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EDITOR:

Margret Doring, FIEAust. CPEng. M.ICOMOS

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eha@engineersaustralia.org.au

or visit the website at:

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Cover Images:

Front: The 1902 steam tug "Waratah" (see page 7) moored at the transept between berths 8 (left) and 9 (right) on the west side of the Woolloomooloo Finger Wharf and viewed from Wharf 11 below The Domain, Sydney.

Image: M. Doring, 1988

Back: "Olive Mount cutting, Liverpool, from Coloured Views on the Liverpool & Manchester Railway with plates . . . from drawings made on the spot by Mr T T Bury". [R Ackermann, London 1831]

Image: the Frontispiece of 'Early Main Line Railways' – see page 23.

This is a free quarterly magazine covering stories and news items about industrial and engineering heritage in Australia and elsewhere. It is published online as a downloadable 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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Editorial – a visit to Sydney.

EHA Magazine is Highly Commended in the 2016 NSW National Trust Heritage Awards

This magazine has been going for more than two years now, and when I received a notice from the NSW National Trust inviting entries for the 2016 Heritage Awards, and there was a category for Publications, I thought – why not? I filled in the questionnaire, sent a link to the magazines with it, paid the fee, and sat back to wait and see what happened.

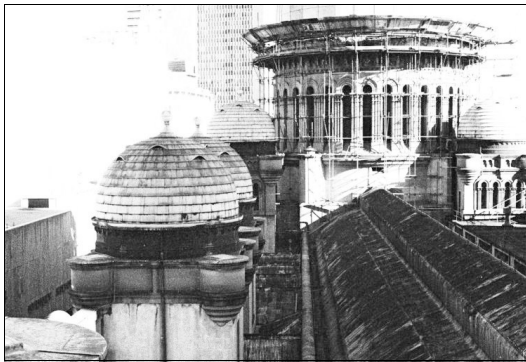
I am pleased to announce that, although we didn't achieve the highest award among the publications (the competition was extraordinarily strong), the EHA Magazine was Highly Commended, and we are now entitled to fly the Heritage Awards logo at our mast-head. I think the Trust would be content with its new place on Page 2. We were invited to attend the Heritage Awards luncheon in Sydney on 6th May – an invitation we were delighted to accept, but couldn't have accepted without the kind support of Engineers Australia (thank you Sheryl Harrington) and the National Trust (thank you CEO Brian Scarsbrick). It's a very long way to go for a lunch date – from the mountains of north-east Victoria to the Harbour City, 700+km by car.

My partner and I had very good reasons to want to attend – we have both been members of the NSW (and Victorian) National Trusts for more than 30 years, and we both had a long history of membership of various conservation committees within the NSW Trust, until we moved south. The drive to Sydney (and home again) was pretty intensive, but so much easier than the first time I did it, 55 years ago! We loved our *Room With a View* of the Harbour, the Bridge, Walsh Bay and the City. We enjoyed riding the North Shore train across The Bridge and through the tunnel to Central, and catching a TRAM to Jones Bay where the lunch was held. But chiefly, we enjoyed meeting so many old friends and colleagues at the luncheon – many of whom we hadn't seen for 20 years. It was good to be back in Sydney again!



From the room with a view -- C. Doring.

After lunch we caught tram and train back to Town Hall station and the Queen Victoria Building. Trying to save the QVB from demolition many, many years ago was what got me into this heritage business in the first place. It's one of the first places I want to go to if I'm visiting the City. I remember it nearly 40 years ago, dark, gloomy and filthy – with the City Library inhabiting one small section, the “Electricity” another, a few dank and depressing City Council clerks' offices in another and a few dingy shops on the ground floor. One needed a good torch, and probably a compass, to navigate the rest of the multi-floored rabbit warren of “temporary” partitioned offices and storage rooms.



QVB in 1981 – with roof glass covered, painted glass & broken glass. Photos - MD



Around 1979 the City Council was persuaded to do something – anything – to save the QVB (perhaps before it fell on the Town Hall). They advertised around Australia and overseas for redevelopment proposals to no avail. The money was not interested. And then Mr Yap Lim Sen from Malaysia stepped in. If Sydney couldn't see the QVB's potential, he could. About that time, I was engaged to escort a group of Sydney's leading contractors and heads of construction companies around the QVB, in an attempt to interest them in its possibilities. They grumbled, and stumbled over rubbish and felt their way along dark corridors, and concluded that I was bonkers and the sooner the QVB was demolished, the better.

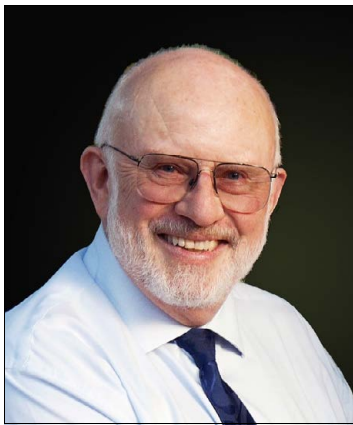
Ten years later, I hope they cringed every time they remembered that evening! In a report in 1986, not long before the QVB was re-opened for business as once again Sydney's premier shopping venue, I wrote: *The most notable change [in the QVB] in the last year has been the re-opening of the glazed roofs and the brilliant flood of light pouring down through the restored galleries to the ground floor. . . . Even more attractive is the brilliant piece of conjectural design evident in the recently unveiled glass central dome. Although it [was] known that a glass dome [once] existed, no records of its actual appearance could be found. The new dome, in tinted cathedral glass of a pattern harmonising with extant coloured glazing in the building, is an outstanding asset to Sydney.* Pierre Cardin is quoted as saying the QVB is: *the most beautiful shopping centre in the world.* I agree.

Richard Venus, BTech, BA, GradCertArchaeol., MIEAust., awarded the 2015 Engineers Australia John Monash Medal

The Engineers Australia John Monash Medal for Heritage recognises an individual who has made, over a considerable period of time, an outstanding contribution to engineering heritage in Australia.

The Citation

Richard Venus has been a passionate advocate for engineering heritage since the late 1970s, when his interest was sparked by assisting two local authors in researching the history of electricity supply in South Australia. At that time he was working as an electrical engineer with the Electricity Trust of SA. He was employed by ETSA for over 30 years, but also became a part-time TAFE lecturer in computer graphics, printing technology and visual communication. This mix of an engineering background and interest in visual communication provided him with a unique combination of skills that led him to establish a business in 1994 (Digital Ink) providing services in research, interviewing, writing, design, illustration and publication to a variety of government and business customers.



He applied these skills to benefit engineering heritage over many years by researching, writing and producing artwork for a number of comprehensive guides for 'engineering heritage' tours, including an innovative guide to the City of Adelaide. He has produced many engineering heritage recognition nominations submitted to Engineering Heritage Australia, resulting in the subjects being publically recognised and formally marked as engineering heritage sites. He is also the principal author of a very successful 50-page document 'Engineering A City', detailing the engineering history of Adelaide, which is now in its 4th reprint with 15000 copies produced to date. He regularly contributes research papers to heritage engineering conferences.

Richard is an outstanding advocate for engineering heritage, not only within the engineering community but also by raising awareness of heritage in the general community. He has served as Chairman of the South Australian branch of Engineering Heritage Australia several times over the last 18 years, and is its Chairman today. He is currently Vice President of the History Council of South Australia. He proposed and was instrumental in organising a highly successful annual engineering heritage conference in Adelaide, commencing in 2012, attracting a wide range of delegates including engineers, architects and historians. Richard regularly presents to general community groups such as Probus, Rotary and historical groups, and conducts engineering heritage walks through Adelaide, raising public awareness of the past work of engineers.

Richard Venus has committed much of his career and life to the recording, preservation, and celebration of engineering heritage. He provides encouragement and imparts knowledge to others, and works to increase community awareness of engineers and engineering. He has made an outstanding contribution to heritage engineering and serves as an excellent role-model for others to follow.



Transporter Bridge in Northern Spain – a World Heritage Site (photo at left). He has endless enthusiasm to contribute when nominations are needed and ceremonies are afoot. He came all the way from SA to the Upper Murray to help celebrate the awarding of a National Marker for the Bethanga Bridge, at which we unveiled a brilliant interpretation panel designed by Richard. And here he is (on the right in the photo at right) at the Overland Telegraph Joining Point Ceremony (see the footnote), around 2000 km from home!

That's not all you should know about Richard Venus. In 2008 he received an Engineering Heritage Award of Merit. He said he was delighted that this occurred on the same night as Sir Charles Todd's induction into the South Australian Engineering Hall of Fame.¹ And there's more – in 2013 his book, The Kangaroo and The King, about Australian stamp perforating machines, won a Silver Medal at the World Philatelic Expo in Melbourne. Then in 2014 he was awarded the Engineers Australia Medal, recognising "meritorious service at the divisional level", by the SA Division.

Richard himself says he never misses an opportunity to visit places of engineering heritage interest, and sent a photo of himself on the Vizcaya



From the Editor.

¹ For those, like me, ignorant of the significance of this, see <http://adb.anu.edu.au/biography/todd-sir-charles-4727> and <https://www.engineersaustralia.org.au/portal/heritage/overland-telegraph-joining-point-adelaide-darwin-1872>

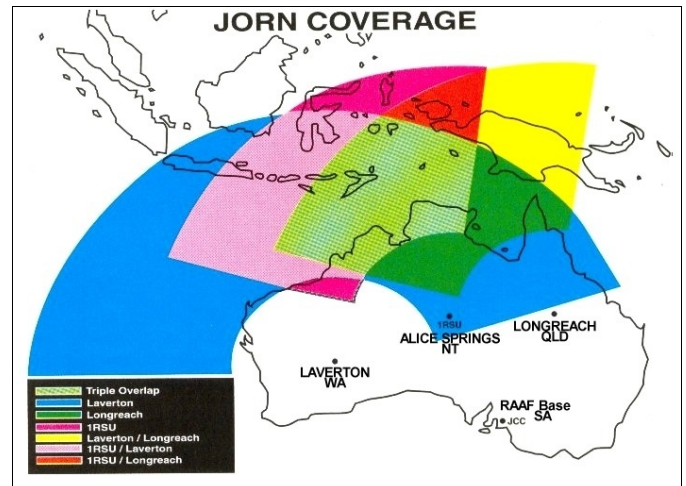
Jindalee – Australia sees far beyond its shores

An amazing technology perfected by Australians

The Aborigines have a concept of a place the eye cannot see, somewhere beyond where the eye can see, somewhere over the horizon. They call that place Jindalee. After the Second World War a group of very clever Australian scientists and engineers, in what came to be the Defence Science & Technology Organisation (the legendary DSTO) were asked to build a radar device that could see beyond the horizon. They borrowed the name for the abstract concept of seeing something beyond where the eye can see from the Aborigines and called their project Jindalee. After five decades of hard work their determination paid off and the system is now in operational service.

On 2 April 2003 the JORN radar system was turned on by the Royal Australian Air Force. JORN stands for Jindalee Operational Radar Network and it consists of three radar stations located near Alice Springs in the Northern Territory, near Laverton in Western Australia and near Longreach in Queensland, tied together by a Coordination Centre at RAAF Base Edinburgh in South Australia.

JORN looks West and North over Australia's Northern Approaches with the three stations able to cover a net area of at least 13 million square kilometres. Contrary to the published coverage, the radars can see, and identify by type, aircraft landing and taking off from Singapore's Changi International Airport, 4100 km from the Receiving Station at Mount Everard, North of Alice Springs. JORN can see light aircraft, airliners, military aircraft, including stealth types, and it can see ships and boats down to medium size metal fishing boats, and perhaps down to 'tinnies'.



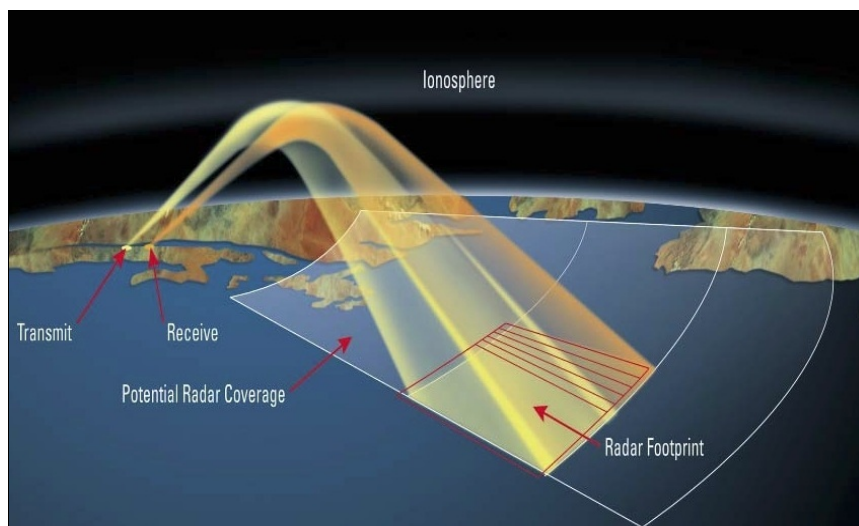
Coverage of the JORN network showing the overlapping operation of the 3 stations, Laverton WA, Longreach QLD, & Alice Springs NT. The RAAF Base in SA is the Joint Control Centre. Image: Key Publications Ltd.

The range of the Jindalee radars is notionally from 1000 km to 3000 km from the stations (as shown on the diagram above). I say notionally because these are defence installations and some aspects of the systems are classified. What we do know is that there have been numerous reports of the Jindalee system receiving signals from a range of around 4000 km. The question of range is not only a matter of 'secrecy', but there is also continuous upgrade work being carried out on the system to progressively improve many aspects of its operation.

The JORN Coverage diagram above is based on the publicly stated range of the system which is an arc from 1000 km to 3000 km from each radar station. The range is being incrementally increased by further development and the range of the system (its capability at any point of time) is unknown to the public for logical defence secrecy reasons.

Design Concepts

Over-the-horizon radars operate in the High Frequency (HF) spectrum in the frequency range 3 to 30 Megahertz. This is quite different to more conventional radars which operate in the much higher 'microwave' frequency spectrum. Over-the-horizon radars depend on the concept of bouncing radar signals off the underside of the Ionosphere to achieve extreme range



(over-the horizon) and on collecting return signals by the same method. Each radar station in the JORN system consists of a separate transmitting station and receiving station located about 100 km apart to avoid interference.

On receiving the return signal at the receiver station the data is converted to digital format and processed to provide a useful image of the target. The processing requires very powerful computers and complex software. The radars can be aimed at any particular location where a search is required. This area or location is termed a 'search box'. The over-the-horizon radar does not scan like a conventional radar but is directed to the area of interest by the operators (see image at left).

How the over the horizon radar works.

Image: Royal Australian Air Force.

Jindalee – Australia sees far beyond its shores

An unidentified contributor (using a *nom de plume*) to *The Aviation Forum*¹ described JORN in these words: *To me, the JORN system is one of Australia's quietest achievers. It is an astounding system, the most capable radar network in the world, all Australian designed and built, and should be acknowledged as one of Australia's finest defence technology achievements.*

Right: Each transmitter station and receiver station has a very large and complex antenna array. A portion of the JORN Receiver Antenna Array at Laverton is shown at right. Image: Defence Public Affairs.



Beginnings



Dr John Strath Image: DSTO

The first over-the-horizon radar may have been the Russian Duga-2 VEYER system built in 1949. However no details of its success or failure have been revealed.

In 1953 in Australia a key scientist named John Strath commenced work on over-the-horizon radar in the Department of Supply and Development, Electronics Research Division (ERD), Long Range Weapons Base Establishment, at Salisbury, South Australia. He built a strong team around him.



The "COBRA MIST" transmitting station at Orford Ness in Suffolk, UK. Image: Wikipedia.

The United States of America built an over-the-horizon radar system called *COBRA MIST* starting in 1964. The project was originally to be built in Turkey however Turkey withdrew support and the project was moved to Orford Ness in Suffolk, England. After severe interference problems prevented the radar from operating, the project was abandoned in 1973. Although the USA persisted with over-the-horizon radar research the strong collaboration which occurred between Australia and the USA, commencing in 1969, was arguably achieved more easily because of the failure of *COBRA MIST*.



F-117 Nighthawk flying over Nevada in 2002
Image: Staff Sgt. Aaron Allmon II (US Air Force)

In 1970 Project Geebung commenced in Australia aimed at defining a future over-the-horizon radar project for Australia.

Project Jindalee Stage A commenced at Salisbury, South Australia, also in 1970 and the project was made public by a Press Release by Minister for Defence, Lance Barnard in 1972. The Jindalee Stage A radar was turned on at Alice Springs in October 1976 and an aircraft was detected shortly after. After this, success followed success on the journey down the long road to JORN. In 1975 Project Jindalee Stage B had commenced and in April 1982 the final components for the Jindalee Stage B radar were delivered to Alice Springs and within one month the first aircraft had been detected. An interesting difference between Jindalee OHR and standard radar is evident when looking for the US Air Force F-117 Nighthawk stealth fighter/bomber. It is hard to see with conventional radar but is not a problem for Jindalee.

¹ <http://forum.keypublishing.com/showthread.php?5609-JORN>

Jindalee & the RAAF

The RAAF became involved in Jindalee in 1982. The RAAF would be the operators of the future JORN. In 1986 Minister for Defence, Kim Beazley, announced in a Press Release that the government intended to develop a network of over-the-horizon radars which eventually emerged as JORN.

All three JORN stations (Laverton, Alice Springs and Longreach – transmitters and receivers) are located in isolated desert country and the layout of their huge antenna arrays are clearly visible from satellite images, as is evident in the image at right.



The JORN transmitting station at Longreach in Qld.

Image: DSTO.



Aerial view of the JORN Receiver Station at Laverton in WA.

Image: Cpl Dave Broos, Defence Public Affairs.

The Wall comes down

At 10:45 pm on 9 November 1989 the world suddenly changed. The first checkpoint in the Berlin Wall was thrown open and thousands of East Germans poured into West Berlin. The Cold War was over. The Western Allies, and the United States in particular, became less interested in developing over-the-horizon radar for the detection of nuclear missiles. This change in emphasis enabled Australia, then working towards JORN, to consolidate its position as a technology leader in over-the-horizon radar.

Operational at last

On 2 April 2003 JORN was turned on but the scientists and engineers worked on. Step-by step the radars were improved – resolution increased, range improved, smaller targets could be detected. This work will not end as users of JORN data expect ever-increasing information and precision from the system.

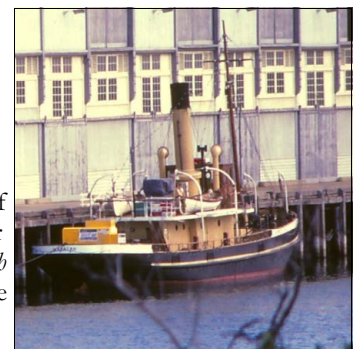
Owen Peake, HonFIEAust.

References: If you would like to know more about the Jindalee and JORN Projects read the nomination for the Heritage Recognition Program. The document is fully referenced and you will find references for all the material in this article in the nomination. The document is not yet on the EHA web page as the project has yet to be approved by the Heritage Recognition Committee. Until the document is on the web page you can contact Owen Peake at owenpeake@bigpond.com and he will forward you an electronic copy.

In the meantime information is available on *Anticipating Tomorrow's Defence Needs – A Century of Australian Defence Science* by Peter Donovan at: <http://www.dst.defence.gov.au/sites/default/files/publications/documents/Anticipating-tomorrows-defence-needs.pdf> and on the RAAF Jindalee fact sheet at https://www.airforce.gov.au/docs/JORN_Fact_Sheet.pdf

Notes & Queries – Steam Tug Waratah

It was only recently, when processing the slides of Woolloomooloo Finger Wharf that I took way back in 1988, that I realised the historic Steam Tug *Waratah* had made her way into some of the photos. Like many tugs, she had an adventurous life. Unlike S.T. *Forceful*, that I wrote about in the March 2015 issue of this magazine, she didn't have to sail all the way from the Clyde under her own steam – she's a local girl. Built in Fitzroy Dock, Cockatoo Island in 1902, she was launched as *Burunda* for the NSW Public Works Dept., to tow dredging plant up and down the coast and also act as a tug, a pilot boat and to do ocean surveying. In 1903, there was an investigation when a "silt punt" *Burunda* was towing out of Newcastle Harbour swung out and collided with two other tugs entering the Harbour. A few years later she rescued the crew of the yacht *Thelma* off Middle Head, Sydney, during a fierce gale. In 1918 she became *Waratah* and in the 1920s she went hunting along the Great Australian Bight for two hopper barges that had gone adrift. During WW2 she did target towing, was an examination vessel and port emergency ambulance, and even got herself shelled off Port Stephens after failing to answer a signal.



Waratah was retired in the 1960s and was going to be scrapped, but the Sydney Heritage Fleet scraped together enough to buy her from the Government. *Waratah* spent much of the 1970s undergoing repairs and restoration. She still looked like a tug when I photographed her in 1988 (at right), but more recent photographs show her re-fitted as a pleasure vessel for tourists. There is plenty of info about her recent life via Google, but to get a more complete version of her life, go to:

http://www.boatregister.net/Library/Maritime%20History/WaratahThesis_Flapan_1980_Optim.pdf

From the Editor

Woolloomooloo Finger Wharf

The rise, decline & amazing resuscitation from near death of a Sydney icon (in two parts)

In 1793, 100 acres of land, covering much of the present Sydney suburb of Woolloomooloo, was granted to John Palmer, a government official, for farming. In a few years there was an orchard, and probably some livestock, and maybe vegetables on the land. By the 1840s, extensive wharfage was developed around Sydney Cove, and Millers Point, on the very edge of the City, but nothing much was happening around Woolloomooloo Bay. The farm was subdivided and sold off for housing, which gradually crept down the hill towards the Bay.

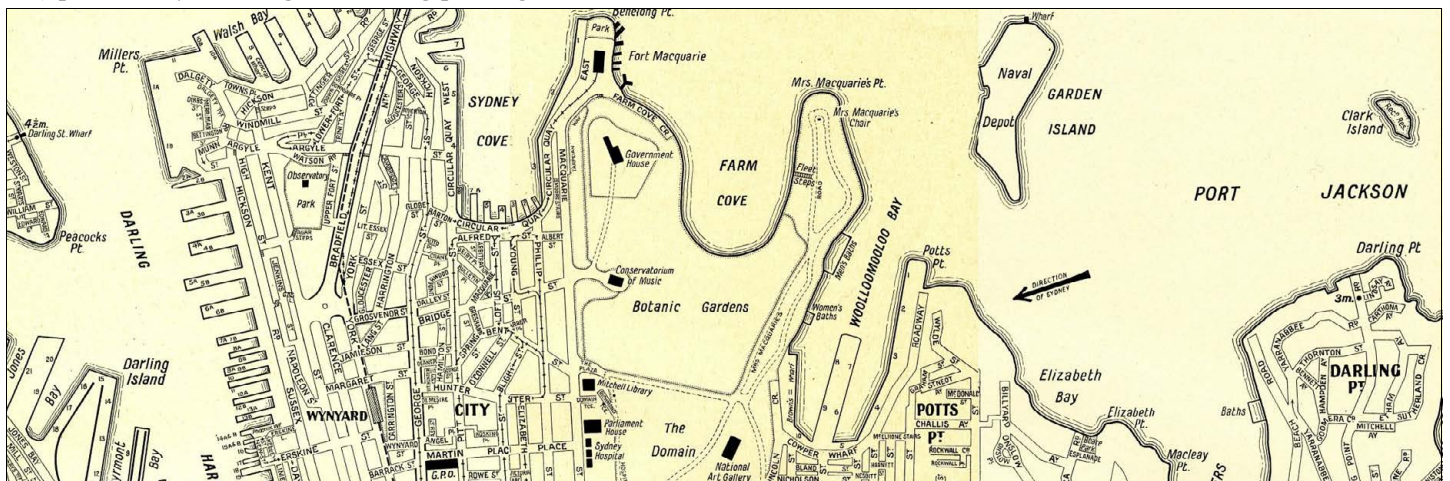


A ship moored in Woolloomooloo Bay in circa 1900. Source Searle Collection, NLA.

Around the south shore of Woolloomooloo Bay was alluvial soil extending into tidal mudflats. It was not considered viable for major commercial shipping, but a few small jetties were used for fishing boats and pleasure craft, and for landing building materials. Later, in the 1860s on the eastern shore, there was a boat building establishment and a steam operated sawmill, and a place for landing coal from the Hunter coalfields. All of these needed more substantial stone wharfing than the little timber jetties, and so the Woolloomooloo wharfage gradually developed.

By the 1880s, old photos show a fairly substantial wooden jetty roughly where the Finger wharf is now (the Admiralty Wharf?), for use by the Manly passenger steamers and the Navy, but in comparison with the wharfage closer to the City, development was slow.

After about 1880, the principal agent of change was not so much the ever increasing cargo and passenger traffic coming to and going from Sydney, but the ever increasing size of the ships carrying them. It was getting so that there was nowhere along the waterfront, or the existing jetties, that many of the newer ships could fit into. Some of the new, larger shipping had to moor off shore, and use tenders for taking passengers and cargo on or off, as if returning to the days of first settlement. Perhaps this is what is happening in the photograph above. The unidentified ship has a set of gangway steps over the side, with a small cluster of passengers waiting at the top for the small steam tender (at centre) to make its way to the steps. The ship is moored in the middle of Woolloomooloo Bay with tugs fore and aft. A throng of people on Admiralty Wharf (lower left) presumably wait to greet arriving passengers.



Parts of maps 2,3 & 4 of a 1940 Gregory's Street Directory of Sydney & Suburbs, showing the Sydney waterfront from Darling Harbour to Darling Point. Note that in 1940, Garden Island was still an island, Potts Point was still a point, the Naval Depot had not "reclaimed" the Harbour across to Potts Point, nor had the Captain Cook Graving Dock been built, and there were still separate Mens' and Womens' Baths on the west shore of Woolloomooloo Bay.

The large ship problem becomes obvious when we observe the row of little jetties shown in Darling Harbour in the map above. By 1900, there was no hope of modern cargo ships (or passenger ships) fitting into those berths. The original Sydney Harbour Trust, forerunner of the Maritime Services Board (MSB), was established in 1901 to take over and re-develop the wharves – particularly those around the City of Sydney waterfront. The Trust took a while to get going, starting by working on housing around Millers Point and demolition of the most deteriorated wharves and buildings and excavating cliffs along what later was named Walsh Bay. By 1909 the Trust was really getting into the swing of the proposed new wharfage. Construction of Pier 8/9 at Walsh Bay commenced in early 1910. Next was the Finger Wharf at Woolloomooloo, started in August 1910. Soon after came Wharves 19, 20 and 21 at Jones Bay in 1911 (see bottom left on the map).

Woolloomooloo Finger Wharf – a description

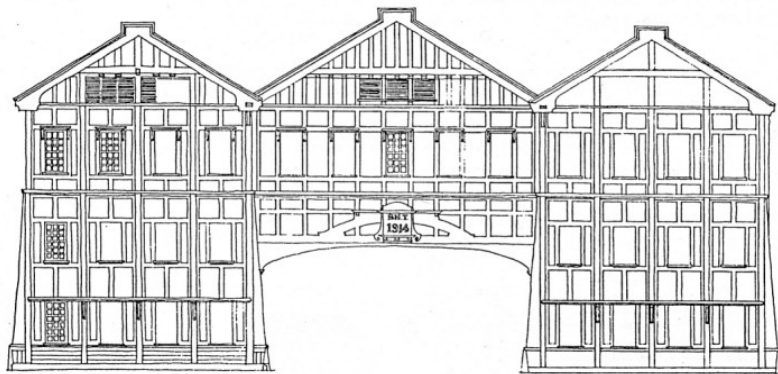
Henry Walsh, the Engineer-in-Chief of the Harbour Trust (after whom Walsh Bay was named) designed the Woolloomooloo Finger Wharf with all the latest mod cons for moving freight. His Woolloomooloo Wharf was practically complete by the end of 1915. It was by far the biggest of all new wharves started by the Trust in 1910-11, and it was among the first finished – after Walsh Bay 8/9 in 1914. Completion of the others was much delayed – until 1919-22.

The length of the Woolloomooloo Finger Wharf (or jetty) is around 1300 feet (say 400m) and width 210 feet (say 64m). It was totally supported on timber piles or piers, and was (and still is) the longest timber wharf in Sydney. Its width accommodated a central roadway 60 feet wide, with two-storey timber and steel cargo sheds 40 feet wide on either side of the roadway, and open aprons on either side of the sheds about 35 feet wide.¹ The two long sheds accommodated four berths – counting anti-clockwise they were Nos. 6 & 7 on the east side and Nos. 8 & 9 on the west side.



Henry D. Walsh.

Image: Walsh Bay website.



An elevation of the south front of the Finger Wharf sheds. The grand entrance to the central covered roadway is set back from the adjoining buildings. Drawing: Planning Workshop.

The covered central roadway was well lit by day with numerous glass skylights. The road was sunk four feet below the wharf apron and shed floor level so heavy cargo could be easily moved from truck or dray across to the shed cargo bays, or vice versa. The road was wide enough for most trucks or horse-drawn vehicles to turn easily.

In contrast to the wharf aprons, *which had ironbark decking, laid diagonally to ensure that cartwheels bore on more than one plank at a time*,² the central roadway decking was wood blocks (probably redgum) over reinforced concrete. Probably because of the anticipated heavy live-loading, the roadway had a different piling system to the plain turpentine³ piles under the sheds and apron. Under the roadway were ironbark piles inside pre-cast concrete cylinders, the gap between wooden pile and concrete cylinder being filled with concrete to protect the timber piles.



South end of the Finger Wharf seen from the Domain. Note the set back gable roof of the central roadway just visible between the south ends of sheds 9 (near) & 6 (far). Image: M.Doring, 1988.

An innovation was the double-sided conveyors – eight pairs of them, four pairs spaced along each side of the central roadway. Dumped wool bales⁴ were expected to be a large part of the cargo handled. A truck or dray could back-up to the base of a one of the wood-slat conveyors (like an escalator), push the dumped bales out onto it, and up the bales went to the first floor, where they were stored, or wheeled out in a hand truck to the gantry platform for loading on a ship.

Right: The central sunken roadway looking north. Shows 2 sets of conveyors on wharf 7 shed (right) & 2 sets on wharf 8 shed (left). Image: M.Doring, December 1987.



¹ Nearly every reference found differs in one or another dimension of the wharf from other references. MJD

² *Woolloomooloo Finger Wharf Heritage Report*, Don Godden & Associates, 1987.

³ Turpentine tree (*Syncarpia glomulifera*), resistant to marine borers and termites

⁴ Dumped bales were three ordinary wool bales, compressed down to one large parcel with an hydraulic press and bound tightly with specially designed wire straps.

Woolloomooloo Finger Wharf – a description



Typical wharf shed interior, possibly 9, looking south. Shows underside of the upper floor structure, described at right. Image: M.Doring, December 1987.

The three gable roofs, over the two sheds and the central roadway, extend the full length of the sheds and are fairly ordinary, with corrugated iron cladding and timber and wrought iron trusses at 20 feet centres bearing on 12x12 inch timber extensions of the storey posts. I imagine the internal valley gutters and downpipes probably caused much trouble over the years. Instead of the more usual ventilation monitor along the full length of the ridge line, the roofs over the cargo sheds had neat rectangular, hipped roof ventilators about 20 feet long at roughly 100 feet intervals. The vents over the central roadway were similar, but twice as long, with glass. (See the interior photo on the previous page. Translucent panels also visible would have been introduced relatively recently).

Because all the floor spaces inside the wharf buildings needed to be column free, the upper floor structures were made unusually strong, with four feet deep riveted plate girders spanning the full 40 feet width of the shed and bearing on 10x8 inch "I" section steel storey posts spaced 20 feet apart. Two layers of hardwood timber decking were supported on 12x12 inch trussed timber beams spanning the 20 feet between the plate girders and set at five feet centres. Every five feet a 12x12 inch slot in the top of each plate girder was cut out and reinforced with angle sections to house the ends of the timber beams (see photo at left).



Roof structure over Wharf 7 shed, looking north.

Image: M.Doring, Dec 1987



Roof vents over Wharf Shed 9 & centre roadway. Image M.Doring, 1988

The outer walls were divided into 20 feet wide panels, between storey posts, with 20 feet wide pairs of sliding cargo doors in alternate panels on both floors (see right). The exception was the transept (crossing) at the centre of the wharf, between wharfs 6–7 and 8–9, (see below).



Wharf shed 9 viewed from the west. Shows typical wall panelling with sliding doors. Image: M.Doring, November 1990.



The transept between wharf sheds 8 (left) & 9 (right) viewed from the west. The then new Navy car park in Fleet Base can be seen through the transept. Image: M.Doring, November 1990.

The wharf sheds had lots of electrically operated gear right from the beginning. The eight double-sided conveyors were all electrically operated. There were four electrically operated goods lifts (one in each shed), used for moving stuff between floors.

Inside each wharf shed there were small overhead travelling (bridge) cranes on each floor, running on steel crane beams mounted on steel RSJ posts against the inside walls. By the 1980s the cranes had all been removed, but a few traces remained in Wharf Shed 9 (see photo at the top of the page). These cranes were used to move cargo around the floor.

Woolloomooloo Finger Wharf – a description



East elevation of Wharf Shed 6, looking south from the transept. Shows a gantry rail on the wall and a welded gantry platform in the distance. Two lattice girder platforms are just visible behind it (see detail). Image: M.Doring, Dec.1987.



Originally the Finger Wharf apron was fitted with eight 3 ton electric cranes (two to each wharf), mounted on gantry platforms which ran on rails fixed to the outside walls of the sheds and the edge of the apron. The cranes could pick up goods (mostly dumped wool bales) from the gantry platform (upper floor level) or the wharf apron level and swing them across into a ship's hold. By the 1980s, all of the cranes had disappeared, and only two of the original gantry platforms, made with steel lattice girders, survived at the south end of Wharf 6, as seen behind a welded gantry platform in the photo detail at left.



Woolloomooloo Finger Wharf, seen from the Domain in 1988.

Image: M. Doring.

Woolloomooloo Finger Wharf – a working life

Long before the cargo sheds were completed the Finger Wharf was in use, with four ships alongside. By mid 1912 the wharf substructure was complete, the decking was almost complete and two temporary sheds were in use at the shore end of the wharf. The [Sydney] *Evening News* of 23rd October 1912 reported:

Woolloomooloo Bay during the last few days has been the scene of much activity, so far as shipping is concerned. The accommodation for overseas cargo carriers has been fully taxed, and gives promise of continuing for some time. The new jetty which is to accommodate big ships, though not yet completed, was utilised and four steamers representing something like 20,000 tons were taken alongside. These included the Nerehana, at the south end of the west side of the jetty; the Clan MacEwen at the north end; the Essen at the south end of the east side; and the Banalong at the north end of the east side. This quartette filled up the space, and for the time being it was difficult to discriminate between the jetty and bay.

. . . It is claimed by the Harbour Trust that when the jetty is open for regular berthing a good deal of congestion, so far as deepset shipping in the season is concerned, will be relieved. . . . while the water space has been curtailed the berthing room has been increased, and Woolloomooloo Bay will probably be known in the future as "Woolloomooloo Wharves". It is claimed further that the shed accommodation when the work has been finished, will be ample for many years to come.

Apparently this shipping occupation of the Finger Wharf went on unabated throughout the construction works, which continued until 1916. It must have been very confusing at times, for the builders, the wharfies, and the ships' crews. However: *By mid 1914, the sheds on Nos. 7 and 8 berths, at the northern end, were completed and by the end of that year the two berths at the southern end (Nos. 6 & 9) were also finished. An ambulance room was provided in shed No. 8 for the benefit of wharf labourers and others. By mid 1915, four 3-ton goods lifts, eight 3-ton travelling bridge cranes and eight pairs of freight conveyors (each capable of handling 2 tons continuously) had all been installed and had been used "satisfactorily" during the year.*⁵

5 Holt & Spearritt in the 1987 Woolloomooloo Bay Development EIS quoting the Sydney Harbour Trust Annual Reports for 1912, 1914, 1915.

Woolloomooloo Finger Wharf – a working life

One can imagine the sighs of relief all round when the last builder packed up his scaffolding and moved out. The wharfinger could at last concentrate on moving the cargoes with no interruptions – and enjoy the ease of doing it. The [Sydney] *Evening News* of 1st September 1915 reported:

The sunken road has proved a great success at the big jetty built by the Commissioners in the centre of Woolloomooloo Bay. This jetty has been in full swing for some time, and the convenience of the loading bays off the sunken road has facilitated the dispatch of waggons from the wharf. The wharf is now one of the busiest in Port Jackson. The gear for disposing of goods is of the most up-to-date pattern.

A search through the *Shipping News* of Sydney papers reveals a huge number of ships passing through the Finger Wharf over the years, and records of many can be found via Google. Some were purely cargo ships, loading dumped wool bales, frozen meat, grain, etc., mostly for Europe, but many doubled as passenger ships, carrying thousands of immigrants to Australia, and Australian passengers to Britain along with their Australian cargoes.

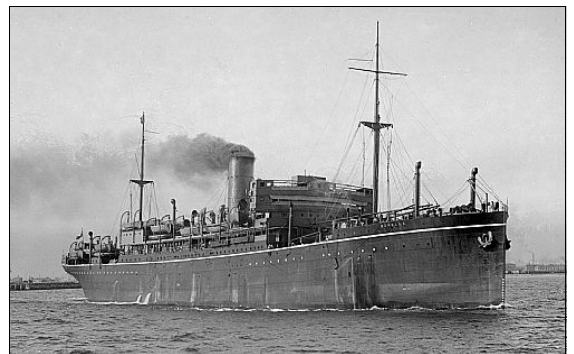
A typical visitor to Woolloomooloo was the *SS Benalla*, of the P.& O. Branch Line. On one trip she brought a hold full of boots and shoes and on another trip brought back *iron girders, corrugated iron, asbestos and some fine goods* as well as 500 passengers. We know about the iron girders et al, because they were recorded by the *Evening News* in July 1915 when she was on the way to Australia: *The P and O Branch steamer Benalla has arrived at Durban all well. The vessel was reported on fire 800 miles from Durban on Wednesday. The Benalla's hatches were opened soon after her arrival, and as soon as No.2 hold was uncovered, it was found that the fire was still strong. Dense smoke issued immediately. The holds are being flooded. and The Benalla arrived at Durban on July 23, where the cargo of iron girders, corrugated iron, asbestos, and some fine goods, was removed from the ship. At the time of the fire the vessel had about 500 passengers for Australian ports on board.*

The *SS Benalla* had an interesting life. Launched at Greenock in November 1912, she made her maiden voyage to Sydney in February 1913, via Cape Town, Adelaide and Melbourne, carrying about 1000 one-class passengers and 18 cases of measles! She was back in Sydney again in November with a Sydney pastor on board, where he had been acting as chaplain and advisor about Australia to 567 migrants (including 160 children) among whom: *Farm hands and artisans predominated, and there were 24 domestics among the females. . . . When she left London the steamer carried 1037 passengers for Australian ports.*

On the 18th April 1914 the *Evening News* reported that there were more immigrants on *SS Benalla*. There were 60 South Africans from Capetown, mainly all classes of artisans. The British were mainly agricultural classes – 32 assisted immigrants – 15 males, 17 domestic servants. 5 boys for Dreadnought Farm, 2 for a training farm at Cowra. Also 5 nominated families. *With the exception of one case of scarlatina, all enjoyed excellent health on the voyage, and it was a healthy, alert looking company that trooped down the liner's gangways to scatter to their various new homes and occupations.*

In September 1914, *SS Benalla* became a troopship, *HMAT Benalla*, and in December 1915 she was *in the Mediterranean carrying 2,500 troops when she intervened in a duel between the British India steamer Torilla and a German submarine, driving the U-boat off with her 4.7 inch gun and standing by the smaller ship until naval forces arrived.* And in 1915 she was: *Taken over under the Liner Requisition scheme for the Shipping Controller's trans-Atlantic munitions and supplies service, an equally risky and exciting adventure!* In 1927, on one of her last voyages before she was broken up in Japan in 1930, she took out the first consignment of steel for Sydney Harbour Bridge.⁶ I would like to think that was landed at Woolloomooloo, but it seems unlikely!

One of the most famous visitors to the Finger Wharf was the second *RMS Empress of Britain* – a great ocean liner built for the Canadian Pacific Railway and launched in 1930.⁷ Her normal run was between Southampton and Quebec, meeting the boat trains, and cruising warmer climes in the winter. In the late 1930s the *Empress* had such competition from the famous Cunard Queens sailing between New York and England, that her mail run became seriously unprofitable, and she went cruising more frequently, visiting Sydney and Melbourne on a round the world cruise for the first and only time in 1938.



S.S. Benalla

Image: SLV.



RMS Empress of Britain (left) at No.7 berth of the Woolloomooloo Finger Wharf in 1938. She was so long, she took up much of berth No.6 as well.

Image: State Library of NSW.

⁶ Information about *SS Benalla* came from the P&O Heritage Ship Fact Sheet.

⁷ Information about *RMS Empress of Britain* came from Wikipedia and other internet sources.

Woolloomooloo Finger Wharf – decline and disuse



Even in 1925 the ships looked too big for their berths. This is SS Orama leaving Finger Wharf berth 7 on 10th January 1925 after her maiden voyage to Australia. Image: National Maritime Museum.

The way the *Empress of Britain* overflowed her assigned berth was indicative of the problems besetting a wharf designed for the ships of 1910, barely able to cope with ships built 20 and more years later. But the Finger Wharf was still one of the best berths in Sydney for passenger ships, and then troop ships during World War 2, and more passenger ships after the War. In the 1950s, the passenger ships were bringing thousands of immigrants from Europe – just like SS *Benalla* 40 years earlier.

A sharp increase in immigrant and tourist traffic in the port in the early 1950's made it necessary to provide additional passenger facilities and a decision was made in 1955 to convert the two storey shed at No 7 Berth for use as a passenger terminal. . . . An additional passenger service between the west coast of the USA and Sydney was to be instituted in Sydney in November 1956 and it was proposed to have the new terminal operational in time for the vessels inaugurating the service. The new terminal was placed in commission according

*to schedule - November 1959. The upper floor of the former cargo shed at No 7 was converted to a modern passenger terminal with special facilities for Customs examination and amenities for travellers and their friends, including offices for tourist and travel agencies, banks, post office facilities and a buffet for light refreshments.*⁸

Unfortunately those changes were too little, too late. Two years later, the new, big, Overseas Terminal in Sydney Cove was opened, and thereafter, Woolloomooloo berth 7 shared the leftovers with a few wharves west of the Harbour Bridge. But the days of the regular passenger ships were declining rapidly anyway, as former passengers took to the air instead. And the cargo ships were deserting the Finger Wharf in droves. The Finger Wharf's biggest thing had always been storing and shipping wool, but the wool trade was declining and the big woolstores around Pyrmont were more than adequate, with easy access to rail and to the Pyrmont wharves. The cargo handling gear was now obsolescent compared with modern machinery.

*Wharf 11, next to the finger wharf in the south-west corner of Woolloomooloo Bay, was rebuilt in 1969 as a concrete longshore berth, designed for bulk steel, containers, and heavy cargo such as cars.*⁹ By the 1970s, roll-on roll-off ships for cars were common, and couldn't use the Finger Wharf.

Containerisation was taking over and the MSB built Port Botany Container Terminal. The Woolloomooloo Finger Wharf became an almost empty shell, as it was when I first explored it in 1987.

During the 1970s and into the 1980s, the suburb of Woolloomooloo underwent huge changes in rehabilitation and rebuilding, while the Finger Wharf remained a hollow empty sore on the end of the Bay – its former magnificence entirely forgotten by most. Occasionally it would be awakened from its slumbers by a ship that was waiting for a more up-to-date berth to be freed up elsewhere. In June 1987 some of the 10 US Navy ships visiting Sydney to celebrate the 45th Anniversary of the Battle of Midway found berths at Woolloomooloo Finger Wharf, generating the sort of excitement that sometimes must have surrounded the wharf during the two World Wars. But apart from those occasions – nothing. Something would have to be done to revive the area.



No photo found of the US Navy at the Finger Wharf in 1987. This circa 1946 photo (after the War) shows HMS Indefatigable at Wharf 1 & two other British aircraft carriers at 6/7 and 8/9. In the background at right is the great Titan floating crane between the ship & Wharf 11. An amazing image from NSW State Records.

In 1985 the Maritime Services Board (MSB), which had replaced the Sydney Harbour Trust in 1936, published a *Stage 1 Report on Redevelopment of Woolloomooloo Bay*. The authors were a “team” of architects and planners, various consulting engineers, marketers and, naturally, merchant bankers. The proposal paid minimal attention to the significance of the Finger Wharf, and basically would have turned most of Woolloomooloo Bay into a giant boat marina with 636 wet berths, and stacks for 200 dry boats. Just imagine!! However – more of that later, in Part 2 of this story. *From the Editor.*

References: Information in this document was derived from my own work, from the internet and a lot from two papers in a 1987 EIS on a Woolloomooloo Bay Development (WBD). These papers were the *WBD Social History & Heritage Significance* by Historical Consultants Patricia Holt & Peter Spearritt, and the *WBD Heritage Report* by Don Godden & Associates.

⁸ Holt & Spearritt in the 1987 Woolloomooloo Bay Development EIS quoting the MSB Annual Reports for 1955-1956.

⁹ Holt & Spearritt in the 1987 Woolloomooloo Bay Development EIS.

The Lake Goldsmith Steam Preservation Association Inc.

Heritage on show at their bi-annual Steam Rally

The Lake Goldsmith Steam Preservation Association Incorporated holds two Steam Rallies each year at their extensive site 15 km south of Beaufort, Victoria and about 177 km west of Melbourne. I attended the 107th Rally on 30 April 2016 and spent most of the day there. These rallies have been held since the late 1950s when the Association was formed.

The Lake Goldsmith collection is somewhat different to the Melbourne Steam Traction Engine Club collection at Scoresby in suburban Melbourne (discussed in the April 2016 issue of this magazine). There is a different emphasis on the steam/internal combustion mix and more emphasis on private “sheds” containing often eclectic collections of machinery. There are an incredible 46 “sheds” according to the Association! Lake Goldsmith has more emphasis on agricultural tractors, more examples of traditional gas/oil engines of the steam-to-diesel transition period and a strong emphasis on mobile steam plant such as traction engines, rollers and steam trucks.



Aerial view of the Lake Goldsmith site, with the Association exhibition hall near the centre and the parade ground at right. Image: Lake Goldsmith Steam Preservation Association.



Tuxford Steeple Engine c1860. Image: O.Peake.

The Association has its own display shed (the Founders Building) with a substantial collection of steam engines powered by a Thompson 200 HP multi-tubular boiler. This collection includes the large locally built Harrison mill engine made by the Albert Foundry, Ballarat in 1880-1890; a large Thompson Inverted Vertical Triple Expansion (IVTE) Generating Set with 120 kW, 3 phase, 415 Volt rated output; a very old (1860s) Tuxford Steeple engine; a 102 BHP Bellis & Morcom inverted vertical compound; a small Robison Brothers & Co Ltd (Melbourne) pumping set; and a very interesting 4 column true vertical oscillating engine made by Wedlake & Dendy c1862.



The Harrison steam mill engine, built in Ballarat c1880s. Image: Owen Peake.



Left: Robison Bros. & Co. Ltd. steam pumping set built in Melbourne. Image: Owen Peake.

The fairground atmosphere at Lake Goldsmith is very strong. There are always large numbers of visiting outdoor exhibits, mainly smaller internal combustion engines driving all manner of small machines, shed after shed of tractor displays and significant mixed-theme private exhibits, a grand parade, and many demonstrations and retail outlets.

Heritage on show at the Lake Goldsmith Steam Rally.



Plenty of activity among exhibits at Lake Goldsmith. Shows a vintage riveted sheet iron water tank and in the background the Founders Building holding the Association's steam collection. Image: Owen Peake.



Thompson 100 kW triple expansion steam generating set. Image: Owen Peake

For anyone wanting to see the Lake Goldsmith collection quickly I would offer three suggestions for must-see exhibits. Firstly, the Association collection of steam engines is significant, decorative and well displayed in a high bay shed with plenty of space. Secondly, the portable steam machines from huge ploughing engines to more “dainty” traction engines and portables are varied, elegant and represent the best of the long-gone steam farming era in Australia. Thirdly, don't miss the colour of the fairground atmosphere both in the streets of the collection and inside some of the more crowded and highly decorated “sheds”.



2 cylinder Ruston & Hornsby diesel engine c1930s in action. Note the whirring fly wheel, about 2m diameter. These engines were used for power generation, saw mill drives, pumping and in factories. Image: Owen Peake.

This is not a site which can be visited quickly. I spent about 6 hours there, took off a few minutes to have a drink and eat a hot dog and did not see everything by a considerable margin. The willingness of the proud owners of the private “sheds” to stop and talk about their machines doesn't help to make a quick visit but it adds immeasurably to the experience.

From a pure heritage perspective the site is awash with significant heritage in many categories. Much of the machinery is movable heritage (my definition of movable being that it is not bolted down to a foundation) which we all know has been under-recognised in Australia's formal heritage recognition systems, including the EHA Heritage Recognition Program.



A few of the visiting mobile/portable exhibits at Steam Fest. Many such exhibits are all around Lake Goldsmith. Image: Owen Peake.



Re-creation of an old-time country General Store which sold everything from motor-oil to dynamite. Note the Avery scales left of the verandah (for wool bales or wheat bags or children or whatever). Image: O. Peake.

This event is well worth attending if you are interested in movable heritage, industrial heritage or machinery heritage and are anywhere near Beaufort in April/May or October each year.

Owen Peake, HonFIEAust.

Photo right: A 2-stand portable sheep shearing machine with engine (probably petrol driven). These machines could be used in yards or carted round from farm to farm. Image: Owen Peake.

Find out more about the Lake Goldsmith museum at:

<http://www.lakegoldsmithsteamrally.org.au/>



Making Connections in Western Australia

2016 Heritage Management & Planning Seminar “Industrial Heritage”.

Engineering Heritage Western Australia (EHWA) recognises the important roles of organisations such as State Heritage Office and National Trust. To develop connections with these organisations our Western Australian Chair Ian Maitland was a key speaker at a recent Heritage Management and Planning Seminar in Kalgoorlie. The Seminar was organised by State Heritage Office with a focus on industrial heritage and was held in the Kalgoorlie Town Hall on 28 and 29 April 2016.

The seminar attracted approximately 80 attendees including two young engineers whose registration, travel and accommodation were sponsored by State Heritage Office. This sponsorship was an initiative of EHWA and Young Engineers WA and was part of the program for an EHWA seminar in October 2015. Young engineers applied by submitting their understanding of ‘industrial heritage’ and how to promote heritage within the engineering industry.

Ian spoke on the Sons of Gwalia mining heritage and



Kalgoorlie Town Hall – still hosting Council meetings over 100 years after its 1908 opening. Image: Australia Photo by Diwanganaa-Photobucket.



The Sons of Gwalia headframe in 2012. Image: Martin Silk, Intelera Consultants.

was one of the leaders on a pre seminar day trip to Leonora on 27 April. Ian’s presentation at the seminar was based on Engineering Heritage Australia’s recognition of the Sons of Gwalia headframe and winding engine with an Engineering Heritage National Marker in May 2015. A comprehensive article on this nomination was included in October 2015 edition of this magazine.

Other presentations during the seminar included: *C.Y. O’Connor’s legacy and legend* by Diana Frylinck; *Eastern Goldfields Firewood Supply Co.* by Tim Moore; *Retaining the heritage value in timber structures* by Greg Meachan; and *The economic application of Kalgoorlie’s historical maps* by Dave Nixon, to mention a few. These and other presentations are available on the State Heritage website at: <http://stateheritage.wa.gov.au/about-us/education-research-events/education-training-seminars>

Engineers build heritage too!

Each year the National Trust organises a heritage festival and in Western Australia this year it was held between 16 April and 18 May. EHWA participated in this year’s festival by hosting an event on 16 May titled *Engineers build Heritage too!*. The program included an overview of the activities of EHA and EHWA and presentations on the *NASA Space Tracking Station Carnarvon* and *Sons of Gwalia – Headframe and Winder*.

Engineers Australia and National Trust publicity for this event said: *Engineers build for the future. But did you know they also help conserve our past? Examples of engineering heritage are all around us – just think of transport or telecommunications. A dedicated division of Engineers Australia identifies items of engineering heritage, records their histories, promotes their protection and more. Come and learn about Engineering Heritage’s important work and interesting research they have uncovered about some structures significant for their rarity, association with particular people or historic, aesthetic, scientific or social reasons.*

There were approximately 70 attendees at the EHWA/National Trust event with many being young engineering students. Making connections with State Heritage Office and National Trust has helped EHWA promote interest in engineering heritage, particularly with younger engineers.

From Mike Taylor, Engineering Heritage Western Australia.

The Melbourne Shrine of Remembrance and the ray of sunlight.

The Shrine of Remembrance in Melbourne has an unusual feature with a strong engineering connection. At 11:00 am on 11 November each year a ray of sunlight falls on a granite slab in the sanctuary called the Stone of Remembrance. The stone is inscribed with a five word passage from the Bible – “GREATER LOVE HATH NO MAN”. The ray of sunlight has faithfully fallen on the word LOVE in this passage every year since the Shrine was opened in 1934. It is said that the beam of light has not arrived (due to heavy cloud) on only five days since the Shrine opened.

The accuracy of this mechanism has been checked by generations of surveyors from RMIT University (formerly Royal Melbourne Institute of Technology, Royal Melbourne Technical College, Melbourne Technical College and Working Men’s College) just prior to Remembrance Day each year. Not that there haven’t been problems. The big challenge came in the Summer of 1971-1972 when Daylight Saving Time was introduced. This put the timing out of kilter by one hour as Remembrance Day falls within the period when politicians are fiddling with our otherwise stable Australian Eastern Standard Time (AEST) in a vain attempt to get the sun to shine longer.

So the team from RMIT had to find a solution or the Remembrance Day ceremony would have to be held at Noon instead of the correct time of 11:00 am when the Armistice was signed. The solution was to insert a set of two mirrors into the path of the beam of light to make the one hour correction. The first mirror is mounted on a pillar on the upper walkway (balcony) surrounding the dome of the Shrine. The second is mounted horizontally above and to the side of the first mirror within the building and in the path of the original light beam



The Stone of Remembrance.

Photo - Owen Peake



The Melbourne Shrine of Remembrance.

Image: Owen Peake.

aperture built into the structure in 1934. When fine adjustments are made by the surveyors each year the result is that the ray of sunlight now descends onto the word LOVE at 11:00 on the 11th of November each year as expected.

Before leaving the Shrine I should remind you that this building was conceived, facilitated and partially supervised by General Sir John Monash. By the time he took on the Shrine project he had already made a name for himself as an engineer with his bridge-building work before World War I; made a huge contribution to the winning of World War 1 on the Western Front; headed up the repatriation from Europe, Palestine and Egypt and the rehabilitation of Australian veterans from World War 1; and

headed the State Electricity Commission of Victoria in its establishment of power generation in the Latrobe Valley using the massive brown coal resources in “The Valley”. Unfortunately Monash died on 8 October 1931, before the Shrine was completed, so he was unable to supervise the finishing touches to the building.

I would like to acknowledge The Age of Saturday 8 November 2014 for publishing a story by Bridie Smith, “Shrine’s ray of reflection proves a fitting tribute”, upon which this article is based.

From Owen Peake.

Vale Richard Gordon Hartley 30th June 1939 – 5th May 2016

Richard Hartley FIEAust was born in England on 30 June 1939. He was educated at Bradfield College, the Royal College of Science and Technology (Glasgow), the University of Glasgow, Liverpool College of Building, and City University, London. He was awarded a BSc (Eng) with Honours in Civil Engineering, Glasgow University, in 1964. From 1958 he worked for British consulting engineers Mott, Hay and Anderson, building and civil engineering contractors Richard Costain, John Laing & Sons and Cubitts in the UK and Canada.

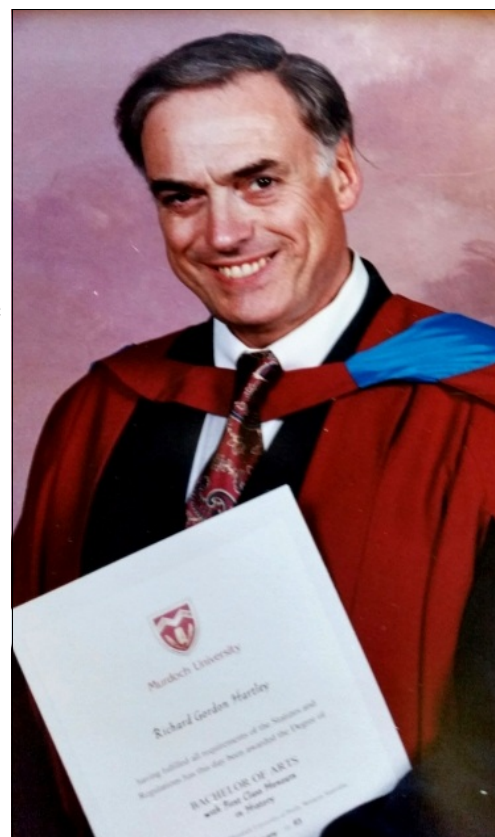
In 1968 he migrated to Australia, joining Maunsell & Partners Perth office in 1968 and he worked for that company for fifteen years as a senior civil and structural engineer. Initially he was engaged on the design of metropolitan freight terminals, mainline earthworks and drainage works which were part of the WAGR Rail Standardisation Scheme. Subsequently he was the project engineer for the WAGR Kalgoorlie/Kambalda Widgiemooltha line and later, as a hydrologist, he worked on the design of an upgrade of the Mount Newman railway drainage system and a new alignment for the railway through the Chichester Range. Later still he worked on a wide range of projects, including the design and supervision of urban and rural municipal works and as an environmental engineer for the Perth/Wagerup gas pipeline.

After retiring from engineering in 1984 due to ill health, he worked in the Western Australian State Archives, accessioning and cataloguing railway and public works drawings before commencing studying for a degree in history at Murdoch University in 1990. He became very interested in researching the history of the mining industry in Western Australia and in 1992 was awarded a BA with 1st Class Honours, his thesis being *The 1904 Watershed in Bewick Moreing's Western Australian Gold Mining Industry*. For the first time people interested in the WA mining sector could read about this most significant company in the State's gold mining history. Further research into the history of the Eastern Goldfields mining industry in the late 1890's and early 1900's, when the Golden Mile was a world leader in metallurgical transformation, led to his doctoral thesis completed in 1998 – *A History of Technological Change in Kalgoorlie Gold Metallurgy 1895-1915*. Dr Hartley received high praise from his examiners for his thesis and his knowledge of goldfields history became legendary among WA historians.

In 1995 he became a founding member of the Australian Mining History Association. His knowledge of Western Australia's early mining history was unequalled. In the early 1990's he and fellow engineer Denis Cumming were slowly collecting information on WA's mining engineers. When Denis died in 1995 he left boxes of material and a project not even half finished. Richard was determined to complete the task to honour his friend. This happened in 2014 when a book *Westralian Founders of Twentieth Century Mining : Career Biographies of Mining Engineers, Managers and Metallurgists Who Worked in the Western Australian Mining Industry 1890 – 1920*, was published at his expense. This is an invaluable reference guide to the mining past of Western Australia. It refers to over 700 mining engineers, managers and metallurgists who worked there in the period. Included are 306 biographies of professionals who shaped one of WA's most important industries.

Richard Hartley became a member of the National Trust of Australia (WA) in 1968 and over the years served on a number of its sub-committees. In 1992 he joined the Engineering Heritage Panel of Engineers Australia WA Division, acted as Secretary for three years and was an active and enthusiastic member of the panel for the next 24 years. He was for some years the honorary archivist for the Division. He participated in the preparation of successful nominations for engineering heritage recognition of the East-West Telegraph Line between Perth and Adelaide, The Trans Australia Railway Line from Kalgoorlie to Port Augusta, Kalgoorlie-Boulder Mines, Ord River Dam and the Western Australian Standard Gauge Railway Project. He was also an active oral historian and recorded oral histories of a number of prominent Western Australian engineers. He prepared numerous published and unpublished papers on mining and engineering projects in Western Australia.

However undoubtedly Richard's greatest achievement was as a result of his engagement in 2002 by the Water Corporation of Western Australia to research and write the history of the Eastern Goldfields water supply scheme. He had been privately collecting information for this task for several years and, assisted by two former Chief Engineers of the Western Australian Public Works Department, he toiled away for five years before *River of Steel : A History of the Western Australian Goldfields and Agricultural Water Supply 1903 – 2003*, was jointly published by the Water Corporation and National Trust of Australia (WA). The book was launched at a ceremony in October 2007 by the then Governor of Western Australia, Dr Ken Michael AC.



Richard G. Hartley on the occasion of his graduation from Murdoch University in 1992.

Photo courtesy of the Hartley Family

Vale Richard Gordon Hartley 30th June 1939 – 5th May 2016

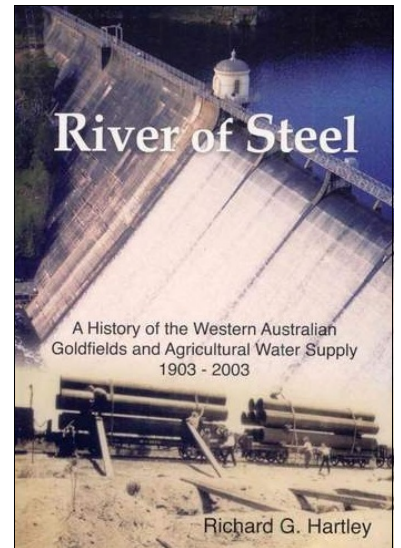
River of Steel was a unique publication. Over the past 100 years or so there have been many books and articles written about the WA Goldfields Water Supply Scheme, many of them highlighting the circumstances of the regrettable suicide of the first Chief Engineer of the Western Australian Public Works Department, C Y O'Connor. Richard's engineering training allowed him to clarify a number of issues, the background to which lay historians, who had previously published books and articles describing the controversial beginning of the scheme, could not have been expected to understand. *River of Steel* also described in detail, for the first time, the management, operation, refurbishment and expansion of the scheme which took place over the first 100 years after it commenced operating.

Partly as a result of the publication of *River of Steel*, in 2009 Richard was awarded Engineering Heritage Australia's highest honour – the John Monash Medal – for his outstanding contribution to engineering heritage in Western Australia. Prior to this award, in 2008, *River of Steel* had come to the notice of the History and Heritage Committee of the American Society of Civil Engineers. They encouraged Engineers Australia WA Division to nominate the Goldfields Water Supply for ASCE's prestigious International Historic Civil Engineering Landmark award. This was successful and in October 2009 bronze plaques, presented by the ASCE, commemorating the award, were unveiled at Mundaring Weir near Perth and Mt Charlotte Reservoir, Kalgoorlie. At the Mundaring ceremony EHA Chair Owen Peake presented Richard with EHA's Award of Merit, for his outstanding commitment to the conservation and recording of engineering heritage.

Two months later, at the 3rd Australasian Engineering Heritage Conference at Dunedin, New Zealand, the Water Corporation of Western Australia and the National Trust of Australia (WA), were jointly presented with Engineering Heritage Australia's Colin Crisp Award, *in recognition of excellence in an Engineering Heritage Publication by River of Steel*. Finally, in 2011, Richard was awarded the Telford Premium Prize by the Institution of Civil Engineers UK for his paper presented to the Institution on *Lessons from Western Australia's Goldfields Water Supply Scheme*.

Former Maunsell work colleagues, Australian Mining History Association members and Engineering Heritage WA committee members joined Richard's family and friends to farewell a highly respected engineer, meticulous historian and generous friend at his funeral service at Fremantle Cemetery on May 17th 2016.

*This obituary was prepared by Don Young, Past Chair of EHWA
with assistance from Adjunct Associate Professor Lenore Layman, Murdoch University, WA.*



The cover of Richard Hartley's book.

Connections

Transactions of the 5th South Australian Engineering Heritage Conference now online.

The Conference, held on 13th May 2016, I understand was a well attended day of interesting presentations – at least it must have been, because the papers, now published online by EA South Australia, are fascinating. I wish I had been there.

The first, a *Structural Assessment of the Historic North Adelaide Service Reservoir* by Peter Statton, an engineer with WSP-Parsons Brinkerhoff, took me back to two studies of reservoirs in NSW that we have done, one older, with brick barrel vaults supported on cast-iron beams spanning between timber columns, and one later, with groined arches of unreinforced light-weight concrete supported on brick columns. The stress analysis system used in Adelaide recently would have been a great boon to our clients way back in 1990, trying to discover why their unreinforced concrete arched roof was still standing after 91 years, when the computer analysis of the time told them the arches were in tension!

Bernard Arnold's paper on *Engineering South Australia's Grain Mills* covers the period of European settlement of SA from 1836, and notes the Colony/State had more than 200 grain mills over time, *with a peak of 88 operational mills in 1880*. This fascinating paper obviously couldn't cover all those mills, but the author does a good job nevertheless, in a wide-ranging account with lots of excellent images. I liked the SA millers who produced the finest flour at a Melbourne Exhibition, but were disqualified for using a "new process" – inter-colonial jealousy perhaps? Richard Venus' account of the long-running controversy about who invented the "stripper" – Bull or Ridley, is an additional pointer to the huge importance of grain harvesting and milling in South Australia.

David Murphy writes of *Radio and Audio Pioneers of South Australia*, starting with William Bragg and Sir Charles Todd, of Overland Telegraph fame, and Ken McInnes gives us a paper of lasting value on *Researching Engineers and Engineering Online – a guide to digitised resources*. And all of these papers are FREE to all. Find them at:

https://www.engineersaustralia.org.au/sites/default/files/shado/Divisions/South%20Australia%20Division/Resources/Groups/5th_sa_engineering_heritage_conference_13_may_2016_2.pdf

From the Editor

Notes & Queries — the Cremorne Railway Bridge, Melbourne.

Did a Tweddell Hydraulic Riveting Machine enable David Munro to cut the cost of bridge building by 60%?

The Age, Saturday 20 March 1886, page 10, reported that the contractor David Munro had purchased a Tweddell hydraulic riveting machine. This machine could install 1,000-1,200 rivets a day, while the normal riveting gang of 3 men & a boy could only install 100 rivets per day. Five men were required to operate the hydraulic press and associated machinery. The press was powered by water at 1500 lb./sq.in. pumped by a 6 horse power engine to a differential accumulator.

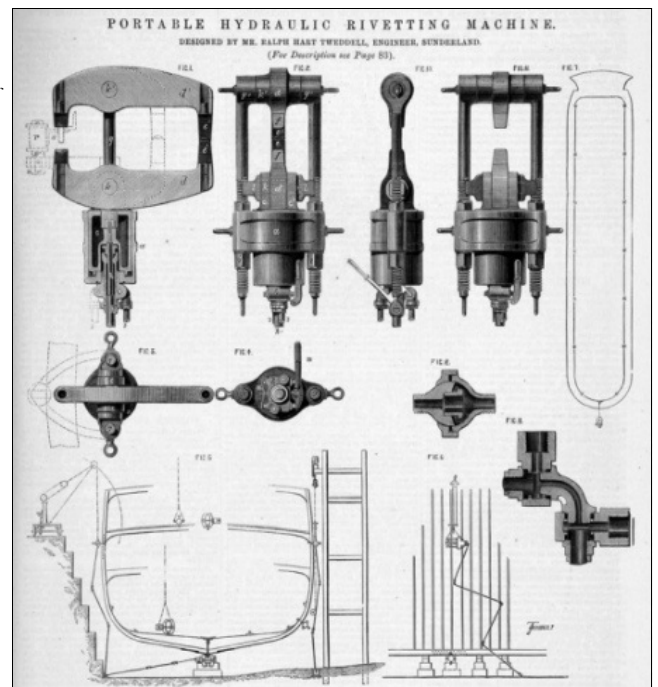
At the invitation of Messrs. David Munro and Co., contractors for the new Princes, Falls and Cremorne bridges across the Yarra, a number of gentlemen, chiefly members of the Victorian Chamber of Manufactures, assembled at the Princes-bridge works yesterday afternoon, and after a brief view of the very extensive operations in progress there, proceeded in vehicles to the Cremorne railway bridge, which connects Richmond with South Yarra, for the purpose of examining the working of one of Tweddell's steam (sic) [actually hydraulic] rivetting machines — the first, and up to the present, the only one at work in the colony.

The Argus, also of Saturday 20 March 1886, page 13, also had an interesting account of the use of the hydraulic drilling machines — part of the description is as follows:

All the rivet holes are drilled instead of punched, necessitating the erection of a large number of drilling-machines. The rivetting is being performed by two of Tweddell's hydraulic rivetting machines, which were specially imported for the purpose. Each of them does the work of 30 men, the rivets being pressed home and "cap"-beaded as easily and rapidly as dough moulded by a confectioner's "shape". The machines are driven by a six-horse-power portable engine. As the riveter is suspended from an overhead travelling carriage, it is capable of movement in every direction, and is connected with the accumulator by a flexible copper coil.

A sentence of Mr. Munro's in the *Age* of the 20th March 1886, confirms a positive answer to the question posed above:

An examination of the working of those machines gave a vivid idea of the almost incalculable saving of expense which they effect, and show the truth of a remark made by Mr. Munro that in future the building of three or four iron or steel bridges will cost no more than one did in the past.



Tweddell's Portable Hydraulic Rivetting Machine.

Image: Grace's Guide



The 1886 Cremorne Railway Bridge. Image: State Library of Victoria a15439.

The first of the three bridges Munro built was the Cremorne Railway Bridge, completed in June 1886. The cost of this bridge was £16,000 compared to the £26,000 cost of the 26 year old bridge it replaced. The new bridge was designed by Messrs Fraser & Chase, the two engineers who had, using Professor Kernot's theoretical work on trusses, designed the 1884 Victoria Street Bridge (Richmond to Hawthorn, also over the Yarra), which was thought by traditionally trained engineers to be too light for its purpose.

The Sandridge Railway Bridge over the Yarra, completed in 1888 (still extant, but now a footbridge), has previously been said to be the first steel (rather than iron) bridge built in the Colony of Victoria. However, both the *Age* and the *Argus* newspapers reported in 1886, while it was still under construction, that the Cremorne Railway Bridge was the first steel bridge built in the Colony. Professor Kernot of Melbourne University, in his book *Some Common Errors In Iron Bridge Design*, page 66, also credits the Cremorne Bridge as being of steel.

Other contemporary bridges over the Yarra that Munro won the contracts for and built were; Princes Bridge, completed 1888; Sandridge Railway Bridge, completed 1888; and the Falls (or Queens) Bridge, completed 1890. These three bridges were built to allow the Yarra River to be widened, to stop the frequent flooding that had previously been occurring.

From David Beauchamp, EHV.

References: *The Age* and the *Argus* stories are on Trove at:

<http://trove.nla.gov.au/newspaper/article/199457741> and <http://trove.nla.gov.au/newspaper/article/6088574>.

Information on Tweddell and his machines is at: http://www.gracesguide.co.uk/Ralph_Hart_Tweddell

A Heritage Journey in Three Chapters

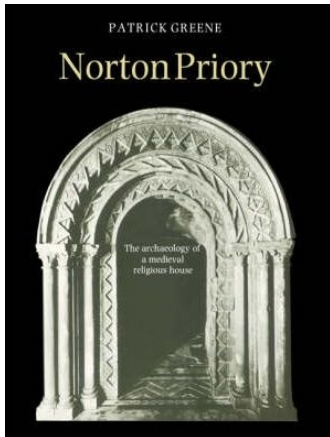
Notes on a lecture given by Dr Patrick Greene OBE, at Melbourne Museum.

On 21 April 2016, the CEO of Museum Victoria, Dr Patrick Greene OBE, presented a lecture at the Melbourne Museum. His topic was: A Heritage Journey in three Chapters. He spoke about the three projects which have taken up the majority of his working career:

- Norton Priory, Cheshire, UK (1971 – 1983)
- Museum of Science and Industry, Manchester, Lancashire, UK. (1983 – 2002)
- Museum Victoria, Melbourne, Victoria (2002 – 2017)



Dr Patrick Greene, OBE. Image: CAMB.



Norton Priory, Cheshire

This project was the excavation and conservation of the ruins of the extensive priory buildings to achieve a public opening in a new town park setting. The remains and archaeological finds proved to be very interesting.

Note: Greene's book *The Archaeology of a Medieval Religious House*, published 1989 by Cambridge University Press can still be found.

A brief account of Norton Priory history and the excavation is at

https://en.wikipedia.org/wiki/Norton_Priory#Excavations_and_museum

Museum of Science and Industry, Manchester (MOSI), UK.

His initial task was to convert the old railway buildings of the former Liverpool Road station into a museum.

The themes built into the museum were:

- The rise of the First Industrial City;
- The meteoric rise of the Cotton Industry;
- The squalid homes of the workers;
- The Blitz;
- The Railway Warehouse (Built in 1830, this was the first railway warehouse as the Manchester to Liverpool Railway was the first public railway in the world);
- To showcase Manchester for the 2002 Commonwealth Games held in the City of Manchester.



Replica of the L&M Loco 'Planet' at Manchester Liverpool Rd Station in July 2006. The 1830 station is on the right, and the 1830 first Railway Warehouse on the left.
Image: Paul Wright in disusedstations.org.



The Melbourne Royal Exhibition Building with the Melbourne Museum behind it.
Image: Urban Melbourne - img0131.

Museum Victoria, Melbourne

Work during Greene's tenure included:

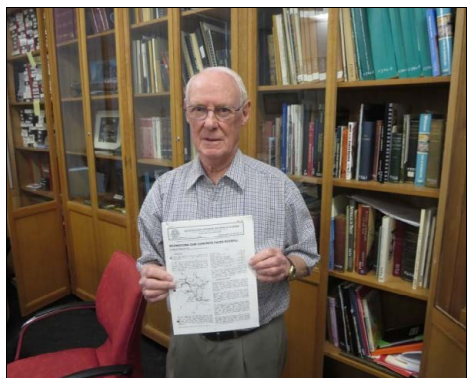
- Commissioning the new Melbourne Museum (being built as he arrived);
- The Immigration Museum;
- Scienceworks (incorporating Spotswood Pumping Station considered to be one of the most important industrial heritage sites in Australia);
- The Melbourne Royal Exhibition Building (getting it onto the World Heritage List, achieved in 2015);
- Aboriginal Heritage – First People Exhibition in Melbourne Museum.

Dr Greene answered several very interesting questions in depth after he presented his lecture giving further insights into his stellar career. He revealed during his presentation that he intended to retire in 2017. Filling his shoes will be a difficult task for the Victorian Government.

From Owen Peake, 13th June 2016.

News from Engineering Heritage Queensland (EHQ)

The Engineering Heritage Committee in Queensland under Chair Andrew Barnes continues with a range of activities, which over the past months have centred on our Archives, the engineering heritage recognition program and oral history.



Jim Simmers in the Whitmore Room, home of the archives. He is holding Vol.25, No.5 of the Qld Division Technical Papers. Photo Brian McGrath.

Retired electrical engineer Jim Simmers is the principal worker in the extensive and valuable archival collection maintained by EHQ. Jim's most recent task was completing the collection of issues of the Queensland Division Technical Papers. These papers, some 700 in all, were published in 33 Volumes from 1960 to 1992. The final one located and added to the collection was Volume 25, No. 5, published in March 1984. When publication of the Queensland Division Technical Papers ceased in 1992, they were replaced for a couple of years by *Engineering Update*. A full list of the contents of the Queensland Division Technical Papers is available from the EA national library in Canberra.

Malcolm Andrews and Kevin Haley have been organising preparation of transcripts - typed and digitised - of the collection of oral histories held in Queensland. This work is proceeding as funding allows.

EHQ's principal current activity for its part in the engineering heritage recognition program (EHR) has been orchestrated by Allan Churchward, and is centred on finalising the Interpretation Panel and liaising with the Division office on arrangements for the Award ceremony for a collection of bridges on the now closed rail line between Mungar and Monto. Twelve bridges between Degilbo and Mundubbera are featured in the Award, and the Interpretation Panel will be erected in the town of Gayndah.

One of the bridges covered by the Award is over Deep Creek at Chowey, a concrete arch bridge with a 24.4m centre arch, and on each side, one 4.6m concrete arch from the concrete abutment and two 4.6m spandrel arches. It was designed by Railways Department Chief Engineer William Pagan, and completed in December 1905 (see photo at right).



Chowey Bridge over Deep Creek. Image: Brian McGrath



Paluma & Gayundah in South Brisbane Dry Dock, 1909. The dock opened 1881. While its design is credited to William Nisbet, engineer Alfred Goldsmith prepared most of the design. Image: John Oxley Library, SLQ.

Some notes from The Editor:

A story in Vol.1, No.3 June 2014 of this magazine tells how EHQ secured a Community Heritage Grant to assist management of their Archive. We hope they soon get another grant to assist in digitisation of everything in it, so we can read all those papers online.

The Mungar to Monto railway seems to have meandered all over east central Qld. Hard to find on a map, but a starting point for locating the railway and its bridges is at: https://en.wikipedia.org/wiki/Mungar_Junction_to_Monto_Branch_Railway The relevant place names are fascinating.

Find a story about Rockhampton Railway Roundhouse 1914 to 2014, Saved from Demolition and Successfully Recycled 1991 to 1994 in EHA Magazine Vol.1, No.4, September 2014.

Other activity in the EHR program in Queensland is research carried out by Committee members preparing Nominations for the **Albion Telephone Exchange & Museum** (Leo Moloney), **Charters Towers Water Supply** (Norm Traves), **Normanton to Croydon Rail Line** (Allan Churchward), **South Brisbane Dry Dock** (Neville Brown), and **Rockhampton Railway Roundhouse** (Stuart Wallace). If any reader has information about any of these sites, information which could be of interest and/or value in preparing these Nominations, please communicate with EHQ secretary Brian King at bfking36@optusnet.com.au

B.L. McGrath, PSM, EHQ.



Inside view of Rockhampton Roundhouse shows turntable. Photo from a paper presented at ASEC NZ 2014.

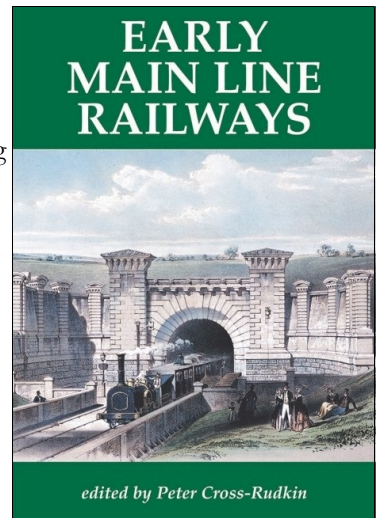
Some New Books

Early Main Line Railways, edited by Peter Cross-Rudkin.

This is a book of conference papers presented at the first Early Main Line Railways Conference, held at Caernarfon, North Wales in June 2014 – an initiative of *The Railway & Canal Historical Society* expanding on the time range of the *Early Railways* conferences in the UK. *Early Main Line Railways* covers the period 1830 (when the *Liverpool & Manchester Railway* opened) to c1870, when Railways were well established around the world and had changed the lives of millions.

The published papers cover a wide field, *dealing with the technical, managerial, cultural, social, economic and financial aspects of main line railways*. A wide territory too – most papers are about the UK, but Ireland, Egypt, India, Colombia, Canada, Argentina, Austria and the USA all get a look in. These interested me, even though Austria is the only place that I know at all well. Many of the papers deal with aspects of the commercial development of railways – competing joint stock companies, parallel routes, wild promotions and bankruptcies. It was regulation free and exciting and dangerous. It all seems a bit insane to one more familiar with the steady, regulated, government development of railways in Australia. However Australian colonial regulation did not prevent the use of different railway gauges in adjoining colonies before Federation – a problem still with us long after the British standardised their gauges.

For anyone who would like know more about the book than I have space for here, an announcement about its forthcoming publication was printed in the October 2015 issue of this magazine, and there is a list of all the authors and titles of papers given at the conference at: <http://www.rchs.org.uk/trial/gwvf.php?wpage=EMLRC> 18 of those papers have been published in the book, plus one by Michael Bailey on Engineering Development, which he presented at an earlier seminar.



Like the Early Railways books, this is a great one for the railways cognoscenti to add to their library, and although the subscription list has been filled, there are still some copies available for sale. To purchase a copy, go to the website given above, or contact the publisher, Six Martlets Publishing, at sixmartlets@uwclub.net or by post at 4 Market Hill, Clare, Suffolk CO10 8NN, United Kingdom.

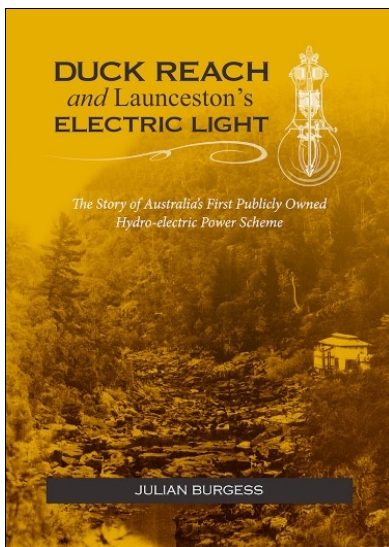
[I have to admit that the publisher is a cousin of] *The Editor*

Duck Reach and Launceston's Electric Light

The Story of Australia's First Publicly Owned Hydro-electric Power Scheme by Julian Burgess.

Publicity for this book sums up the meaning of Duck Reach quite well – *Situated in the steep and rocky Cataract Gorge* [in Northern Tasmania], *the Duck Reach Power Station was built by the Launceston Municipal Council in 1895 and generated hydro-electricity almost continuously for 60 years from 1895 to 1955. It was one of the earliest public power stations in the world and a remarkable engineering achievement in Australia* – although the publicity omits the disastrous 1929 floods, which nearly swept the whole thing away.

However, the book itself certainly doesn't leave out the floods, and it is about a lot more than just Duck Reach. It is as much a history of electric power in Launceston – in transmission (substations, poles and wires), lighting the city, powering its factories, operating its trams and how it all came about. We are told a great deal about many of the people involved, with Appendix 4 providing *Selected Biographies* of three engineers. Practically every page has extensive and pertinent quotes from contemporary sources and if anyone felt the need of a more technical recording, a conference paper by electrical engineer Miles Pierce has been republished as an addendum.



The power station was built near the bottom of the Cataract Gorge, and on the opposite side of that gorge from the inhabitants of Launceston, which made for extraordinary difficulties in access and construction. As the author says: *Today, the idea of using the [Cataract Gorge] as the site for a power station would be inconceivable*. However, several useful appendices describing *The Historic Elements of Duck Reach, Duck Reach and Gorge Environment* and *Summary of Tree & Plant Species* should come in handy when the renaissance of the power station happens as proposed in Chapter 16, *A New Beginning*.

The book has a wonderful abundance of illustrations, mostly archival, and therein lie my only disappointments. Not being familiar with the region, I would have liked a map which included the marking of many places named in the text – viz: Dalrymple's Bend,

Cataract Gorge, Picnic Rock, First Basin, etc. And I find the muddy and overly dark reproduction of nearly all images, even scanned texts, disappointing.

Nevertheless, the book is a great read, and well worth its modest price. It is available from the publisher, Christopher (Gus) Green – Email prossergreen@vision.net.au Price – soft cover \$35.00, hard cover \$69.95 plus postage & handling \$13.40 Australia wide.

From the Editor

