomplishments resulted in significant increases in operational safety, longevity of train and locomotive components, and cost-effectiveness. It also allowed for the major increases in tonnages of ore being moved. Many advances in railway technology have continued to be made by and for the mining companies, not the least of which is the ongoing adoption of automated train operation.

The research programme and the experience of contractors and company staff led to a substantial body of knowledge and experience directly applicable to the region and the operational requirements of the mining companies. It also caught the interest of overseas mining companies and railway operators. The first international conference on heavy haul railways was held in Perth, WA in 1978, which followed the period of intensive initial development of the four Pilbara railways. A wide range of railway professionals and other interested people from Australia and overseas attended, including engineers, scientists, economists, manufacturers and business management personnel.

Further evidence of the international status of the Pilbara railways has been reported in a paper by William Walker[4] : *The Pilbara railways are unique for a number of reasons. One of the most important is that, unlike other Australian railways, they are vertically integrated with the mining and port infrastructures.* The Australian Bureau of Agriculture and Resource Economics (ABARE) in a report in June 2006 on export infrastructure and access, commented that *the Pilbara iron ore export chains stand out for the way that mine production, transport, cargo assembly and blending, loading and shipping are integrated.* The major advantage of this is that they are very responsive to fluctuations in demand.

4 Walker, William, *The Genesis of Heavy Haul Freight Railroads in the Pilbara*, Journal of Australian Mining History, Volume 13, October 2015.

From Pit to Port – The Pilbara Heavy Haul Railways.

Mining companies from around the world, including the USA, Canada, Liberia, Sweden, China and Brazil have made technical visits to view the Pilbara railway operations and equipment. The largest iron ore company in the world, the Brazilian CVRD (VALE), while they were constructing a railroad through the Amazon Jungle to their new Carajas mine, sent railroad officials and engineers a number of times. Asked why they visited the Pilbara so often, they replied that they were going to build an Australian railroad in the jungle.

In 2015 Engineering Heritage Western Australia submitted a proposal to Engineering Heritage Australia for the heritage recognition of the Pilbara heavy haul railways. This was accepted, and an Engineering Heritage International Marker was awarded to the Hamersley and Robe River railways as inaugural components. This was later installed at Dampier, along with an interpretation panel.

Above: A view looking north-east from a lookout near the town of Dampier. At right, the EHA marker and panel. Lookout sign at left. image - Rio Tinto.

Above: The view looking east from the lookout -- a curved panorama (due to a wide-angle lens?) with Dampier behind the camera and the Hamersley railway in front of the camera, Shows locos pushing a loaded ore train from south to north towards the ore dumper at Parker Point. Image source not known.

The Wider Significance of the Pilbara Railways

The heavy haul railways are an essential part of the development of iron ore production in the Pilbara, which is also of historical and economic significance to Western Australia and Australia as a whole. This was the first large scale industrial development in the Pilbara. It was also the start of a major export industry that has been of great economic importance to the country. It has been the catalyst for the development of new towns and ports and associated infrastructure, and led to large increases in population and local economic activity. The world community has benefitted from the production of steel from Pilbara iron ore and the many beneficial products and structures it has been used for.

An ore train pulled by two diesel locomotives back to back, leaving a mine on the Robe River line in the 1990s. Image - Rio Tinto.

From Pit to Port – The Pilbara Heavy Haul Railways.

The historian Dr David Lee has stated:[5] *Building the infrastructure of an iron ore industry in the Pilbara was a colossal challenge, one described as like building a 'state in miniature'. … The Snowy Mountains scheme is held up as the benchmark of Australian engineering and technological ambition and prowess in the twentieth century. The foundation Pilbara projects, constructed by private enterprise and over a much shorter time period, are at least a comparable achievement.*

A Rio Tinto image.

The first mining and railway developments relied to a significant extent on Japanese and United States inputs. Export contracts with Japanese steel mills were the stimulus for commencing mining, and Japanese investment was an essential part of the funding for the first projects. This gave rise to some of the earliest Australian business relationships with Japan since before World War 2, and these have continued to today. In recent years Chinese investments in mines and orders for iron ore have come to the fore, but the industry's role in developing a strong relationship with Japan remains of historical significance.

The Robe River line (bottom left) crosses over the Hamersley line (bottom right) on its way to Cape Lambert, about 70km north of the crossing. Image - Rio Tinto.

Early US involvement consisted of investment in mining, and the provision of expertise in the construction and operation of heavy haul railways. The latter included the winning of construction contracts by US companies and assistance given by US train drivers who had been working on construction trains. This included training in long, heavy train handling given to mining company drivers recruited from the state government railway systems, whose prior experience had been limited to smaller trains. This laid the foundation for ongoing cooperation between railway practitioners in the two countries.

The development of iron ore mining in the Pilbara has had a profound effect on the social and cultural environment of the region. From a sparsely populated area given to pastoral activities, gold mining, fishing, pearling and traditional Aboriginal living, the region now has major mining infrastructure spread over wide areas, new and expanded towns, ports and services, and a considerably larger population with a wider range of employment. Early changes took place during the construction phase, with the arrival of large numbers of workers and the setting up of temporary accommodation. Thursday Islanders played an important part in railway construction, along with people from all parts of Australia and overseas. Subsequently the mining companies have developed programmes for Aboriginal training and employment.

While it is not possible to single out the heavy haul railways as the main driver for these changes, development of the Pilbara iron ore mining industry would of course not have been possible without the railways. They can therefore be considered as important contributors to the region's changed social and cultural environment, and to the economic development of Australia. The original railways have formed the nucleus of the present-day world-renowned systems and are worthy of heritage recognition.

Photo: L to R -- The author Bob Morrison, EHWA, Chris Salisbury, Chief Executive Iron Ore of Rio Tinto, and Ian Maitland, EHWA, on 22nd August 2016 at a function in Perth held to celebrate the 50th anniversary of Rio Tinto's first shipment of iron ore from the Pilbara. They are holding the EA Engineering Heritage International Marker later installed at Dampier. Image - Rio Tinto.

5 Lee, Dr David, *Iron country: Unlocking the Pilbara*, Minerals Council of Australia, 2015

Book Review: "Apart from the Roads & the Aqueducts ..."

"The Bridges & Civil Works of Harold Irwin, 1911 to 1938" *by Patrick Irwin & Andrew Boak*

The recent publication of this book was heralded by the story *Ghosts of Bridges Past*, which appeared in the July 2017 issue of the EHA Magazine. *Ghosts* was a great story, and in effect was a distillation of the essence of *Apart from the Roads & the Aqueducts*. The book contains a brief biography of Patrick Irwin's grandfather Harold Irwin, contractor and *Ballarat construction pioneer*, and a shorter account of the life of Irwin's *skilled and practical* foreman and faithful offsider, Tom Scott. The rest of the book is a detailed account of the various contracts undertaken by Harold Irwin, from 1911 to 1938, most of them with Tom Scott as his foreman. It is liberally illustrated with archival photographs from the albums of Harold Irwin and the Scott family, sometimes enhanced by reproductions of original contract drawings and contract cards from the Country Roads Board (the CRB - now VicRoads). Where the works still exist, Patrick Irwin has added his own, recent photographs to the story. Patrick was immediately inspired to write his book by the marvellous vintage photographs in his grandfather's Photo Albums. I understand he started his research of Harold Irwin in the VicRoads Archives, and came across Andrew Boak, a VicRoads engineer, who became his collaborator and principal researcher in the production of this book about Harold.

When we published the *Ghosts* story, I had been under the impression that Harold Irwin was a consulting engineer, perhaps because one of his sons, Bill Irwin (Patrick's uncle), became a famous Australian design engineer, and the co-author, Patrick Irwin, is also an engineer. But Patrick's book makes it clear that Harold was a contractor (or builder). We tend to hear (or read) a lot about the designers – the engineers and architects of buildings and other structures and civil works, and little about the contractors who actually built them. The only other book I know devoted solely to contractors is the recently published (in 2014) *The Contractors* by Mike Chrimes and Hugh Ferguson. This massive volume is devoted to British contractors, from the 17th Century to the 21st Century. I acquired a copy more than a year ago, and haven't had time to more than dip into it since. I was delighted to be presented with *Apart from the Roads* . . . all about an Australian contractor, and I have read it thoroughly, some of it more than once. As a former employee of building contractors, wholly engaged in on-site work myself, I was doubly pleased to find this fascinating record of the life, and more particularly the works, of a long forgotten construction contractor, operating in times and conditions that are hardly imaginable to the reader today.

Harold Irwin's education at the Ballarat School of Mines saw him graduate as a mining assayer at the age of 21 and he followed that course for a few years before returning to Ballarat and graduating again as a mine manager. But the mining boom was over, and how he managed a segue into a career as a construction contractor, specialising in reinforced concrete, is not told. Patrick does say: *His imagination was captured by the possibilities of reinforced concrete and he studied the literature and became an expert, as the durability of his structures attests.* Harold's mineralogy and chemical knowledge and surveying training must have aided him in this self-education, another almost forgotten accomplishment.

Harold's earliest major contracts described in Chapter 3 were some irrigation channels in the Mallee, in western Victoria. Only a couple of pages, but those pages are packed with details of how Harold went about the job, what the work must have been like, and how different the construction (or excavation in this case) methods were in 1911 than today. To me, this evocation of the past, which continues throughout the chapters, is the most fascinating and valuable aspect of the book.

On the page following the List of Contents is a map of Victoria, with 28 arrows, emanating from text boxes around the edge of the map, and pointing to the locations of the various works named in the boxes and detailed in the following chapters of the book. This is an unusual and useful concept, and clearly illustrates the wide range of areas Irwin covered (from the Mallee in the west to the foothills of the Great Dividing Range in the east) in a time when travel was not as simple as it is today. And Harold Irwin was not a man who had an army of workers, climbing cranes, earth moving machinery or concrete trucks that could go anywhere at his beck and call all over the country, as many contractors have today. When he wasn't tied up with desk work, he would have taken his surveying tools, I expect including a dumpy level, on site with him and supervised his own small team of employees - carpenters and labourers who probably all camped out next to the job. Horse teams would have been found locally. They seem to have made their own derrick cranes and pile drivers out of local timbers, and their construction materials were mostly sourced locally.

In Patrick's preamble he says: *Imagine going into the bush without a mobile phone, chainsaw, concrete pump, nail gun or electricity and then building a major structure, with cutting edge technology, based on a rudimentary drawing? This is what my grandfather did and some of his bridges are still standing after almost 100 years.* There are very few people still around who remember those days, and what it was like to do without so much stuff we now take for granted. I do to some extent. My Dad was a Soldier Settler after World War 2, and we lived without electricity, or anything electric, until about 1953, and Dad who was always right up to date with the latest machinery, didn't get a chainsaw until 1966. And yes, I had to be pretty handy with an axe myself in the 1950s!

My only criticism is the large number of typos, which could have been eliminated by engaging the services of a book editor. Nevertheless, I thoroughly enjoyed reading this book, and I commend it to anyone who would like to learn what real life in the construction industry was like in the early 20th Century – times long gone and mostly forgotten now.

Margret Doring
Editor, EHA Magazine.

Book Review: "The Hawkesbury River Railway Bridges" by Bill Phippen

We announced the publication of this book in the previous issue of EHA Magazine. I have since had the opportunity to read the book , and for the purposes of introducing it, I can do no better than repeat what I wrote before:

Bill Phippen's book fills a gaping hole in the recorded history of Sydney's connections with Newcastle, northern NSW and Queensland, even further north. This is a detailed and profusely illustrated account of the design, construction and history of the two successive Hawkesbury River railway crossings.

One thing that struck me when doing historical research into the early days of industry in the Hunter region, was the almost palpable frustration recorded at the difficulties encountered in communicating (and trading) with Sydney, just south of the Hawkesbury River. There was the Great North Road – for what it was worth – but if you wanted to go to Sydney faster than a horse and cart could, you had to catch a ship.

By 1888, you could catch a train from Newcastle about 1000 miles north to the Queensland border, change trains and be in Brisbane a couple of hours later – but there was no train from Newcastle 100 miles south to Sydney. The Sydney link was still incomplete. The besetting problem was the wide and immensely deep drowned valley of the Hawkesbury River, needing a bridge of a size which had hardly been envisaged before. But it had to be done. The first Hawkesbury bridge was designed and built by the Union Bridge Company of the USA, and all steel was sourced from Scotland. Work began on it in the early 1880s and it was opened in 1889. Fifty years later it had to be replaced – an urgent need in wartime – and notably (unlike the 1880s bridge), with design and construction done in-house, by NSW Railways, and all materials sourced in Australia.

In 300 pages of very readable text (not counting the Appendix), there is rarely a page without at least one illustration – maps, diagrams, drawings, cuttings, but principally the most wonderful collection of photographs. And every photograph is pertinent to the text and has a descriptive and explanatory caption. I found myself taking so long poring over those photographs, soaking up every detail, that I would lose track of the text. So many images I decided to count them and came to the extraordinary number of 400, plus a few small ones overlooked – and every one sharp and clear and part of the story.

But it is not just a picture book. It is a lesson in how to make a potentially dry and dusty tome, with a subject almost unintelligible to the layman, into an absorbing and penetrating story, accessible to most readers. The author covers pretty well every topic needed to give a clear picture, from developing the decision to build the Hawkesbury crossing, through the politics, the tender process, the finished designs, and then the construction – from the massive operation to build the foundations, then the piers, the trusses and, most importantly, how it was all built. With the first bridge, we learn much about the contractors and workers and their lives on the Hawkesbury, in an age which seems impossibly long ago and far away. I felt I was almost re-living the vicissitudes and longueurs of building in the 19th Century, with no power tools, no motor cars, no telephones. However, we are fortunate that they did have the use of cameras, and that the author's research discovered so much invaluable material, including the Appendix – a transcription of the *Record Book of Ryland and Morse.* These 1880s contractors kept a day to day record of who was there and what they were doing, even to the church service on Sundays and occasional entertainments for staff and their families.

We also get an interesting and penetrating discussion of why and how the first bridge gradually failed, the efforts which were made to overcome the problems and the accelerating deterioration in 1937 which triggered an in-depth examination of the failing members and the consequent decision to build a new bridge, while struggling to keep the old bridge safely in service until its replacement could be opened.

After a fairly brief discussion of design work on the new bridge, the author launches into an even more interesting, indeed fascinating, detailed description of the whole construction process, from building and sinking the foundation caissons to building the piers, making the bearings, fabricating the steel components at Chullora workshops in Sydney, assembling the spans in the yard on Long Island, floating the finished spans out on the river to be seated on the piers and finally, laying tracks across the new bridge. And the author hasn't neglected the proof testing (with 6 big locomotives on the bridge at once), then the formal opening on 1st July 1946, and last, the dismantling of the old bridge.

I enjoyed this book a lot, and I have few criticisms. The index is somewhat sparse, and although the book does have a chapter on *Basic Terminology*, it would have benefited from an additional Glossary. The editing has been commendably thorough, and with the exception of a classic typo in the Introduction, any flaws are extraordinarily few and far between. I commend this book to a wide readership, including anyone interested in how such things are made or in the history of development in Australia – not just to railways buffs or bridge fans.

Margret Doring
Editor, EHA Magazine.

The Hawkesbury River Railway Bridges can be purchased for $88.00 at the Australian Railway Historical Society bookshop or online via https://www.railwaybookshop.com.au//default.asp

Apart from the Roads & the Aqueducts is priced at $45 plus $9.90 postage & packing. Go to: http://www.irwinstructures.com.au/ and click on Contact Us to telephone or email for an invoice for payment by EFT.

Engineers Country Weekend 2018

16, 17 & 18 November

This casual family weekend for Regional Engineers, Associates and friends will be held in Geelong and will continue the successful format of previous weekends held in country Victoria.

The weekend (see program below) will showcase Geelong and includes Saturday night dinner plus a Heritage recognition ceremony on Sunday.

A Deakin University tour, Advanced Manufacturing and/or Carbon Revolution (Friday afternoon; details to follow) and a tour of industrial sites on Saturday afternoon.

An opt-out pre-weekend 'meet-and-greet' is available Friday night on board the Hygeia, cruising along Geelong ports.

Accommodation

Delegates to make own reservations. Rydges Geelong offers a 15% discount on accommodation (see https://www.rydges.com/accommodation/melbourne-vic/geelong/).

Registration

Registration of interest for attendance at the events should be confirmed by 1st November 2018. Early registration will assist with arranging details with venues.

Cost

An EA/IPWEA member fee of $190pp covers the full weekend program (Friday, Saturday & Sunday).

SCHEDULE

Friday 16 November

3.00pm (tbc)	Meet at Deakin Waurn Ponds Campus Centre of Advanced Manufacturing
6:00pm onward	Welcome meet and greet at Geelong Waterfront. Departing on the Hygeia at 6.30pm. Commentary will be provided by Geelong Port Operations
	Note: If attending only on Saturday and Sunday cost is $150.

Saturday 17 November

9:00am – 12:00pm	Free morning. Suggested things to see can be provided, including self-drive tour
12:00pm – 1.00pm	Own arrangements for lunch
1.30pm – 5.00pm	Coach tour of some of Geelong's industrial sites
6.30pm – 10.30pm	Dinner at Rydges: "The Future of Geelong"

Sunday 18 November

10.30am – 11.00am	Self-drive to Lower Stoney Creek Reservoir, Brisbane Ranges National Park
11.00am – 12.00pm	Heritage marking ceremony for the Dam; the first concrete dam in the southern hemisphere and the third in the world
12.00pm – 1.30pm	BBQ lunch by local Lions group

Proudly sponsored by:

Victoria IPWEA
INSTITUTE OF PUBLIC WORKS ENGINEERING AUSTRALASIA

Register online at www.ipwea.org/victoria or for further information contact:
David Le Lievre at david.51.lelievre@gmail.com or on 0417 058 904
Vicki Shelton at vshelton@geelongcity.vic.gov.au or on 0439 004 994

Engineers Country Weekend 2018

16, 17 & 18 November

ENGINEERING HERITAGE NATIONAL MARKER

THE INSTITUTION OF ENGINEERS AUSTRALIA

Register online at www.ipwea.org/victoria or

Complete the following Registration Form:

Name: _____

Partners Name: _____

Postal Address: _____

Organisation: _____ Contact Phone: _____

Contact Email: _____ Dietary Needs _____

Please indicate the number of attendees for the weekend (Friday, Saturday and Sunday program)

☐ Full Registration per Person $190.00 (GST inc.) for IPWEA or EA Members and Partners

☐ Full Registration per Person $205.00 (GST inc.) for non-members of IPWEA or EA

OR

Event registration only please indicate the number of attendees at selected events

☐ Friday Evening Meet & Greet ($40 (GST inc.) per person)

☐ Saturday Visits & A/noon tea ($50 (GST inc.) per person)

☐ Saturday Formal Dinner ($90 (GST inc.) per person)

☐ Sunday Visits & Lunch ($50 (GST inc.) per person)

TOTAL AMOUNT _____

Payment method

☐ Direct Debit to BSB 063 633 Acc. No:10145355
Please use ECW18_"SURNAME" as your reference number on your direct deposit to help to process your order.

Credit card payments accepted when you register online at www.ipwea.org/victoria or for further information contact:
David Le Lievre at david.51.lelievre@gmail.com or on 0417 058 904
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Connections

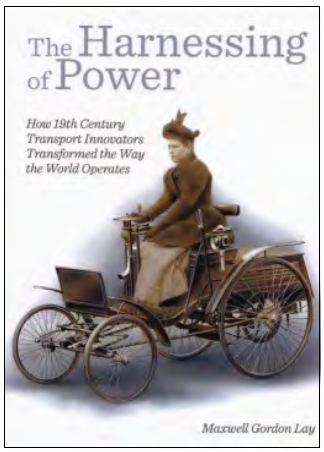
By Muscle of Man & Horse

Building the Railway under Sydney 1916 – 1932 – *a book by Bill Phippen*

Sydney was one of the first cities in the world to build a commuter railway beneath its streets. Using then recently developed electrical technologies and then modern construction techniques for the trains, the plan was as future-proof as any could be, and still serves the city very well, more than a hundred years after work began. Yet the oldest technologies – the muscles of men and horses – carried the main task of the construction. Prodigious feats of earth moving and tunnelling were undertaken with shovels and small drays. The ingenuity of the professional staff – anonymous men, largely hidden to history by the towering figure of J.J.C. Bradfield – was challenged to produce quality work without the tools of construction taken for granted even a couple of decades later. This is the story of the railway built under the city and how it got there. This superb hardcover book is published by the Australian Railway Historical Society NSW. It can be purchased for $88.00 at the ARHS bookshop or online via https://arhsnsw.com.au/product/by-muscle-of-man-and-horse-6/

The Harnessing of Power

How 19th Century Transport Innovators Transformed the Way the World Operates – *a book by Max Lay*



This book examines how the 19th century's transport legacy of bicycles, trains, ocean-going steamers, trucks, trams, buses and cars arose, creating numerous new technologies and markets. Nothing like this range of transport changes had occurred before, and the 20th century changes were incremental compared with those of the 19th century. The book explores where the key transport features came from and why there were so many inventions, innovations and inconsistencies. The Industrial Revolution was a key part of the process as it had strong links with transport developments. The book adopts a broad, global perspective, but initially has a strong British focus as the Revolution was a process predominantly initiated and implemented in Britain. Nevertheless, by century's end France and south-western Germany were the dominant change-makers and the USA was appearing on the horizon. The book also highlights the many inventors and entrepreneurs who caused these dramatic transport changes. This hardcover book was published in 2018 by Cambridge Scholars Publishing, Lady Stephenson Library, Newcastle upon Tyne, England NE6 2PA, UK. To order the book, go direct to: https://www.cambridgescholars.com/search?Q=The+Harnessing+of+power

England's Redundant Post-War Coal & Oil-Fired Power Stations

Guidelines for recording them and archiving their records

These guidelines were published 10 March 2016, and I'm sorry it has taken me some time to catch up with them. Historic England says: *This guidance note provides advice to the Energy Industry on the appropriate and proportionate level of recording of redundant power plants for posterity. It covers description, investigation, photographic and videographic recording of the structures; approaches to oral history and information-gathering from the workers on the site and the local community, and advice on archiving the historic records and artefacts.* Find the guidelines at: https://historicengland.org.uk/images-books/publications/englands-redundant-post-war-coal-and-oil-fired-power-stations/

Old film footage of Melbourne in 1910

I've had this web link for years and forgot it existed. As so often happens, it turned up when I was looking for something else. There is so much nostalgia in this film for any ancient Melbourne native. The city, in those panoramas, actually looked much the same as it did when I was a child in the 1940s. No Hansom cabs or cable trams then though! And does anyone else remember when the State Library was also an Art Gallery and Museum? Those curious displays of stacked, stuffed animals! I think the displays were somewhat more sophisticated by the time I came along – and in glass cases. See Richmond Station, with all those steam trains roaring in and out, and Henley on Yarra a bit like the Grand Canal at Carnevale. Find the film at: http://kristofferpaulsen.tumblr.com/post/47749436698/amazing-old-film-footage-of-melbourne-in-1910

Thank you Kristofferpaulsen whoever you are.