ENGINEERS AUSTRALIA

# EHA MAGAZINE

Engineering Heritage Australia Magazine Volume 2 No.8 May 2018

# Engineering Heritage Australia Magazine

MAY 2018
Volume 2 Number 8

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

Engineering Heritage Australia Magazine is published by Engineering Heritage Australia, a Centre within Engineers Australia.



Contact EHA by email at:
eha@engineersaustralia.org.au
or visit the website at:
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Cover Images:

Front: Attending to the boiler on the Paddle Steamer "Melbourne" as it steams upstream. The boiler and steam engine were made by Marshall Sons & Co. of Brittania Iron Works, Gainsborough, Lincolnshire and London.
Photo: Owen Peake

Back: The Pichi Richi steam locomotive NM25 at Port Augusta on 22nd October 2017. It was there to be part of the Centenary celebrations for the opening of the Trans Australia Railway on 22nd of October, 1917.
Photo: Keith Baker

ISSN 2206-0200 (Online)

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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# *Editorial*

It was decided that this issue of the Magazine would be all about the 19th Australasian Engineering Heritage Conference, held in Mildura, Victoria, in October 2017. Owen Peake selected the authors to feature in this issue, and commissioned the stories to be derived from their Conference papers. Here is what Owen had to say about the task:

## *How were the articles chosen for this issue?*

I asked all authors to provide one story for the magazine. If an author had more than one paper in the conference (there were several in that group) I asked them to pick the paper they would prefer to write about. About half of the authors responded to this request by the cutoff date that I specified and the responses received were then edited and appear in this special magazine issue.

## *How did we set the length of the special issue of the EHA Magazine?*

I decided that this special edition should be roughly the same length as a typical EHA Magazine. The magazine is usually 28 pages but some editions have been 24 pages and some have been 32 pages. As we prepare the magazine on the basis that some people will choose to print it the page count is always a multiple of 4 pages.

## *Was there enough good material in the conference for the special issue?*

I was Chair of the Peer Review Committee for the conference. The Peer Review Committee was most impressed by the quality of the papers presented. The papers were professionally prepared and the content was interesting and added value to the sum of engineering heritage writings in Australia, without exception. All the authors must be congratulated most heartily!

The other outstanding feature of the papers was their diversity. While many papers followed the theme of the conference (which was quite broad) there were enough subjects which had little to do with the theme to make the conference more engaging. By the way, none of that was planned. It just happened because we had a skilled and imaginative group of authors.

OWEN PEAKE
18 May 2018

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# *Errata*

On pages 20-26 of the January 2018 issue of the EHA Magazine there was a major article on the design and construction of the *Railway Bridge over Eddy Avenue in Sydney*, written by Bill Phippen OAM, B.Sc., B.E., FIEAust. He supplied more than enough excellent images to illustrate the article, and I as Editor selected which of the images to use in the magazine. In some cases I added to Bill Phippen's captions, or wrote the entire caption where he had not provided one.

Unfortunately my captions and additions included a number of errors or omissions, such as the caption for a photo at the bottom of page 24 where I had added a note that a distant detail showed a "Tram Controller's Kiosk" (a term used for similar structures by some of us when I was at school in Melbourne, and riding the trams there). I should have described the structure as a Signal Box (occupied by a Signalman).

Other complaints I received (at second hand) were as follows:

*On page 20 the leading photo for the article was taken on 9th October 1926, not "circa 1926" and is looking to the south-west, not the "south-east". The entrance leads to the electric train platforms, not electric train "stations" and the tram on the colonnade is definitely leaving, not "entering (or leaving?)". Finally, the spire is that of Christ Church St Laurence, not "Lawrence".*

*On page 23 lifts were not installed from the concourse to the platforms for another fifty years and the roof of the building in the foreground is that of a waiting shed, not "possibly a substation for the trams".*

*On page 24 our civil and structural engineering colleagues have taken issue with the description of the "walls (or piers)" being of "reinforced concrete" when these structures and much of Bradfield's work employed unreinforced concrete as shown in the drawing on p26.*

I have apologised to Bill Phippen for any errors in my additions, and I emphasise to readers that they were my own doing, not his. My only excuse is that I am neither a tram nor rail "aficionado" and I am not a Sydney native.

Margret Doring, Editor.

# *October 2017 – A month to remember.*

## *Engineering Heritage Plus!* *by David LeLievre, Chair, EHV.*

October 2017 included the 19th Australasian Engineering Heritage conference at Mildura, Victoria, the Centenary of the Murray Water Commission, the Centenary of *Big Lizzie* (a giant tractor) in Mildura, a Celebration of Steam in Peterborough SA and a celebration of the Centenary of the Trans-Australian Railway (TAR) in Port Augusta, SA.

October 2017 was always going to be a month to celebrate. I was in Port Augusta SA on 14th September 2012 to celebrate the Centenary of the turning of the first sod of the TAR in 1912, and I entered 17 October 2017 in my diary to celebrate the joining of the rails of the TAR. At that stage I was Chair of the Geelong Regional group of Engineers Australia (EA). As time progressed, with EA policy discouraging long term appointments I resigned as Chair of the EA Geelong Group and was appointed by Engineering Heritage Victoria (EHV) as its Chair, replacing the very dedicated and knowledgeable Owen Peake.

I then realised I needed to form a committee to organise the 19th Australasian Engineering Heritage Conference (AEHC). It was to be a combined effort with Engineering Heritage South Australia (EHSA). To cut a long story short, we picked Mildura (near the SA border) as the place, October as the month to avoid the summer heat, and we convinced the local Sunraysia Regional Group of EA to hold the Engineering Country Weekend immediately after the conference. So, the dates were set, the AEHC on 9-13th October, followed by the Country Weekend on 14-15th. Still time for TAR on the 17th?

After a lot of effort and with a lot of frustration, the conference came together. We did not arrange a preconference tour, to minimise the cost, but did provide attendees with the option of self-drive tours starting from Sydney, Canberra, Melbourne or Adelaide. The Adelaide tour was to include an Engineering Heritage Recognition Ceremony for the Humphrey pump at Cobdogla. Unfortunately the pump did not cooperate, and the ceremony was postponed. Back to the conference.

### *Monday Evening River Cruise & Welcome Reception. (9th October)*

The theme of the conference was "Steam, Streams, & Schemes; Putting Water to Work; Steam Power, River Navigation and Water Supply". What a perfect way to start the conference, on the steam powered paddle steamer *PS Melbourne* on the River Murray in the weir pool, upstream of Lock 11. The weather was balmy, the river flat as glass, and the scenery fantastic. Food and drink and little formality set the environment for the attendees to mingle and chat and get to know one another. We were fortunate to have Julie Jewell and Councillor Mark Eckel from the Mildura Rural City Council (MRCC) join us, as they were instrumental in helping smooth the way for the conference.

The wake of PS "Melbourne". Photo: Owen Peake.

### *The Conference: The Benetook Room, Mildura Information Centre. (10th - 12th October)*

Day 1. Now for the crunch! All the preparation, all the advice, some different opinions – would it work? My wife and I were staying just over the road. Ella Dowie from EA had done a brilliant job packing the conference bags and was at the registration desk from 8 am. The room looked great, with the MRCC providing a large Chaffey Trail banner for one wall.

The conference started at 9.00 am with *Acknowledgement of Country & Welcome*, a welcome from the MRCC, so far so good. I had the time keeper task, 30 minutes per paper, no more. I had the school bell, others kept the time for me, the speakers all managed time very well! The food for morning tea, lunch and afternoon tea was terrific. The day finished well, all the preparation the team put in had paid off and we all went "home" satisfied and relieved.

Day 2. Change of plans. I was to give a radio interview with Councillor Mark Eckel at Mildura's Old Gold FM at 8 am. We swapped timekeeping duties, the conference program went well. The Conference Partners left at 10.00 am for a tour of the area including Wentworth. It started to rain, a potential disaster if it exceeded 10 mm, as it would close the road to Psyche Bend Pumping Station and completely disrupt the plans for Friday 13th. The rain stopped at 8 mm, the partners' tour was not impacted, Friday's program looked safe. Day 2 was another success. The EHA committee and some others had an informal dinner just down the road, a pleasant night for all.

Day 3. We had settled into the routine and all went well. The high-quality presentations continued, the final session was the Plenary Session – a chance for feedback. Most feedback was positive. That night the Conference Dinner was held in the Chandelier Room of the Grand Hotel. The night went well and we all left satisfied that the conference was a success.

The 2016 & 2017 John Monash awards and 2017 Colin Crisp awards were presented at the Conference Dinner. The 2016 John Monash Medal was presented to Keith Baker. His story was published in the January 2017 issue of EHA magazine. The 2017 winners of the John Monash Medal and the Colin Crisp Awards are recorded elsewhere in this EHA Magazine.

Image, right: Keith Baker with Judy at the Dinner. Photo: OwenPeake.

# *October 2017 – A month to remember.*

## *The Post-Conference Coach Tour, Lunch and Barbeque (Friday 13th October)*

The Coach Tour group, with the author in the front row at left, and many familiar faces – Ed. Image provided by Owen Peake.

The tour took in some of the heritage around Mildura, Lock 11 and weir, part of the Chaffey trail, lunch at Chateau Mildura, the Central Pump Station and then Psyche Bend Pump Station for ceremony and plaque unveiling, first by the American Society of Civil Engineers (ASCE) and then the Engineering Heritage Australia National Marker [see page 3 of the January 2018 issue of EHA Magazine]. The ASCE award was the first in Victoria and only the fifth in Australia. The evening finished with a barbeque shared with the guests of the Engineers' Country Weekend, organised in conjunction with the Institute of Public Works Engineering Australasia (IPWEA). The weather was perfect, the food, drink and companionship excellent, a great way to end the week.

## *The Engineers' Country Weekend.(14th & 15th October)*

The weekend was hosted by the Sunraysia group of EA and supported by the IPWEA. It focussed on some of the engineering and local attractions around Mildura and Wentworth. Some of the highlights were the Engineering Heritage Recognition ceremony of *Big Lizzie* on Saturday, morning tea on the PS *Ruby* and a visit to Lock 10 at Wentworth. A perfect synergy for the theme of the conference. Many of the EHA Conference delegates stayed on for the Country Weekend. [Some details of the weekend programme can be found on page 5 of the July 2017 issue of the EHA Magazine. The nomination for *Big Lizzie* can be found at: https://www.engineersaustralia.org.au/portal/heritage/big-lizzie-1916 ]

Big Lizzie, with figure to give scale. Photo: Owen Peake

## *Morgan and Peterborough SA. (17th to 19th October)*

After the Country Weekend some of us drove to Peterborough via Morgan. At Morgan we inspected the Wharf and surrounds including the Museum and had lunch watching the ferry make many crossings over the Murray River. The Wharf was a conference topic. [ paper is at: https://search.informit.com.au/documentSummary;dn=385005843143649;res=IELENG ]

On the way to Peterborough the route takes you on the Goyder Highway, a significant name in South Australia's history. In Peterborough we attended a dinner hosted by the (now disbanded) EA South Australia Division Retired Engineers group. Another Engineering Heritage marker was unveiled at Steam Town, to commemorate its significance in Railway Heritage. [The Steam Town nomination is at: https://www.engineersaustralia.org.au/portal/heritage/steamtown-peterborough-sa-1977 ] A plaque was unveiled for the entrance garden, developed with funds from the Retired Engineers group. The sound and light show was also a worthwhile attraction.

Image left: Morgan Wharf. Photo: David LeLievre.

Continued bottom of Page 6.

# *Peter Elliott Spratt, AM, FAIB, FIEAust, CPEng*

## *awarded the 2017 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.*

Professor Mark Bush (left) and Peter Spratt after presentation of the 2017 John Monash Medal. Photo: Bruce Cole.

### The Citation

Peter Spratt is a multi-disciplinary Civil Engineer who has been practising as a heritage and conservation engineer for much of his career. He had experience initially in local government, then as a partner in a consulting firm and more recently as a sole practitioner. His conservation experience includes about 200 studies and projects over 40 years.

One of his major studies concerned the massive disintegration of the historic buildings at Tasmania's convict settlement at Port Arthur, built around 1845. Given that some Roman buildings still stand after 2000 years, he wondered why the four-storey penitentiary and eleven other buildings were disintegrating after only one century. Peter turned to science for the answers and discovered why the brickwork was decaying and devised remedial work to preserve the historic structures.

He has been involved in work on over 750 buildings including about 30 historic churches and cathedrals. He characteristically applies a combination of scientific research to understand the cause of a problem, followed by imaginative engineering to develop a practical solution. He has developed many innovative techniques for overcoming defects in historic structures. His work to instrument the Richmond Bridge to monitor the vibrations caused by traffic, as an early warning system for damage, earned him the Colin Crisp Award in 2013. This follows an Award of Merit from EHA in 2009. In 2016 he received the prestigious award of Life Fellow of the Australian Institute of Building.

Peter has served on the Tasmanian Heritage Council for 9 years, and chaired its Works Assessment Committee. He has led many heritage grant proposals to enable building owners to carry out conservation works. Over many years he has led heritage walks through Hobart's CBD. He recently authored the first engineering heritage practice notes for EHA, and has developed a draft Engineers Heritage Charter which will be widely applicable for assessment & conservation of all types of engineering heritage.

Over a long and distinguished career, Peter has made an exceptional contribution to the preservation of historic structures, often developing new and novel techniques. He continues to tirelessly promote engineering heritage through his professional work, in the community and within Engineers Australia.

Peter was made a Member of the Order of Australia on 26th January 2011 *For service to engineering through the conservation of historic buildings, the establishment of an online Building Degree course and through contributions to industry associations.* – Ed.

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Continued from Page 5

# *October 2017 – A month to remember.*

## *Port Augusta SA. (20th to 22nd October)*

Sunday 22nd started with a drive to Quorn, to catch the Steam Locomotion hauled train to Port Augusta. W25 did the work to Stirling North, NM25 was added to double head the train into Port Augusta's narrow-gauge platform. A century ago, some passenger from Adelaide would have travelled to Port Augusta via Terowie, Peterborough and Quorn then to depart on the first passenger train across the Nullarbor to Kalgoorlie, change trains and on to Perth.

The celebrations on the platform were booming, the Mint was selling commemorative coins, Australia Post with commemorative stamps, the Police band played, modern locomotives and crew cars were on display and there were lots of happy people. We returned to Quorn via steam train later in the day, with lots of souvenirs. What a perfect way to end two weeks jammed full of Engineering Heritage.


The sign celebrating the centenary of the Trans Australian Railway, just after its unveiling on Port Augusta Station platform. 22nd October 2017. Photo: David LeLievre.

# *The 2017 Colin Crisp Awards*

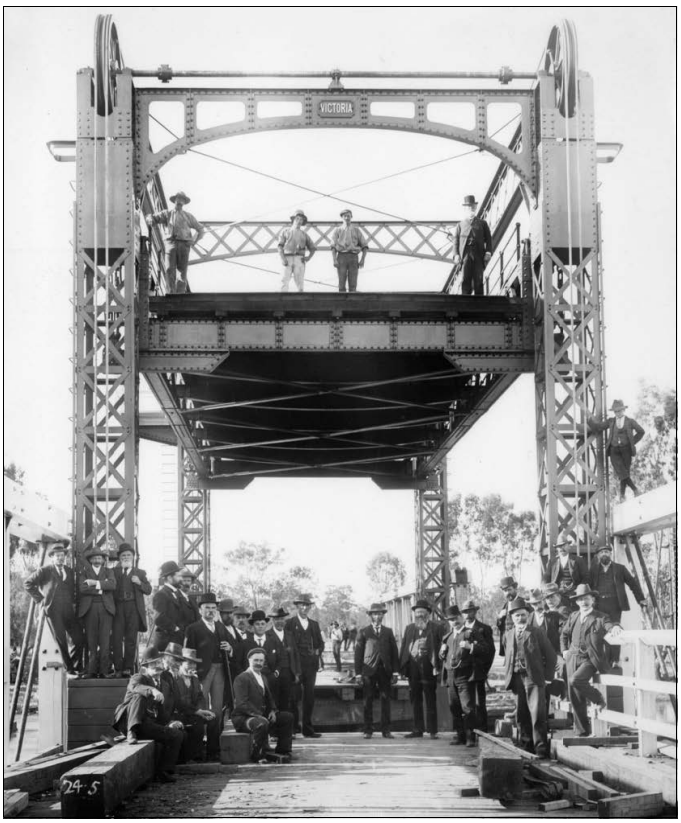
*The Colin Crisp Award perpetuates the memory of Colin Crisp, who was a structural engineer well known for his work in the conservation of heritage structures. This project award is given for excellence in the conservation and recording of items of heritage significance, in recording engineering accomplishment and the development of technology, or in education and raising awareness in engineering heritage.*

## *The Award for Documentation: to NSW Roads & Maritime Services and GHD Newcastle.*
## *The Project: a Movable Span Bridge Study, by I.Berger, D.Healy and M.Tilley.*

NSW Roads and Maritime Services (RMS) currently manages 26 movable span bridges in NSW, of which 14 are still operational. Between 1802 and 2005 there were five distinct types of movable bridges built which included pontoon, vertical lift, bascule, swing and sliding spans. In total 66 movable span bridges were constructed in NSW, of which the majority (48) were of the vertical lift or the bascule type, but many of these have now been demolished or are permanently closed.

The RMS Movable Span Bridge Study documents the overarching history and individual past of the vertical lift span bridges, bascule bridges, and the sole remaining RMS swing bridge in NSW, along with the only vertical lift table bridge in Australia. The study provides extensive research and background information utilising numerous documents and sources to establish each bridge's history and integrity and to enable their engineering heritage significance to be evaluated and assessed.

Presentation of the Award – Owen Peake of EHA left, Ian Berger - Environmental Officer (Heritage), NSW RMS 2nd left, then M. Tilley & D. Healy from GHD. Photo from Owen Peake.




Cover image from the Movable Span Bridge Study shows the Barham Bridge Official Opening on 8th October 1904.

Through comparative analysis of the lifting mechanisms of all 66 bridges, the study built a classification system that identifies each bridge as belonging to one of 13 sub-types. This classification provides a better understanding of performance and shortcomings of those movable span bridges that are still operational as these issues are common to all bridges within a type. Another benefit of this classification is that it enables the standardization of replacement components across each type and the development of more consistent maintenance schedules.

The RMS Movable Span Bridge Study has been completed by GHD in conjunction with the Environment Branch of Roads and Maritime Services. The study will play a vital role in assisting Roads and Maritime Services in managing their heritage movable span bridges into the future.

The Study closely follows the Burra Charter process in its sequence of investigations, decisions and actions recommended.

The combination of rare RMS archival photographs and stored bridge plans enables a better technical understanding of each bridge's operation than has been previously achieved, forming a valuable reference within Australia and overseas. This is particularly important for the 22 bridges that have been replaced and are no longer available for inspection.

From the Editor: The Study can be downloaded from the RMS website in two files:

Part 1 – *http://www.rms.nsw.gov.au/documents/about/environment/protecting-heritage/moveable-span-bridge-study-volume-1-vertical-lift-span-bridges-part-1.pdf* and
Part 2 – *http://www.rms.nsw.gov.au/documents/about/environment/protecting-heritage/moveable-span-bridge-study-volume-2-bascule-and-swing-span-bridges-part-2.pdf*

# *The 2017 Colin Crisp Awards*

*The Colin Crisp Award perpetuates the memory of Colin Crisp, who was a structural engineer well known for his work in the conservation of heritage structures. This project award is given for excellence in the conservation and recording of items of heritage significance, in recording engineering accomplishment and the development of technology, or in education and raising awareness in engineering heritage.*

## *The Award for Conservation: to Sydney Trains and Ventia Utility Services. The Project: Macdonaldtown Gasworks Remediation – Restoration of the Heritage-Listed Southern Gasholder.*

Accepting the 2017 Colin Crisp Award for Conservation (left to right): Gretta Logue of Sydney Trains and Ian Brookman and Tim Lovell of Ventia. Photo: Owen Peake.

Ventia Utility Services Pty Ltd undertook the restoration of the Southern Gasholder for Sydney Trains. The Southern Gasholder is the only Victorian-era gasholder still standing in New South Wales. The conservation work was part of the Macdonaldtown Gasworks Remediation. The site is part of the former Eveleigh Gasworks.

The Southern Gasholder, listed on the State Heritage Register as part of the Eveleigh Railway Workshops, was an integral element of the former Gasworks, which was built in 1892 to meet increased demand for railway carriage, station and yard lighting. The Southern Gasholder was operational until 1977.

The Southern Gasholder, measuring approximately 20 metres in diameter, has two nested internal steel lifts. It also has a steel superstructure that measures up to 13 metres in height. The superstructure supported and guided the two-stage lift of a steel bell, the containment tank that stored the manufactured gas.

Sydney Trains had originally intended the restoration of the gasholder to be carried out in-situ; however during early investigations, Ventia recognised that restoring the gasholder's superstructure offsite would achieve a better long-term conservation outcome. Subsequent offsite restoration minimised the structural risks and allowed protective treatment of all metal-work and the reuse of most of the original fastenings. The remaining bell structure was restored onsite under controlled conditions before the superstructure was reinstated.

Significant challenges were faced because the remediation of the site required soil to be excavated to depths of up to 6 metres around the gasholder's substructure. Ventia engaged geotechnical consultants Coffey Geotechnics, alongside structural and conservation consultant Bill Jordan & Associates, to develop an excavation sequence that would not have any adverse impacts on the below-ground brick annulus of the gasholder. The security of the gasholder's substructure was also maintained during remediation excavations by dewatering its brick annulus and steel bell.

The replacement of the Southern Gasholder's only missing components, its decorative finials, was achieved by casting them from the similar parts of the disassembled Molong Gasholder. The new finials were placed atop the gasholder's columns in February 2017, enhancing the structure both technically and aesthetically, and completing its restoration.

Restored Southern Gasholder at the former Eveleigh Railway Workshops Gasworks, shown before the finials were attached.

Image: Macdonaldtown Gasworks Remediation website.

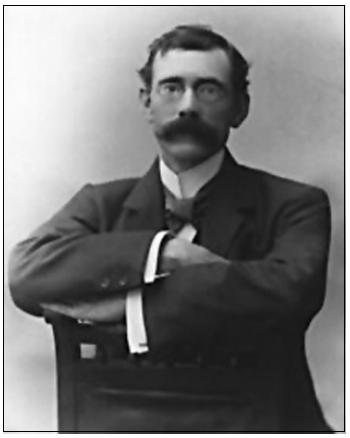
From the Editor: Sydney Rail and Ventia received other awards for the Gasholder project, and notably, they were the winners of the National Trust NSW 2017 Heritage Award for the Conservation of Objects. The National Trust website has a commendably detailed account of the process and results at https://www.nationaltrust.org.au/conservation-interiors-southern-gasholder/
Macdonaldtown Gasworks Remediation website has a series of photos of the work-in-progress and some historical images at: http://macdonaldtownremediation.com.au/heritage/ and http://macdonaldtownremediation.com.au/milestones/heritage-listed-gasholder-repair/

# *Public Water Supply, Sale, Victoria.*

## *An Historian's Perspective*

*by Peter Synan*

Sale has a fascinating public water supply story. Fortunately its most handsome historical structure – a brick water tower built 1887/88 and designed by architect/engineer John Grainger – is still intact and structurally sound. Compared to similar brick water towers in Victoria, it has three compelling advantages: decorative brickwork, setting in a public garden and its unmodified condition.



Engineer John Grainger, c.1898.
Image: Grainger Museum, Melbourne.


Sale Water Tower behind Coronation Gates, 2016.
Image: Synan Collection.

This water tower once received water pumped from the Thomson River about one mile distant. Fifty four feet (16.5 m) high and with a capacity of 40,000 gallons (182 kL), it reticulated Sale until 1922 when it was replaced by a taller, 60,000 gallon (273 kL) reinforced concrete 'John Monash' tower. It was fully decommissioned around 1970 when the adjacent swimming pool it served was closed. In its turn, the 'Monash' tower was replaced in 1976 by an even taller 'wine-glass' tower of 100,000 gallon (455 kL) capacity.

A community committee supported by the Wellington Shire Council began the restoration of the brick water tower in 2017, the centenary of the death of John Grainger. Apart from restoring a heritage building in accord with a conservation management plan, the refurbished building will also showcase the story of providing Sale with a potable and secure water supply, highlight colonial workmanship, especially in bricklaying and tank making, and thirdly, offer a superb lookout over early Sale and its gardens.

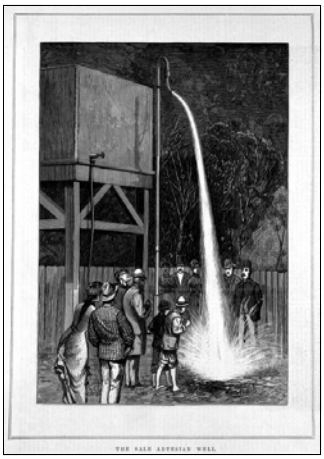
A budget of around $100,000 will provide floor replacement, staircases, weatherproofing, repair of louvre windows and glazing of others, painting, display boards and installation of power and lighting.

Sale's third Water Tower, built 1976.
Image: Synan Collection.

The tower has four 'rooms' which were once leased as a granary for local livery stable keepers. The ground floor room is to display a series of storyboards, beginning with water carriers using horse and dray and bucketing water from the river, and conclude with the current operations of Gippsland Water drawing water from the Boisdale aquifer.

Swing Bridge, near Sale, designed by engineer John Grainger - built 1883. Image: Sale Historical Society.

The second floor is to be devoted to John Grainger, the engineer, and to his composer son, Percy Grainger, who visited Sale twice as a flamboyant concert pianist. This floor will present John Grainger's legacy in bridges, notably the Swing Bridge, Longford, the Princes Bridge, Melbourne and the Albert Bridge, Adelaide; and in public buildings, the Auckland Art Gallery, the Fremantle Town Hall, the Gold Warden's Court, Coolgardie, and the Robur Tea House, Southbank, Melbourne, among others.



Artesian Well, Sale, 1881. Image: "Australasian Sketcher", 1881.

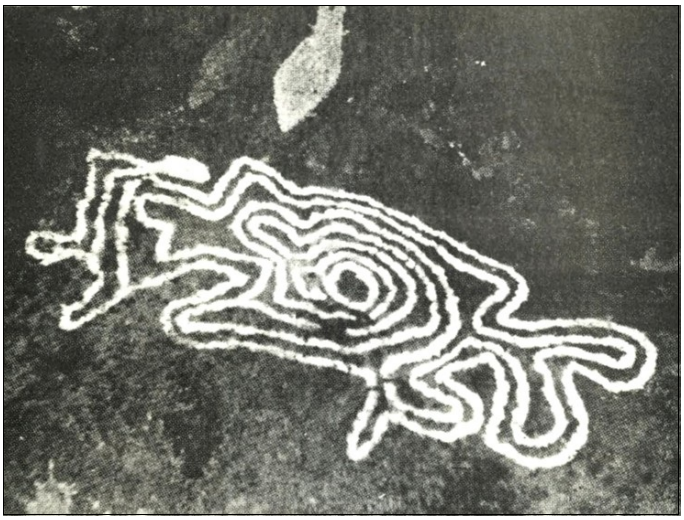
The third floor will feature John Niemann, a German-Australian and a figure oddly neglected by historians. Niemann was the first to successfully drill for artesian water in Victoria, beginning at Wadelock, near Stratford, in 1879 and at Sale in 1880. The Sale Artesian bore shot 43 feet (13 m) above the surface, making Sale a celebrity municipality. The fourth, or top floor – the lookout floor – is also to be furnished with displays, some highlighting the construction of the tower and tank, and others informing the visitor about the vistas from the existing windows and doorway.

With major financial support from the Latrobe Valley Authority, the John Leslie Foundation and the Wellington Shire Council, this water museum is expected to be completed by late 2018.

Reference: EHA Mildura Conference paper *Public Water Supply, Sale, Victoria – An Historian's Perspective* by Peter Synan OAM, BA, B.Ed. Mayor of Sale 1978-80, 1982-84, 1985-87. The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *Brewarrina Fish Traps, on the Barwon – Darling Catchment, NSW.*

*by Cat Kutay & Susan Beetson, University of Technology, Sydney.*

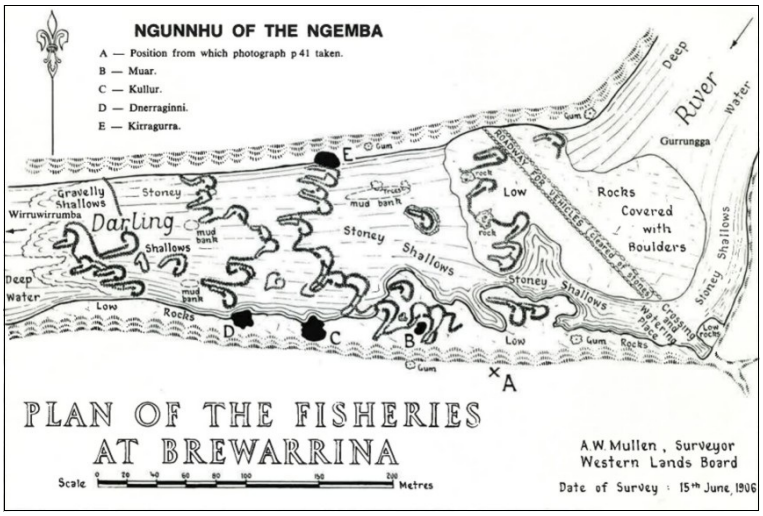


Rock carving showing fish approaching a trap opening.
Dargin, P (1976) "Aboriginal fisheries of the Darling-Barwon Rivers".

According to Aboriginal lore, Biaime created the landscape around Brewarrina, including rock holes from his footprints and depressions where he camped. He also threw his net across the Barwon River and he and his sons showed the local Aboriginal peoples how to build his Ngunnhu (the fish traps) in the shape of his net with interlocking weirs.

The area has been used by Europeans since the 1840's and much of the traps have been destroyed for river crossing and to reuse the rocks for other constructions.

In 1848, WC Mayne, Commissioner of Crown Lands at Wellington, successfully requisitioned the Government to reserve one square mile on the river bank, known as Fishery to preserve the Aboriginal built fish traps. WC Mayne stated: … *To form these must have been a work of no trifling labour, and no slight degree of ingenuity and skill must have been exercised in their construction, as I was informed by men who have passed several years in the vicinity, that not even the heaviest floods displace the stones forming these enclosures.* This gazettal prohibited non-Aboriginal people from fishing. The local Aboriginal peoples and the police enforced this lore/law until about 1906.




A.W. Mullen's 1906 plan – a draftsman's version from Dargin, P. (1976).

The construction has long been acknowledged an engineering feat and listed as an Australian heritage site in 2005. Budj Bim in Western Victoria has been accepted for assessment for the World Heritage List. The sovereign Ngemba Elder custodians are to be consulted, to consider any proposal for Brewarrina Fisheries (Biame's Ngunnhu) to be nominated and assessed for the World Heritage List. The authors plan to consult with the community and will work with the NSW division of EHA to promote this.

The site was listed in the Australian National Heritage List citing: *The Ngunnhu is exceptional as it is an unusual and highly innovative development. ... The structure of the Ngunnhu demonstrates the development of a very efficient method for catching fish involving a thorough understanding of dry stone wall construction techniques, river hydrology and fish ecology.*

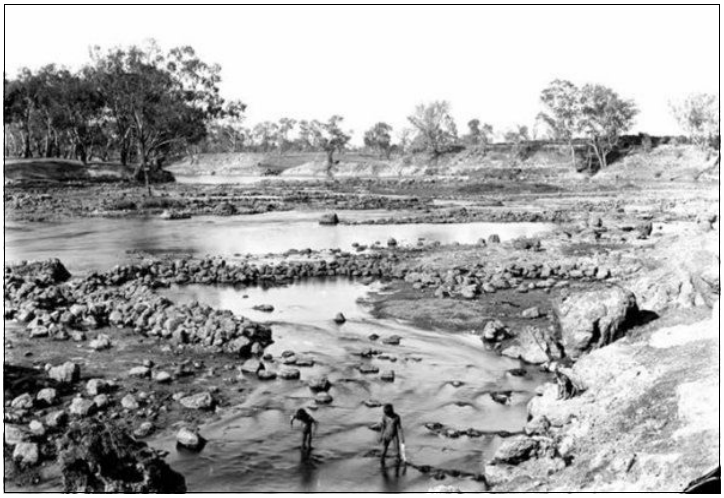
The authors plan to work with students investigating options to reclaim the ancient technology and survey for the original traps, understand the cultural method of construction and their use in terms of engineering, knowledge of hydraulics and the conservation of fish stock gathered in the traps.

Image left: Grinding holes on a rock shelf, from Dargin, P. (1976).

# *Brewarrina Fish Traps on the Barwon - Darling Catchment, NSW.*

The fish traps were used to support large gatherings of Aboriginal peoples, while hand fishing was conducted on the river at other times (see image at right). Baiame set up rules for when gathering for trade and ceremony (corroborees), including a dedicated camping area for each of the various language groups, so that peace would be maintained and the fish be enjoyed by all at these gatherings. Each group was allocated a section of the fisheries to maintain, such as stabilising and replacing displaced stones.

Making string for fishing line, from Dargin, P. (1976).



Brewarrina Aboriginal Fish Traps. Image from National Heritage Places.

The pens or pools were built using dry-stone wall techniques. They comprise of rocks knitted together in layers, a method that provides greater strength. Further stability is gained by placing large capstones along the tops of the walls. In large floods, these walls are strong enough to withstand even the strongest of flood waters. According to Aboriginal Lore the walls were built in drought when the river was low. The year the traps were built is not known.

The traps are tear-drop shaped with the convex wall facing upstream. The curves act as arches against the weight of the water from the Barwon River with the sides tapering off in a tear-shape following the lines of the currents. This is combined with pond gates which are made to enable fish to be swept in either as they migrated upstream or downstream. The construction accommodates the various water levels, to ensure there are still runs in low water for the fish to be caught by yards or the yards can be opened up for the fish to migrate up stream.

Brewarrina Aboriginal Fish Traps (Baiame's Ngunnhu), from Dargin, P. 1976.

The fish traps in the present day. Photo - B. Hanna, NSW Heritage Office.
Note the heron looking for fish near the centre of the image.

Fish are able to migrate up the river and over the first set of walls and into holding yards where Aboriginal peoples are able to catch the fish by hand or by spear. The size of the fish determines to which holding yard that fish is directed. Aboriginal peoples will use hands and feet to splash the water, which further encourages the fish from larger yards into the smaller ones. Smaller fish are able to swim over all walls and are free to migrate up stream, the original designers being conscious of sustaining fish populations.

Reference: EHA Mildura Conference paper *Enduring Engineering for Our Water Resources* by Cat Kutay and Christopher Lawrence, Centre for Indigenous Technology Research and Development, University of Technology Sydney.

The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *The Significance of Windmills.*

*by Keith Baker*

Windmill against Wind Farm, near Portland, Victoria. Photo – Keith Baker

Windmills have existed across the world for centuries, developed progressively in the Middle East, China, Europe, USA and Australia. Whether for grinding, pumping or generating electricity, they raise strong emotional reactions in art and literature, as well as protest movements and tourism.

I had started to write a story for the EHA Magazine about windmills that I had visited but decided on a conference paper with more of a message and less as a travelogue. I began thinking about what made windmills culturally significant and how this related to the heritage assessments that had been made, and to the guidelines EHA had produced for its Recognition Program and its Conservation Guide.

We had seven criteria for heritage significance and it would be a challenge to illustrate each of these with a different windmill around Australia.

Windmills at Mykonos, Greece. Photo – Keith Baker.

Old Brisbane Mill. Photo from the Australian Department of Environment & Energy and the Australian Heritage Council.

Some obvious places to start looking were the former Register of the National Estate (now the Australian Heritage Database), the various State Heritage lists, local government listings, windmill enthusiasts' websites and the Engineering Heritage Recognition Database. Surprisingly, there were a range of stone towers remaining from colonial grain mills, but much less recorded in the heritage literature of the more numerous rural water pumps that had played a vital role in the development of Australia. Looking at the EHA criteria one by one, the paper made use of a range of former assessments to verify the history and heritage features of the selected engineering works. The following briefly summarises the body of the paper.

## *Historical Significance*

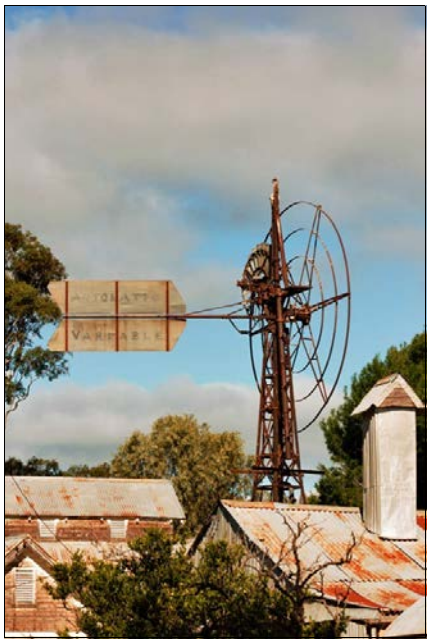
Constructed in 1828 to process the wheat and corn crops of the Moreton Bay penal settlement, the Old Windmill Tower in Wickham Terrace, Brisbane had a treadmill attached as a tool for punishing convicts. Included in the Queensland State Heritage Register, the Old Windmill has great historical significance as it shows evidence of a significant human activity, it is strongly associated with the forced use of convicts on the treadmill during the settlement phase, and it shows the continuity of various activities over a considerable period, including using it for a time ball.

# *The Significance of Windmills.*

## *Historic Individuals or Association*

Nixon's Mill, a stone flour mill built in 1843 by Frederick Nixon, is among the most substantial mills in South Australia and is the oldest surviving windmill structure in the State. Nixon was a surveyor under Colonel Light, and a man of some standing in the community, having bought land in Mount Barker in 1841 where the mill was built. Included in the SA Heritage Places Database, the former Nixon's Windmill is significant for its association with its first owner and the role he played in the establishment of the area in the first decade of the Colony of South Australia.

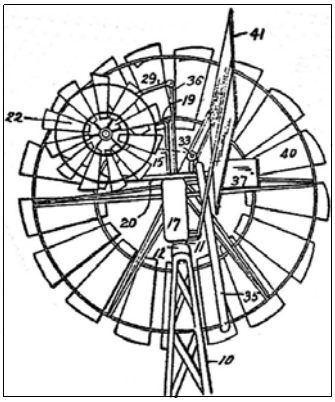
Nixon's Mill, Mt Barker, SA. Image: localwiki.org.

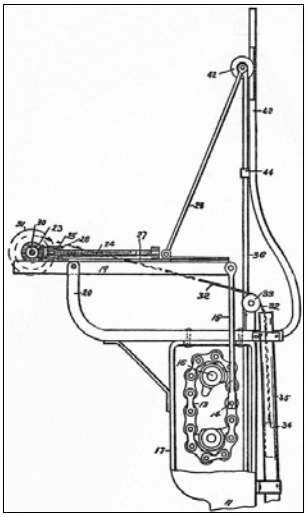


Above: Fortescue variable stroke windmill.
Image: T. Glastonbury.

## *Creative or Technical Achievement*

This windmill had no formal heritage recognition, but came to notice as a restoration project by engineering undergraduate Thomas Glastonbury. The 'IXL' mill, patented around 1910 by Albert Fortescue, used a sprocket and roller chain drive rather than a conventional crank. In 1912 Fortescue patented a more advanced design having the capacity of changing the pump stroke to suit the wind conditions, so that it could start pumping under low wind conditions and increase the pumped volume per stroke as the wind strengthened. I considered that the Fortescue Automatic Variable Geared Wind Engine was highly significant for its innovation and creative technical achievement.





Right: Two drawings of the Fortescue Windmill Mechanism
From The Windmill Journal.

Below: Ruins of the Hope Farm windmill.
Image: T.Glastonbury

## *Research Potential*

An original land grant made to First Fleet assistant surgeon Thomas Arndell, contains ruins of a windmill dating from 1804. The site is now within Cattai National Park, managed by the NSW National Parks and Wildlife Service. NPWS studies indicate the park contains evidence of the earliest period of European settlement in Australia. Although it was not the first windmill to be built in Australia, the ruins of Hope Farm Mill are significant as possibly the oldest remaining industrial building in Australia which has the potential to reveal substantial archaeological information.

## *Social Significance*

Gilgandra in the central west of New South Wales is known as the Town of Windmills. Its skyline was once dominated by 360 Windmills. The town celebrates its windmill heritage in a range of ways, including in the council logo, a named sporting team, and windmills prominently displayed outside the rural museum leading to an avenue of windmills along the highway through the town. The assortment of windmills in Gilgandra is significant for their social value to the local community, helping to define its sense of place.

Right: Gilgandra Windmill Walk. Image: Keith Baker.

# *The Significance of Windmills.*


## *Rarity*

Made by the Steel Wings Windmill Company of North Sydney in 1910, an unusual windmill was originally erected at Goolgumbla Station in the NSW Riverina. It was relocated to Jerilderie and restored in 1979, where it is now the only one of its type and size in operation worldwide, with a 25ft diameter wheel rotating inside a pivoted frame. Similar but smaller *Steel Wings* windmills have since been located and restored in SA and Qld. *Steel Wings* at Jerilderie has only received local government heritage recognition, but is highly significant for its rarity as the largest of its type remaining and one of only three *Steel Wings* known to be operating in the world.

Left: Steel Wings windmill, Jerilderie, NSW. Image: Keith Baker.

## *Representativeness*

A highlight of the 2003 Engineering Heritage Conference held in Toowoomba was a visit to the Toowoomba Foundry which had manufactured Southern Cross windmills since 1903, and a plaquing ceremony that was held nearby. It was not the oldest windmill, or one that had been associated with particular place or event. Its significance was as one of the 250,000 Southern Cross windmills that had been manufactured; representing the Southern Cross windmills spread across Australia and overseas.

Right: Peter Cockbain about to unveil an EHA heritage marker near Southern Cross Windmills, Toowoomba, Queensland in 2003. Image: Keith Baker.

## *Multiple Values*

The discussion of windmills above concentrated on a single value for each. However there is often a range of values present which add to the overall significance. Callington Mill in Tasmania is a good example. On the Tasmanian Heritage Register, it rated highly on six of the eight State criteria and more recent restoration, including reconstruction of the sails and milling machinery, further enhanced its heritage value.

Left: The 1837 Callington Mill, in Oatlands, Tasmania. Image: Keith Baker.

My conference paper, *From Aesthetics to Function, History to Rarity: the Significance of Windmills* concluded with pointers for both assessment and interpretation of engineering heritage works.

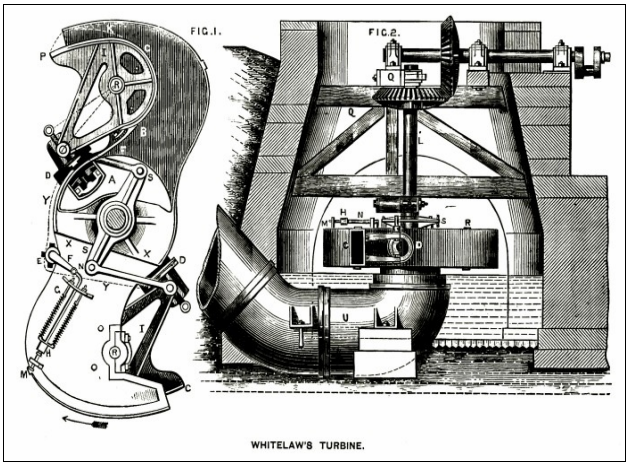

Right: Gilgandra again – the Museum with a variety of windmills. Image: Keith Baker.

Reference: EHA Mildura Conference paper *From Aesthetics to Function, History to Rarity: the Significance of Windmills* by Keith Baker, Engineer, Past Chair EHA, Canberra.
The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

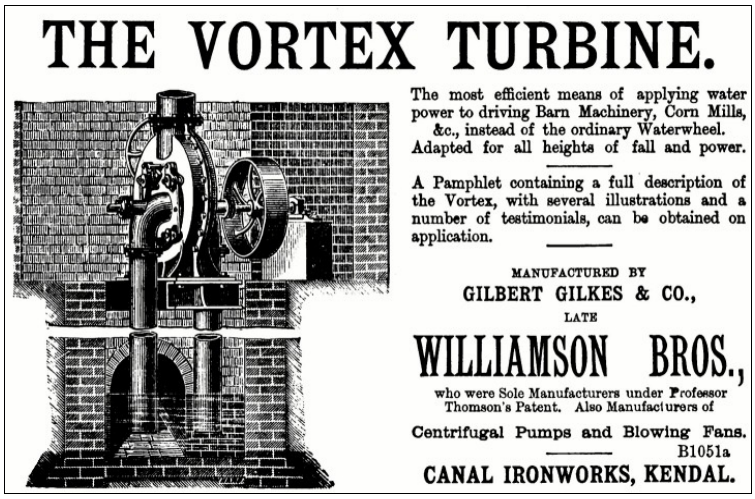
# *Richard Jenkin Polglase, engineer.* *by Peter Evans*

In 1866 and 1867 an aging engineer installed five and possibly six water turbines in the remote and rugged Woods Point goldfield of Victoria. These innovative turbines were the very first such installations in Victoria and, very possibly, in Australia.[1] That engineer was Richard Jenkin Polglase. Polglase was born in 1817 in Gwinear, Cornwall, England to farmer Ralph Polglase and Eleanor Polglase (née Jenkin). We know little of his early life and education except that he became an engineer. Whatever his talent in his chosen field, he was no financial success, as he was declared insolvent on 29 February 1856.

Perhaps looking for a fresh start, he arrived in Melbourne around 1858 and, from January 1859, managed the Crown Iron Works (in partnership with Henry Tregellas) at 274 Elizabeth Street.




The first of Polglase's turbines was a Whitelaw & Stirrat patent, possibly the only 'Barker's Mill' ever installed in Australia. "The Engineer", 7 April 1882.

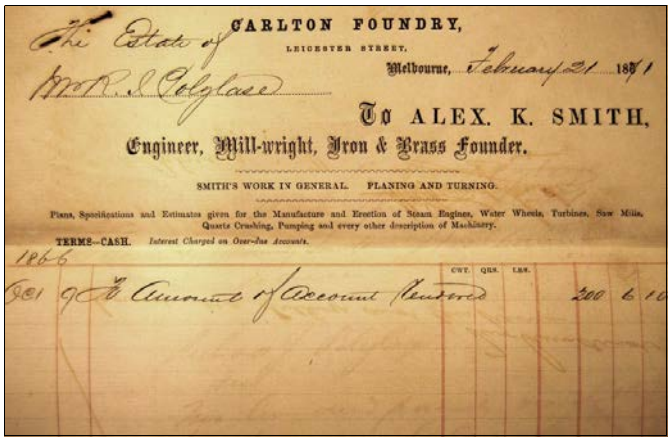



The remaining Polglase turbines would appear to have been of the Thomson Vortex design. "The Engineer", 7 April 1882.

An early interest in gold mining was indicated by the application for a patent for improvements in machinery for breaking stones, and by the trial at the Crown Iron Works of a patent amalgamator. The partnership between Polglase and Tregellas was dissolved in February 1862 (with accounts to be paid by Polglase), and the Works was put up for sale in June 1862.

He is next recorded at Gordon(s) as a sawyer at the Green Hill Sawmills. Here he again became insolvent on 27 February 1864. He was described as 'elderly' when he moved to Woods Point in 1866. The earliest newspaper reference to him at Woods Point is in March 1866, and he then appears regularly both in connection with the installation of the turbines and with speculation in mining shares and leases. By August 1867 he was again in financial difficulty, and was declared insolvent for a third time on 17 January 1871.

Since 1866 he had been accumulating debts, mostly small amounts for stores and labour. In 1869 he offered his creditors six shillings in the pound, which some of them accepted. But, in 1870, a debt of £200 6s 10d to A. K. Smith's Carlton Foundry was too large to be ignored, and it was Smith who enforced the insolvency. There was also a debt of £140 0s 0d due to Wright & Edwards for the supply of machinery. Both of these debts were almost certainly due to the purchase of turbines and associated crushing machinery. Polglase's liabilities totalled £1,429 13s 10d and his assets a mere £27 15s 6d, and he surrendered his estate for sequestration. A certificate of discharge was granted on 26 May 1871.




Polglase's debt to Alex. K. Smith. An extract from Richard Polglase's 1870 insolvency. PROV, VPRS 759/P0, unit 246, file 13406.

Richard Jenkin Polglase died at his residence at the corner of Raglan Street and Skipton Road Ballarat on 1 March 1878 at the age of 61, having battled a bowel complaint for five months. He was buried in Ballarat the following day, his death unremarked in the local press save for a funeral notice. The lack of any probate documents (and his repeated insolvencies) indicate that his estate was probably negligible. Whatever his abilities as an engineer, he was clearly no businessman.

Reference:
EHA Mildura Conference paper *Water Turbines of the Woods Point Goldfield 1866-1867* by Peter S. Evans, Light Railway Research Society of Australia Inc. The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

1 Re Barker's Mill: The first of Polglase's turbines was a Whitelaw & Stirrat patent, possibly the only 'Barker's Mill' ever installed in Australia. *The Engineer*, 7 April 1882. And see: http://physics.kenyon.edu/EarlyApparatus/Fluids/Barkers_Mill/Barkers_Mill.html
Re Thomson Vortex Turbine - see https://www.lakelandmuseum.org.uk/williamson-brothers-vortex-turbine-number-one

# *Barwon Sewer Aqueduct, Geelong, Victoria.*

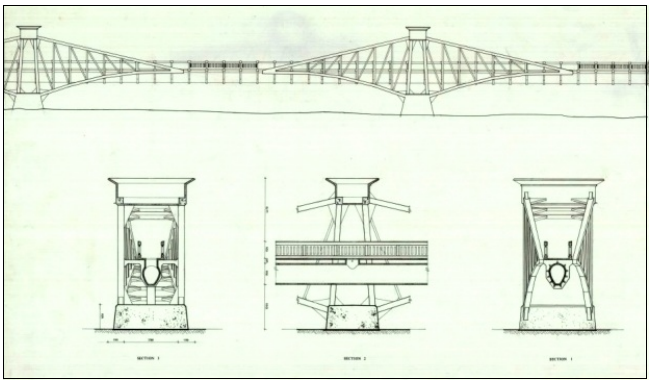
*by David Beauchamp*

The Barwon Sewer Aqueduct at completion, during a flood on the Barwon River. This image was scanned from Barwon Water's original glass slide collection..

The 756 m. long Barwon Sewer Aqueduct was at the time of its construction, from 1913 to 1915, described, in the English *Concrete & Constructional Engineering* Journal as '*one of the finest concrete constructions in Australia*.' Today, over a 100 years later, the aqueduct is derelict, concrete has spalled from many of its members exposing rusting reinforcement and it is under threat of partial demolition. Despite this, the largely intact aqueduct remains an impressive structure. It is also an example of how little was known about the durability of reinforced concrete structures at the time of its construction.

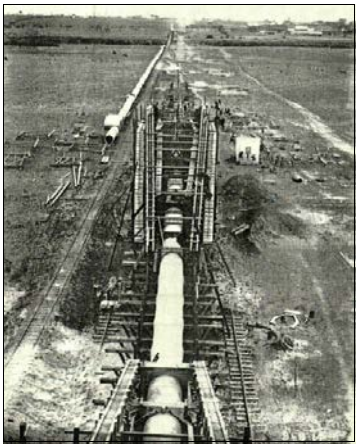
The aqueduct today, concrete spalling, propped, fenced off and disused. Photo - David Beauchamp

Early in the 20th century Geelong became the second city in Victoria to install a sewerage system consisting of a main outfall sewer that collected only sewage and disposed of it, without treatment, to an ocean outfall at Black Rock south of Geelong. To carry the outfall sewer across the flood plain of the Barwon River and the river itself a 2,400 feet long (731.5 m.) aqueduct was required.



Part of a drawing of the Ovoid Sewer Aqueduct, by Rosemary Burn for the 1992 Matthew Flinders measured drawing competition.

In 1912 the firm of Stone & Siddeley won the tender for the construction of the aqueduct. Their design consisted of 14 reinforced concrete towers supporting pairs of balanced triangular trusses. Between and supported by the trusses was a maintenance walkway with the ovoid outfall sewer pipe slung below it. There was a gap of 40 feet (12.2 m.) between the ends of the opposing pairs of trusses, which was spanned by the walkway designed to act as a beam. All of the compression members of the trusses and towers were reinforced according to the Considère system, which used closely spaced spiral reinforcing wound around the longitudinal bars. Testing had shown that such an arrangement markedly increased the strength of compression members.

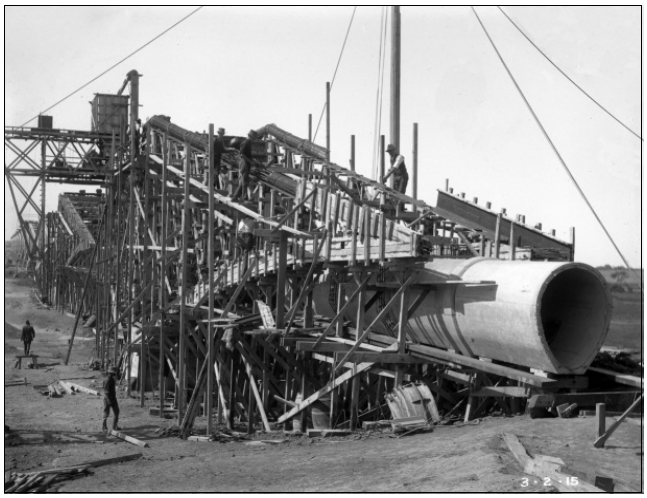


IMAGES

Construction of the Barwon Sewer Aqueduct, 1913 to 1915.

Left: Pipes laid out on the ground prior to being lifted into position.
Image - from the Barwon Water collection..

Right: Erection of the form work at the work site.
Image - State Library of Victoria.



# *Barwon Sewer Aqueduct, Geelong, Victoria.*

The aqueduct started to show problems only seven years after its construction, with cracks occurring in the tension members of the truss and rusting of the reinforcing apparent in some of the vertical compression members. In addition some of the spans had sagged. These problems continued over the life of the aqueduct. From 1923 to 1991 various repairs were made to try and correct these problems with more than $1.15 million being spent on this work.

Image below:
The aqueduct today, fenced off and disused.
Photo – David Beauchamp.

Image above: Girder section of the aqueduct with exposed reinforcement visible.
Photo - David Beauchamp.

The problem with the Considère system was, that in the days before concrete vibrators were available to compact concrete, a very wet mix was necessary to enable the concrete to be placed around and between the closely spaced spiral reinforcement. This wet mix resulted in concrete that was both porous and permeable so that ingress of water to rust the reinforcing could easily occur. This, together with the lack of adequate cover in the smaller members of the trusses, led to corrosion of the spiral reinforcing and subsequent spalling of the concrete.

In 1909 Stone designed a series of reinforced concrete bowstring trusses spanning 51 m. to support the roof of a woolstore in Geelong. These were erected in 1910-12. Similarly to the aqueduct the Considère system of reinforcing was used for the compression members. By the mid-1920s problems with spalling concrete and rusting of the hooped reinforcing were occurring to the bowstring trusses. By the 1980s, the bowstring roof trusses had deteriorated to such an extent, they were no longer considered possible to repair. Despite a huge campaign to save it, the building was demolished in 1990.

Barwon Water is the owner of the aqueduct and the flood plain that it traverses. At the beginning of 2017 it proposed to create a public park (Aqueduct Park) on the flood plain. To give safe pedestrian and boating access under the aqueduct four spans were proposed to be demolished. Since the announcement a small sub-committee of EHV has been working with other interested bodies from Geelong to try to persuade Barwon Water that there are other solutions and that if these were adopted the aqueduct could remain intact. As yet (April 2018) Barwon Water have not announced their final proposal.

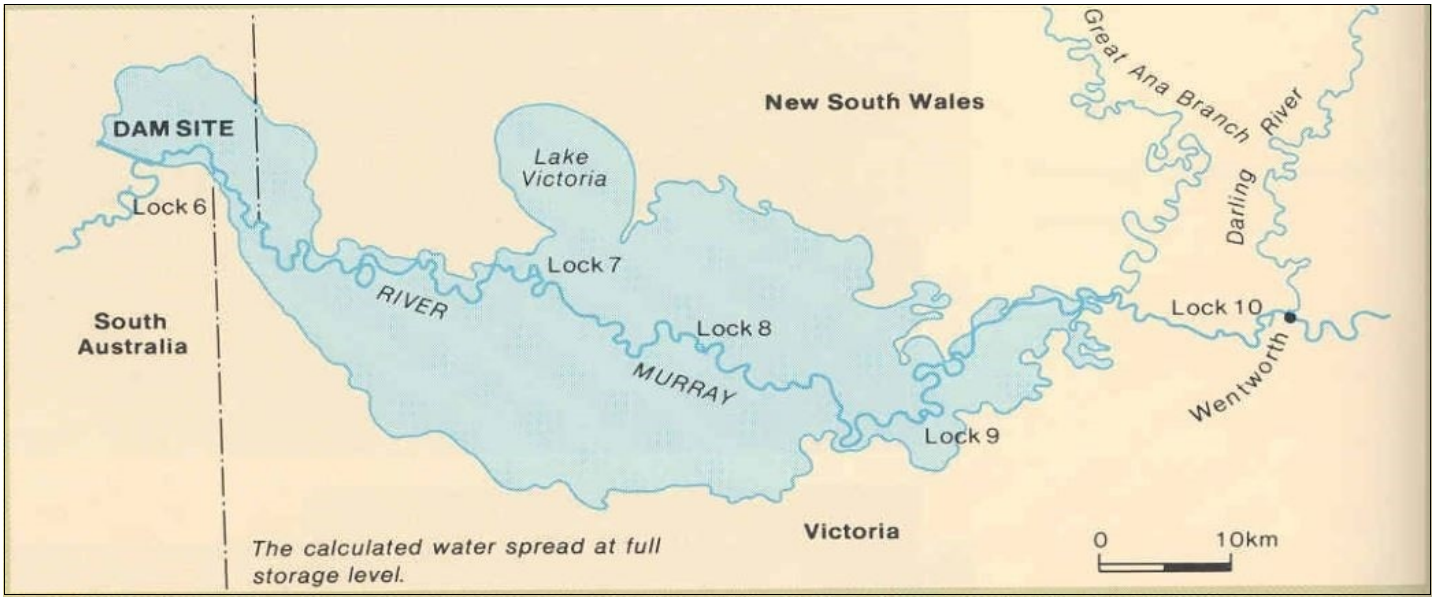

Image above: from page 7 of Barwon Water's Aqueduct Park Masterplan, showing the visual impact of removing a number of spans of the aqueduct.

Reference: EHA Mildura Conference paper *From Finest Reinforced Concrete Construction to Historic Ruin In 100 Years - The Barwon Ovoid Sewer Aqueduct* by David Beauchamp, B.E., MICE, MIEAust.(retired). The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *Proposed Chowilla Dam in South Australia.*

## *Solving groundwater problems before computers*

*by David J. Hartwell*




Proposed location of the Chowilla Dam - dam wall site at left. The map shows the area of land that would have been covered by water when the dam was full.
Image above - Murray Darling Basin Authority – Dartmouth vs Chowilla Dam ( http://riverstories.mdba.gov.au/striving/article/dartmouth-vs-chowilla-dam ).

On 21 April 1960, the South Australian Government announced a plan to construct Chowilla Dam on the Murray River. This would have resulted in significant flooding in the neighbouring states. The subsequent political wranglings as well as environmental objections eventually led to the abandonment of the project ten years later.

For a good account of the Chowilla politics, try Chris Guest's excellent book *Sharing the Water – One hundred years of River Murray politics*, published by the Murray-Darling Basin Authority (ISBN 9781925599046).

(See cover at right).

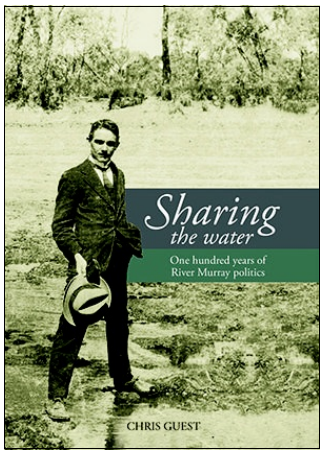
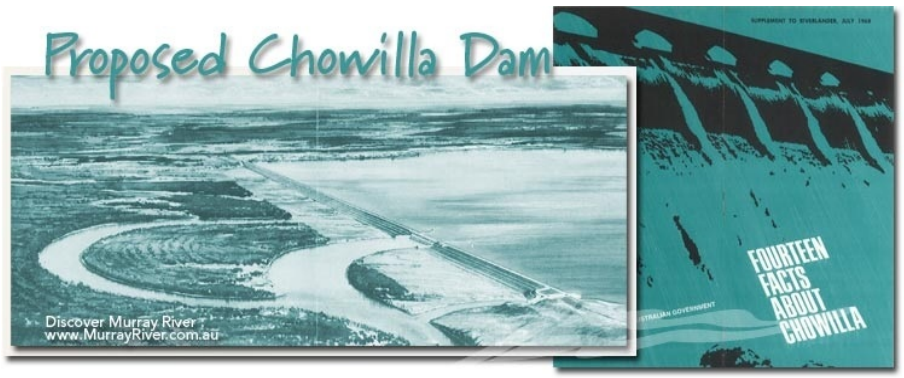



Image left: Site of the proposed Chowilla Dam.
Aerial photo from Adelaide Advertiser 1967.

Image below: Cover from a South Aust. Gov't supplement to the Riverlander, July 1968, promoting the 'benefits' of a dam at Chowilla. The text can be found at:
http://www.murrayriver.com.au/renmark/chowilla-dam/

Studies were undertaken in the early sixties and the issue of risk to downstream agriculture from saline groundwater below the dam emerged. The modelling studies applied to the problem were documented on film which has been digitised, but is not yet available online. The film provides a fascinating insight into what was achieved without the use of electronic computers.



The models included conductive paper models, two and three dimensional electrical resistance models and the parallel plate Hele-Shaw model.

A grid of electrical resistances to match a two dimensional plan model can represent the variations in aquifer properties. Such models can be extended to a layered or three dimensional systems by additional resistances between the model layers which simulate the vertical permeability.

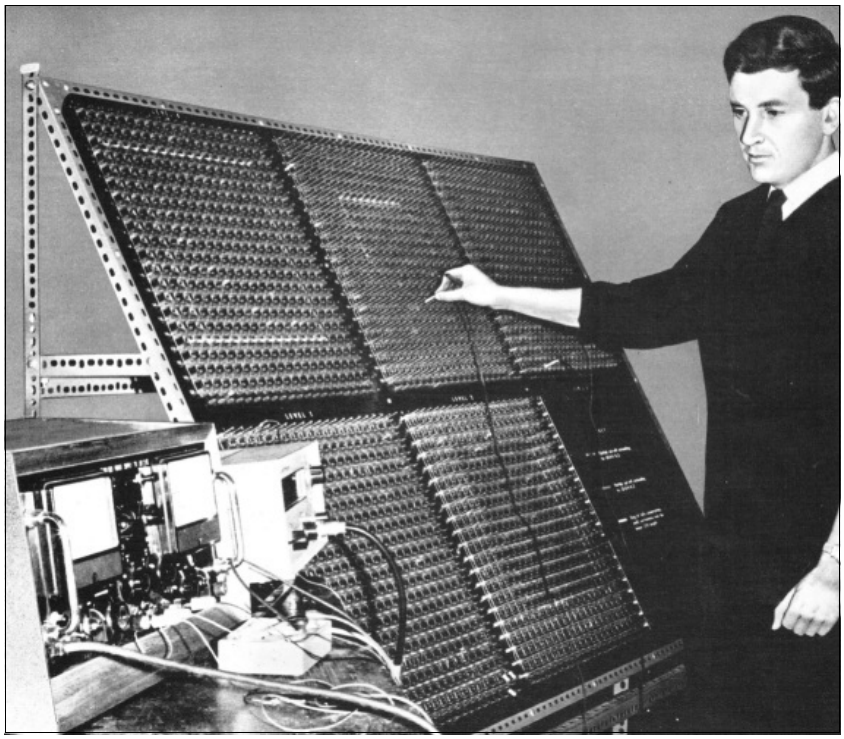


Image above: Three dimensional resistance analogue model. Source not provided.

One of the analogue models used is shown in the image at left. In this particular set up, five panels each with 20 by 20 elements were connected side by side to form a vertical five layer model.

This arrangement is flexible and the sensitivity to changes in parameters is tested by changing resistors. However, the model as set up has a total of 3600 resistors, each individually selected and fixed. Compare this to changing parameters on a computer model!

The three dimensional analogue was used to study the Chowilla Dam underseepage including studying upstream and downstream clay blankets to extend the flowpath and downstream wells.

## *The Hele-Shaw model*

Groundwater flow differs from surface flow in that it is laminar; the Hele-Shaw model cleverly simulates laminar flow by using two parallel plates with a narrow gap and a viscous fluid to reduce the Reynolds number.

The two-fluid model simulates a thin section through the dam where the path of fluid particles can be traced with injected dye. The model constructed for Chowilla was about five metres long, see image at right, and consisted of two parallel Perspex plates set 1/8 th inch (3.2 mm) apart.

The image at right shows the model with the dam embankment in yellow and the saline groundwater in red at the start of a run. The model allows the effect of freshwater seepage on the saline groundwater to be studied with respect to time.

Image above: Dye tracer to show flow paths of fresh water.

Image above : Hele-Shaw model of Chowilla Dam.

This was critical since the quantity of saline groundwater that needed to be pumped to evaporation ponds and the duration were important economic aspects.

References:
EHA Mildura Conference paper – *Chowilla Dam, A Case Study of How We Studied Groundwater Problems Before Computers* by David J Hartwell, Groundwater Management Consultant, Finchampstead, Berks U.K.
The paper can be found on Informit – go to:
https://search.informit.com.au/search;action=doSearch
and copy the paper title into the search box.

The Hele-Shaw images at left & above came from the film mentioned above. It is hoped that this film will become available on Youtube soon.

# *Pigs do fly – the F-111 in Australian Service*

*by Owen Peake*

The F-111 always impressed me from the very first time I saw one at an air show.

When I worked as CEO of the Power and Water Authority in the Northern Territory I did a lot of driving on the Stuart Highway "visiting the troops". A trip to Alice Springs involved a round trip of 3000 km, driving from Darwin to Alice and back so as to visit the small regional groups of Power and Water employees at Pine Creek, Katherine, Mataranka, Elliot and Tennant Creek along the way.

During this time I often encountered a solitary F-111 flying on its Terrain Following Radar just above the tree tops beside the highway. These sorties were flown at sub-sonic speeds, to avoid startling the locals, but pretty fast for such a low flying aircraft. You never heard them coming – a glimpse in peripheral vision then a fraction of a second in full view ahead before the aircraft disappeared again into the terrain.

An F-111 in its element – fast and low.
Image: "From Controversy to Cutting Edge", Mark Lax.

Take your pick – an array of weapons which the F-111 could carry. Image: From Controversy to Cutting Edge, Mark Lax.

The F-111's were based at Amberley in Queensland but used the Delamere Firing Range west of the RAAF Base Tindal, just south of Katherine. Apparently following the highways was more fun that going between Tindal and Amberley in a straight line!

The Terrain Following Radar (TFR) was very reliable according to the RAAF F-111 crews but things happen quickly at such low altitude and, say, a speed of Mach 0.85. It required very quick reflexes to manually fly the aircraft out of danger in the event that the TFR failed or was inaccurate. Hence confidence in the TFR was critical to crews and the best way to build that confidence was apparently to fly low on TFR as often as possible.

In such encounters you had little time to take in any detail. It wasn't even easy to determine if the wings were folded back or swung forward. What the aircraft might be carrying under its wings was even harder to spot. It all went by in a flash followed by the mighty roar of the engines as the F-111 disappeared over the horizon.

Would any radar that happened to be looking for an F-111 flying so close to the ground see it? Probably not! Flying fast and low was a major protection for the F-111 which was designed long before the era of stealth aircraft that we hear so much about these days and which conventional radars have such difficulty detecting.

My Honda Accord always seemed to crawl along after these encounters, despite a brisk pace – remembering that there was no speed limit on the Stuart Highway until very recently.

As the F-111 got older my respect for it increased. It was so far ahead of its time and proved to be safe and reliable in RAAF hands. The RAAF's F-111s retired after 30 years of service having never seen any combat – there was simply no one in the neighbourhood who wanted to take on such a formidable weapon system.

Last load of bombs to the Delamere Air Weapons Range before retirement. Image: RAAF

Reference: EHA Mildura Conference paper
*Pigs Do Fly – the F-111 in Australian Service*
by Owen Peake, FRMIT, HonFIEAust, CPEng, EHA, Melbourne, Victoria.
The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *Sarrans Hydro-Electric Dam – France.* *by Merv Lindsay*

In 2015, I visited the Sarrans Dam after it had been emptied for maintenance. This dam in South West France on the Truyere River is one of a series of dams on the Lot River tributary system but it is also the largest and is ranked by Electicite de France (its owner) as its 6th most important hydro dam.

Location map showing the Truyère River and the site of the Sarrans Dam.


Le Barrage de Sarrans, showing the full dam, the wall & the hydro-electric power station. Image: TripAdvisor.

To contextualise my paper, I need to give a summary of the history of the dam and why it is important. France has a 2000 year history of harnessing the energy within its waterways. By the 20th century, traditional mills were disappearing and the new focus was on electricity generation. There was an ambitious program of constructing large scale hydro dams. Sarrans Dam was commenced in 1929 and completed in 1932 and at that time was the largest dam in Europe. Controversially (now), it was funded by reparation monies paid by Germany after World War 1.

In that era, hydro supplied some 10% of France's electricity. Now it provides 7% but it is an extremely important 7% as the inherent features of hydro have enabled France to transform its power generation to 70% nuclear, then more recently, to enable efficient introduction of renewable into its grid. So it can be argued that this evolution of purpose is in itself something of an adaptive reuse of the hydro infrastructure.


The empty dam in 2015, with a ruin (perhaps a former mill?) in the background. Photo: Merv Lindsay.

My first visit to the empty Sarrans Dam began a short love affair with the dam over the following months. I visited it four times, observing a fascinating transformation of the dam floor and gaining an understanding of its history, social relevance, environmental relevance and how these are balanced against its heritage significance at multiple levels. My paper presented at the Mildura EHA conference was informed by that love affair and is intended to challenge conventional views about the choices made when a valley is flooded by a larger dam development.


A new bridge overlies an ancient bridge. Photo: Merv Lindsay.

That first visit was on a misty afternoon in spring and what we encountered was a time capsule exposed only for the second time in 90 years. Preserved roads, bridges (including a heritage listed 13th century stone bridge), remnants of houses, mills, bakeries, farm boundaries and an insight into the images that would have been the last memories of the inhabitants of that valley before it was flooded. Adding to the fascination was an emerging coverage of beautiful bright green vegetation as seeds stored in the cold depths of the dam began to germinate and over subsequent visits, I watched the full cycle of this new growth. We also observed the temporary re-establishment of the stream through the valley, following its course through this new and beautiful regrowth, beside ancient roads and under the preserved bridges.

So I drew conclusions that no doubt can be challenged, that should this dam one day cease to be of value to its community, the valley will heal and life will return and enter a new chapter in its history.

I have also concluded by my subsequent research that there is an over-powering argument for a recognition that, if a sensitive approach is applied to the flooding of large valleys, they can be borrowed and not destroyed, and the whole country can benefit from this until there comes a time when the valley may be returned and its environment and heritage enabled to re-emerge permanently from its time capsule.

I commend my paper to you.

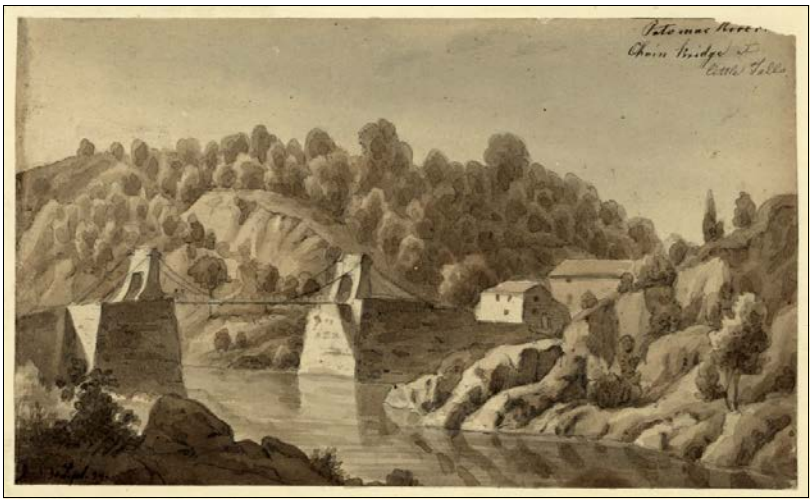

Regrowth amid uncovered bridges and ruins. Photo: Merv Lindsay.

Reference: EHA Mildura Conference paper *Sarrans Hydro Electric Dam, France – is Heritage Destroyed Or Locked in A Time Capsule?* by Merv Lindsay, BSc(Eng), FIEAust, CPEng, NER, FIENZ, GradAICD.
The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *From the Potomac to the Murray*

## *Captain Washington Meredith (1839-1934) and the Locking of the Murray River*

*by Jeannette Hope, Wentworth NSW.*



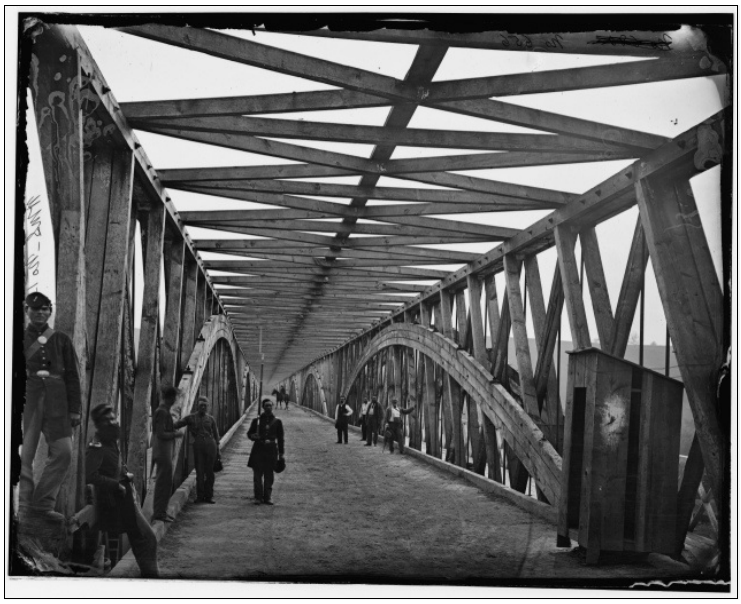
"Potomac River, Chain Bridge at Little Falls". Augustus Kollner, artist, 1839.
Image - Library of Congress http://www.loc.gov/pictures/item/2004661958/

In 1862, Washington Meredith, then a young Union soldier, was on sentry duty at the Chain Bridge over the Potomac River, about 4 miles (6.5 km) north of Washington DC. The Potomac marked the boundary between Virginia and both the federal District of Columbia and the surrounding state of Maryland. It was a strategic crossing in the Civil War; the Battles of Bull Run (1861, 1862) took place in Virginia just 25 miles (40 km) from the national capital.

It was in the early part of 1862, during the grand review of the Northern Armies, that Washington Meredith stopped Lincoln – not to mention Stanton and several army officers – at the Chain Bridge between Washington and Virginia, where he had been posted as sentry. General McClellan had issued orders that no-one was to be allowed to cross without a pass. The distinguished cortege headed by the President, rode up. Meredith halted them. They had no passes.

"What shall I do?" Meredith asked his Lieutenant.
"Hold them back" advised the Lieutenant.
Meredith held them back until the passes arrived from headquarters.[1]

The Chain Bridge that Meredith guarded was a crossbeam truss structure built to replace a chain suspension bridge that had collapsed in 1852. The latter was the fifth bridge at this location, and the third chain bridge; the first wooden bridge had been built in 1797. The name Chain Bridge was transferred to the sixth bridge in place during the Civil War, and has been retained for subsequent bridges. The current and eighth Chain Bridge is a steel girder structure built in 1939.[2]



Chain Bridge, Potomac River, with Union soldiers on guard, ca 1861-2.
Image: Smith, W. M., photographer. (pub.1865) Washington, D.C. "View across Chain Bridge over the Potomac". Photograph - from Library of Congress, https://www.loc.gov/item/cwp2003000927/PP/

The Chain Bridge was also the site of the first Union Army Balloon Corps balloon crossing, on October 12, 1861. The balloon, the Union, had been inflated in Washington and then 'walked' to the battlefield at Lewinsville, Virginia, crossing the Chain Bridge on the way. The trip took nine hours, but on arrival a wind gust took the balloon away before it could go into action as an observation post (with information transmitted by a telegraph wire down the tether).[3]

Little did Washington Meredith imagine when he stood on the bridge over the Potomac in 1862 that more than 50 years later he would play an important role in the locking of the Murray River in Australia. Even today, Australians know little about the contributions of Meredith and another American engineer, Robert Curtis Cutting, who supervised the lock construction from 1914 to 1922. A third engineer, Captain Edward Neele Johnston, of the US Army Corps of Engineers, is occasionally mentioned, in passing, in histories of the Murray River Works.[4] Johnston designed the locks in 1912-13 and was probably responsible for the subsequent employment of Meredith and Cutting.

1 The Cincinnati Enquirer 23 Jul 1934 *Life of Adventure at End for Inmate of Altenheim*; Barred Lincoln on Bridge. (Obituary Washington Meredith).

2 https://en.wikipedia.org/wiki/Chain_Bridge_(Potomac_River)

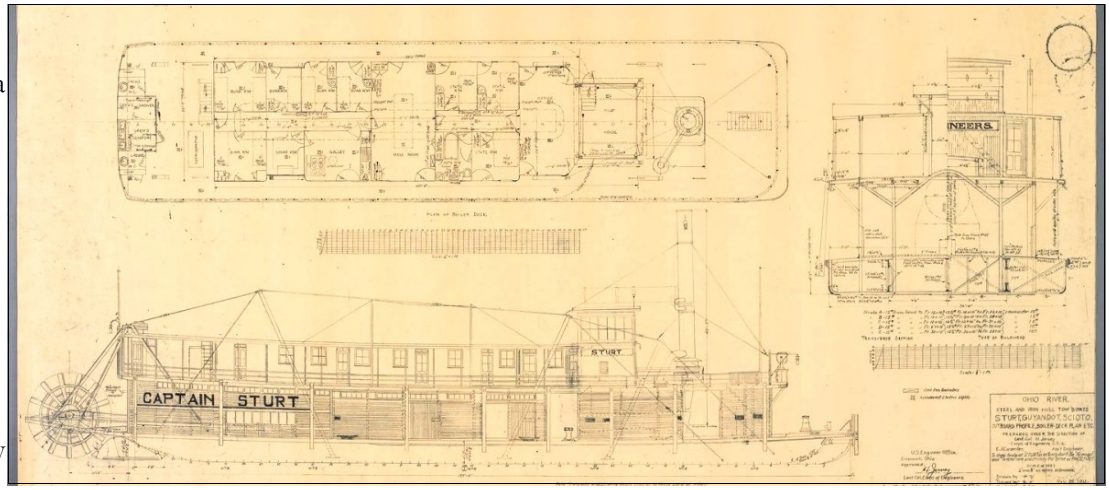
3 https://en.wikipedia.org/wiki/Union_Army_Balloon_Corps

4 Eaton, J.H.O. 1945 *A Short History of the River Murray Works.* River Murray Commission.

# *From the Potomac to the Murray*

Washington Meredith was born in West Virginia in 1839. He had an adventurous life. He was a riverman and boatbuilder on the Ohio and Mississippi and an engineer for the Cincinnati water-works for more than 12 years. In 1898 Meredith was one of the founders of the United States Mining, Dredging & Lumber Company, and took a steamboat up the Yukon River during the gold rushes in Alaska. When the United States entered WW1 Meredith tried to enlist, giving his age as 60, rather than the actual 77 and requesting command of a submarine chaser. Although knocked back, he retained an interest in submarines and when the US submarine S51 sank in 1925 off Rhode Island, after colliding with a merchant steamer, he patented an appliance for escape from disabled submarines.

In 1915-16, Captain Washington Meredith spent a year in South Australia reassembling a stern-wheel steamboat whose steel hull had been built in Cincinnati, Ohio, and shipped to Australia in sections. The Paddle Steamer Captain Sturt's primary role was pushing barges loaded with granite from a quarry near Mannum to the River Murray lock construction sites.




Copy of an engineering drawing, SS 'Captain Sturt', Murray River paddle steamer, paper, dated 1912, hull built by Charles Barnes Co., Cincinnati, Ohio, USA, used by River Murray Commission to build locks in South Australia, Australia, 1917-1935. Image - MAAS Collection https://collection.maas.museum/object/323547

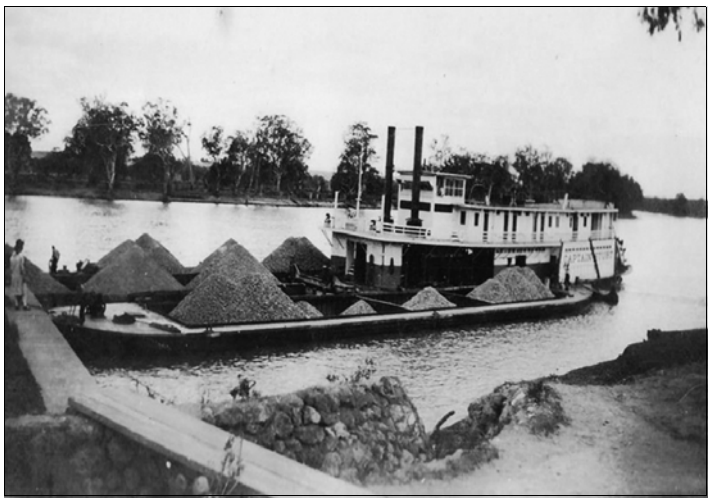

Paddle Steamer Captain Sturt under construction.
Image courtesy of SA Water, Book 78, page 33, image 87.

At the end of his task, Captain Meredith was interviewed by the Adelaide Advertiser:

*He has been building river boats for 65 years… the Captain Sturt is an experiment as far as river navigation in Australia is concerned inasmuch as it pushes its freight ahead instead of towing the barges astern, but it is by no means an experiment as regards the United States, where the Charles Barnes Company, the constructing firm, has 100 craft of the same type plying up and down the Mississippi, Wabash, Kentucky, Alleghany, and various other rivers. The Captain Sturt is the eleventh of the type Captain Meredith himself has superintended in construction, and in his opinion they have no equal for the handling of barges and derrick and dredge boats.*[5]

PS Captain Sturt worked from 1916 to 1938 in the construction of locks and weirs and the Goolwa Barrages. She was refitted as a houseboat in 1946 and moored at Goolwa, but by 1997 had fallen into a state of disrepair. The upper decks were removed and her hull filled with cement to become the centre of Goolwa's Captain Sturt Marina, where her paddle wheel is still visible.

Captain Washington Meredith died in 1934 at the Cincinnati Altenheim, a retirement home for men, built by German settlers.



PS Captain Sturt pushing rock barges. From Rodney Hobbs, source unknown.

Reference: EHA Mildura Conference paper *Locking the Murray: the Heritage of Engineering Process* by Jeannette Hope, Heritage Consultant, River Junction Research, Wentworth, NSW, 2648.
The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

5 *Adelaide Advertiser* 25 November 1916. See Trove https://trove.nla.gov.au/newspaper/article/5538150

# *Solar Thermal Power Plant in Australia.* *by Robert Mierisch.*

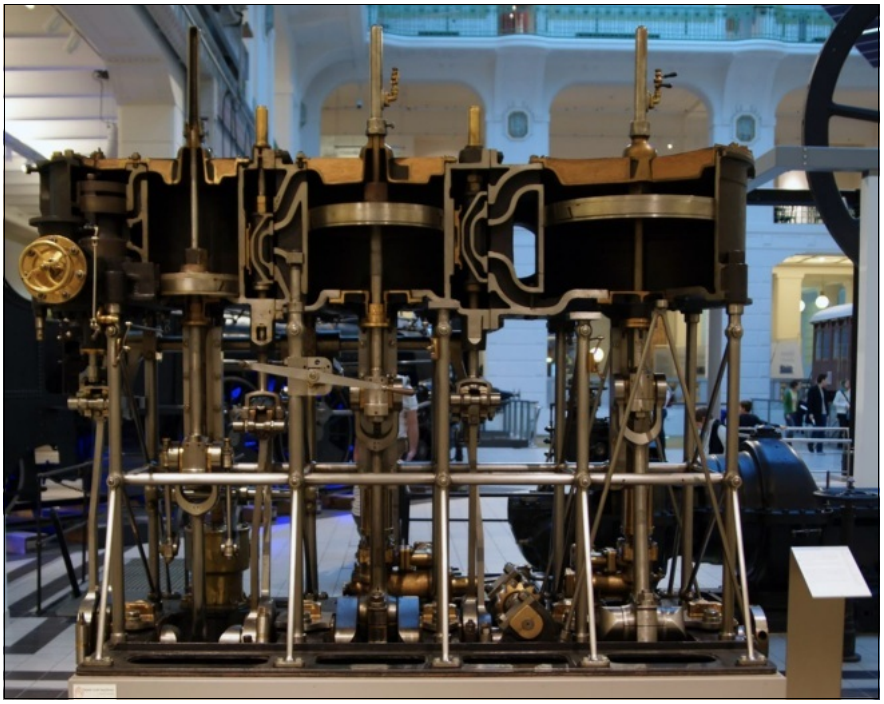
Robert Mierisch worked in the USA for most of the period from early 2007 to early 2015. Venture capitalists in California supported both the solar thermal startup companies he worked for: "Ausra" and Terrajoule. He co-founded Terrajoule in 2009 to demonstrate solar thermal power on a smaller scale.

Since his return to Australia, Robert has continued his work to prove solar thermal power, at "one per farm" scale. He predicts the technology will lead the way to larger scale cheap reliable energy supplies for all of Australia and many other countries. "One per farm" units will provide 24-hour electricity and provide hot water, winter heating, spa heating and swimming pool heating.

Robert has not yet found investors to support his work in Australia, although there are some prospective investors currently evaluating the financial potential of the work now. The paper entitled Reciprocating-Piston Steam-engines (Mierisch, 2017) was an important first step in publicizing the potential of the technology in Australia.

Australian farmers and small towns need cheap 24-hour solar electricity and the prospect of electric powered vehicles will only increase demand. With "one per farm" approach, they can have it. When enough farmers have shown the way, the same technology has the potential to work at "one per town" scale and grid connected scale.

Robert has determined that solar thermal plant at the proposed scales works best using high efficiency steam engines, not steam turbines. The highest overall efficiency for a steam engine plant reported in open literature is 29.5%. That engine used four stage expansion and was probably like the three-stage engine shown in the picture below.

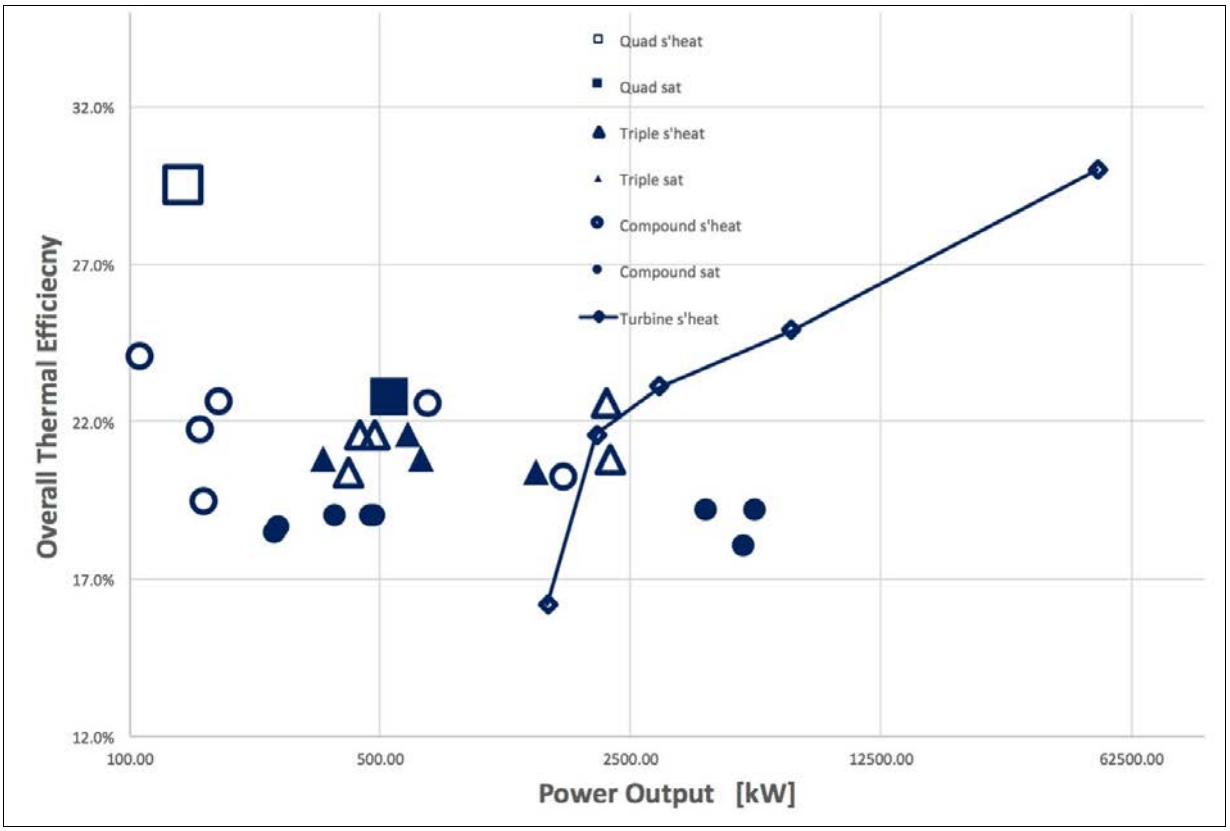


A triple expansion steam engine, shown sectioned. Source not provided.

The optimum size of solar thermal plant modules is about 1 MWe-peak. Also, plant size as small as 10 kWe-peak is practical and will be attractively priced. There is a "dis-economy of scale" for solar thermal plant. Larger systems have high costs with massive pipe arrays or very large boilers mounted on top of very high towers. The highest efficiency steam engine power plant had output of about 100 kW. It is presented as an open square symbol in the graph (see next page) published in the author's paper (Mierisch, 2017).

At Ausra, Robert was Research Director, Thermal Systems. Ausra built a 5 MWe demonstration plant and was planning a 177 MWe-peak plant. At Terrajoule, Robert was working on a scaled down plant, about 100 kWe-peak. He led the team that built the three steam engines. Two of the steam engines achieved the target efficiency.

Since his return to Australia he has worked to refine the design of "one per farm" scale and much larger plant.
The "one per farm" systems will use at least one 10 kWe-peak reciprocating-piston steam-engine, and in some installations as many as 11 or 12 engines. For larger power requirements, the plants will use a mixture of 10 kWe-peak steam engines and 100 kWe-peak steam engines.




GRAPH OF STEAM PLANT EFFICIENCY VERSUS OUTPUT.

Currently, Robert is working on the business plan for "one per farm scale" (10 kWe-peak) power plant, and that plan will be presented to a prospective marketing and investment group. Rolling out the technology at the smaller scale will prove the concept of the technology and lead to wide acceptance of the technologies at a much larger scale. The economics of the "one per farm" scale plant indicates that systems that are produced in volume will cost from $10,000 to $100,000 depending on output and location. All scales of plant will provide significantly cheaper energy than grid electricity or PV with batteries.

All the proposed solar thermal plants will use inclined trough Solar Collector Assemblies (SCAs) that are resistant to damage by hail-stones, bullets and cyclones. None of their cooling systems will evaporate water for cooling.

Skyfuel Trough Array. Source not provided.

Robert is also supporting another team working to build plants with output of many hundreds of megawatts, although in Australia funding for a venture of this scale is presently very challenging. The Australian National Energy Market consistently produces low prices for low demand scenarios that are serviced by base load generators, while occasionally producing extreme prices so that peak generators can recoup their short and long run marginal costs. The current market rules as implemented do not presently directly support hybrid renewable alternatives, such as solar thermal with storage, for grid connected generators.

Existing approaches to solar thermal plant have proven to be expensive. They need to provide superheated steam to operate steam turbines. Reciprocating Piston Steam engines do not require superheating making the plant dramatically cheaper. Small scale "one per farm" solar power plants will demonstrate the potential for solar thermal technology and have the potential to seriously disrupt the current economics of renewable energy in Australia by substantially reducing the capital and operating costs of solar thermal plant for electricity generation.

Reference: EHA Mildura Conference paper *The History and Future of High Efficiency Steam Engines* by Robert Mierisch, FIE Aust, M.Eng (Research), Mechanical Engineer.

The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *Punts, Pontoons and Ferries*
## *on the Murray-Darling River System in NSW.*

*by Rex Glencross-Grant*

### *Introduction*

This work[1] identified some 58 punts, ferries or pontoons at 47 sites comprising crossings for people, livestock and transport over waterways of the Murray-Darling River system in New South Wales between c.1844 and 1928. While most punts and ferries were intended as temporary crossings, until a bridge could be built, nevertheless their average service life was nearly 40 years.

### *Historical context*

After early inland exploration by Charles Sturt (1828-29 and 1829-30) and Major Thomas Mitchell (1836) into western NSW and Victoria, large tracts of country were effectively opened up for early selectors, which in turn resulted in "… a great stampede of people of substance to the area". Two early selectors were notably W.C. Wentworth and Ben Boyd, with both selecting large tracts of prime land in the lower Murrumbidgee and Murray areas. Wentworth took up land around Balranald and Boyd took up large holdings around Hay, on the Murrumbidgee River.

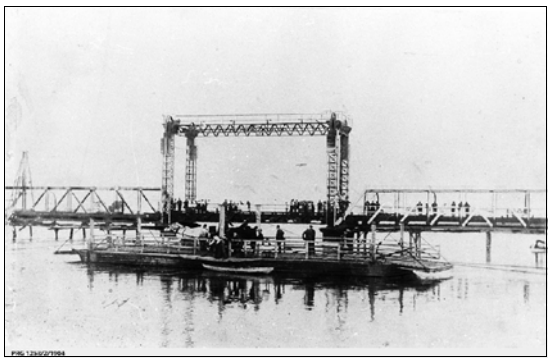


Figure 1: A punt operating across the Murray River at Swan Hill during construction of the lift-span bridge, c.1896.
Image: SLSA, PRG1258/2/1904.

### *Punts in the context of entrepreneurship and historical events*

The ill-fated Burke and Wills expedition to the Gulf of Carpentaria used punts to cross the Murray River at Swan Hill on 12-13 September 1860 (see Figure 1 above); the Wakool River at Kyalite on 13-14 September and the Murrumbidgee at Balranald several days later. For the Darling River crossing at Menindee, packs and saddles had to be removed from horses and all equipment ferried across the river in a bark canoe.

Figure 2 : The Tooleybuc punt over the Murray River and an inn in the background. Image: Caire photo in Painter, 1987.

Ned Kelly also reputedly had an association with punts during his bushranging spree in the late 1870s, but some are unconfirmed folklore. He did attempt to cross the Murray River at Bungowannah near Howlong in 1878, but high-water level and a sunken punt prevented his crossing. In terms of his travels to and from Jerilderie, he crossed by available private boats to avoid public crossings, which were at the time under intense scrutiny by police.

There was also a very strong connection between inns and punts. At numerous sites the licensee of an inn also held the licence of a nearby punt, or vice-versa (see Figure 2 at left). No doubt there was commercial synergy to such ventures to meet the needs of those waiting to cross at a punt. In some instances, floodwaters delayed punt crossings for many days, so no doubt licensees did well from the extended trade.

### *Punts & Ferries – starting dates for services*

Some of the earliest recorded starting dates for punts on the inland waterways of the Murray-Darling river system are on the Sydney-Port Phillip Road at Gundagai in c.1844 and Albury in 1848. In the far west, one came into service over the Darling River at Wentworth in 1853. (see Figure 3, right).

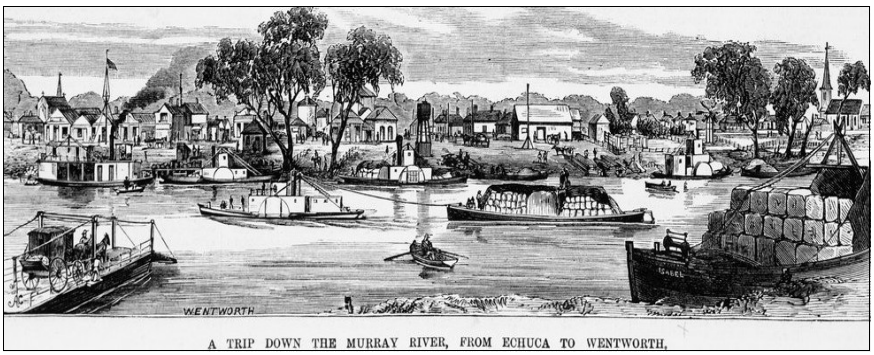



Figure 3: Wentworth punt (left hand side) ferrying a horse buggy across the Darling River.
Image: SLV - ID703123

Two sites are still operating on the Murray River in NSW, at extreme ends, one at Wymah (Figure 4, next page) in the Upper Murray and the other at Speewa, in the Lower Murray. These are operated for NSW Roads and Maritime Services free of charge to users.

1 The work referred to is the Reference: *Punts, Pontoons and Ferries: Temporary and Transient River Crossings of the Murray-Darling River System in New South Wales to 1925*. by Rex Glencross-Grant, Civil and Environmental Engineering, University of New England, Armidale, NSW.
The paper can be found on Informit – go to: https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# *Punts, Pontoons and Ferries*

## *Operation of Punts, Ferries and Pontoons carrying charges and load capacity*

Figure 4: Present day Wymah ferry over Hume Reservoir, upstream of Albury, with motorcyclist on board.
Photo - Glencross-Grant, Oct. 2017.

Punts in most cases were provided by the NSW Government (under the auspices of the Department of Public Works), but their operation was tendered out on a regular basis. It appears as though leaseholders had discretion as to carrying charges (prior to nationalisation), which no doubt varied depending on competition from other punts and volume of traffic. Rates charged in most cases made operation of punts a lucrative venture for those fortunate enough to run them. Charges varied from 2d to 1s per person; 6d to 2/6 for saddle horse; 2/- to £2 for dray, cart or team; and 3/- to £3 per 1000 sheep. One of the more expensive sites was over the Murray River at Albury, but that was soon replaced with a bridge.

Figure 5: Bullock wagons loaded with wool using punt over Murray River at Mulwala, with stand-by punt on RHS. Photo: Mulwala interpretative panel.

The size of punts and their carrying capacity varied depending on sites, and demand for, and type of, stock movement. It was reported that some punts were capable of carrying nearly 1000 sheep (e.g. Narrandera) or large horse teams and wagons (e.g. Mulwala, see Figure 5, left), but others had strict load limits, such as Carrathool with 5 tonnes or 10 head of cattle.

It was found that at several sites, operators were even more entrepreneurial and provided pontoon [bridge]s, which were small boats tied together (as at Brewarrina), punts that were inter-connected end to end (as at Hay) or especially constructed (as at Echuca, see Figure 6, below). The latter two afforded much more rapid transit of livestock, by simply being driven across, and were much more lucrative for operators in that stock could be moved so quickly and with minimum effort on the part of the operator. As an example, William Brown owned the New Ferry Hotel at North Wagga and provided a punt from 1850. The punt was capable of carrying 10 tonnes at rates of 3d/person, 1s/saddle horse, 5s/day for cart or gig, £2/16s per 1000 sheep.

## *Service and service life*

Common complaints made against punt operators (puntmen or ferrymen) were that they at times offered preferential treatment, were unreliable, ran irregularly, and were often drunk on duty. In some cases, ferrymen were even reported to be belligerent and off-handed with users of the 'service'. In one instance (Yelta-Curlwaa over Murray River near Wentworth), the service was often operated by the 12-year old daughter of the punt lessee. He also ran a nearby inn.

Of all the punts surveyed at the numerous sites, the average service life was about 40 years, and most, if not all of the punts, were replaced by either fixed-span or lift-span bridges, depending on navigability of the watercourse.

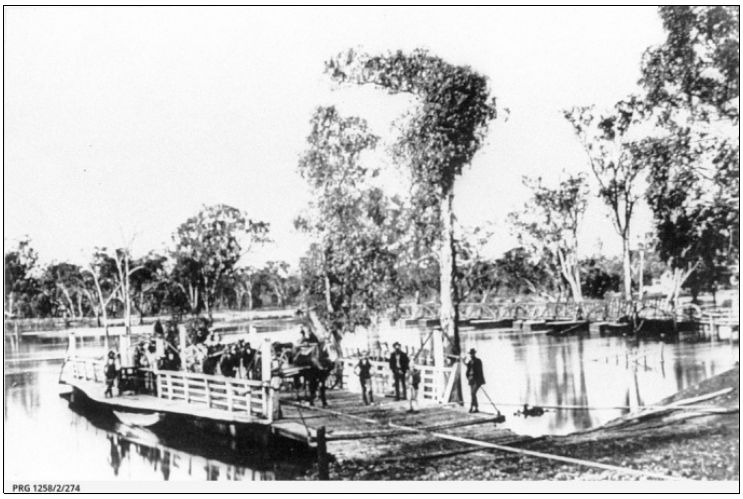



Figure 6: Hopwood's punt and pontoon bridge in background, c.1872.
Image: SLSA - PRG1258/2/274.

## *Conclusion*

The development of overland transport routes in inland NSW, how they related to particular river crossings and how streams were crossed by stockmen, their livestock and teamsters, their drays or bullock wagons, set the context for this article. Apart from the difficulties of taming a new land, one of the great barriers to the development of a new rural area was overcoming its initial physical and psychological isolation. The old punts across inland waterways, the hotels and staging posts, and the post and telegraph offices, were all links in a metaphorical chain of communications, which gradually broke down isolation.

While there was an active period of establishing punts and ferry crossings at many locations by government agencies of the day (c. 1844-1928), there also came a period of active replacement of such services with bridges (1872-1928), where justifiable. The rapid increase in the number of opening bridges (some 20) during the subject period attested to this active bridge building programme, but with commensurate reduction in numerous punt and ferry services.

# *Reducing Risks to Historical Buildings from Ground Vibrations*

*by Bill Jordan FIEAust CPEng*

## *Background*

Ground vibrations generated by construction equipment, mine blasting and other sources are frequently blamed for causing destructive damage to buildings, infrastructure and natural features. While this is sometimes the case, human perceptions of the effects, and the reactions to these perceptions, often do not accord with the facts as measured and analysed. Conservative measures taken to prevent damage often increase costs while providing no benefits for the building owners. Research carried out by the author over many years has resulted in a more rational approach to the problem.

## *The Risks and Their Reduction*

The risks range further than first appreciated, and all have to be considered. They include ground vibration, air blast, fly rock, lack of maintenance, termites and reactive clay soil movements. Existing damage, by reducing structural integrity, makes the buildings more susceptible to outside actions, including ground vibrations. By working to understand the risks and the means of their mitigation there are benefits to all involved.

Unrealistically low limits cost miners and constructors a lot of money and there is more temptation to have "accidents". High limits help increase cooperation, and frequency control for the ground wave is an important element in allowing the higher limits. Just understanding how the building reacts will, in itself, give the confidence needed by regulators to allow higher limits. In one of the first cases investigated by the author the consent conditions limit for a group of mid-19th century buildings was set at PPV (peak particle velocity) = 2 mm/s. Investigation and analysis raised this to 10 mm/s and the mine was saved about $1M per year. Subsequent work on the buildings concerned has led to a limit of 40 mm/s, with frequency control.

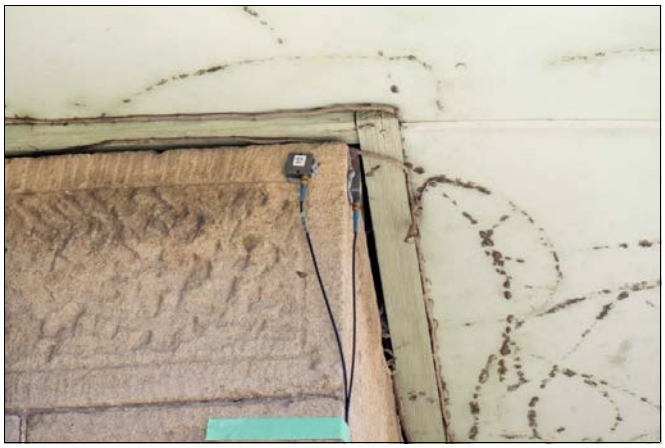


FIGURE 1 : Accelerometers mounted on the corner of a window to measure in-plane movements.

## *Ground Vibration*

Historically, and still in most places, ground vibration is regulated by PPV measured by triaxial geophone. It is resultant of the 3 axes and is typically 5 mm/s or 10 mm/s. What damages a building is strain (or displacement). But $s = v/(2\eth f)$ where

s =displacement, v =velocity & f = frequency,

i.e. the higher the frequency the lower the displacement/strain at a particular PPV. Importantly, resonant behaviour is a major factor, but is still often neglected.

There are many different standards throughout the world which have some relationship but many differences. The Australian explosives standard, AS 2187.2—2006, reproduces UK and USA standards as a suggestion. There is presently no guideline in the Australian standard for historical buildings as is found in some overseas documents.

## *Building Reactions*

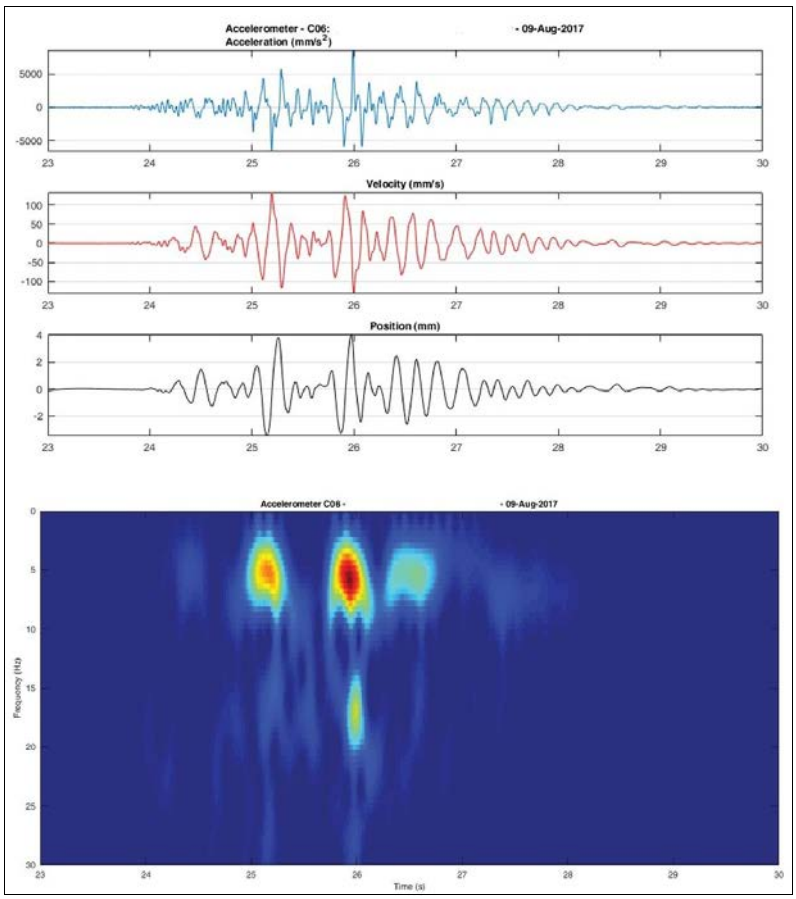
In the absence of specific guidelines for historical buildings, the criteria set out in the *Structural Design Actions* code AS1170.0, for serviceability limit states, deflection criteria have been used – but halved to reflect the more sensitive and fragile historical structures encountered in much of the work.

## *Vibration Measurement*

At all sites where controls are present, ground vibration monitoring using a triaxial geophone is carried out as part of the operation and to fulfil consent conditions. The buildings themselves are temporarily fitted with sensitive, lightweight accelerometers which are linked to seismic recorders, the setup being sensitive enough to record the actions of quite light wind on the buildings. Both the geophone and the seismic recorders are fitted with GPS receivers which allow times to be compared to a high accuracy.

Equipment setups are seen in figures 1 and 2.

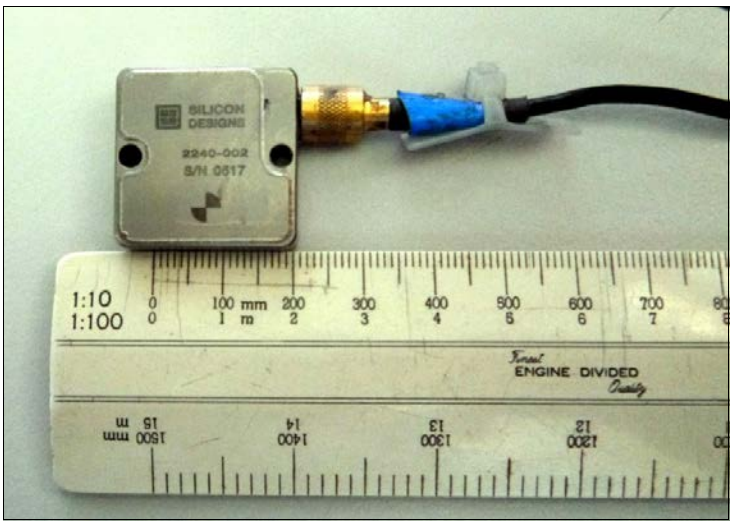
FIGURE 2 : Field setup of a seismic recorder (Networked to a second one).




The ground and building vibrations are analysed to produce waveforms of acceleration, velocity and displacement together with spectrograms showing the frequencies plotted against time. The spectrogram approach has been particularly important as the frequencies generated by a blast sequence, or even the starting and stopping of a vibrating compactor, can change over the course of the event. Typical plots are shown in figure 3 at left.

FIGURE 3 (left) : Waveforms and spectrogram for a typical blast of short duration (7 seconds) recorded at the top of a chimney. Most of the energy is a direct reflection of the groundwave at about 5 Hz ; some slight resonance in the building occurs at about 17 Hz, but not enough to be of concern.

FIGURE 4 (below) : The 10g accelerometers do not affect the vibrational characteristics of most fabric to which they can be easily attached without damage.




## *Conclusions*

Work over the past 10 years has led to the development of some powerful tools to monitor the reactions of buildings when subject to ground vibration from mining and other sources and has shown the potential to save large costs in construction and mining, making the operators more sympathetic to conservation needs.

FIGURE 5 (below) : Mounting accelerometers on this 6m high rock formation, isolated in the middle of a mine site, was quite a challenge!

Reference:
EHA Mildura Conference paper *Reducing Risks to Historical Buildings From Ground Vibrations* by Bill Jordan of Bill Jordan & Associates, Newcastle NSW.
The paper can be found on Informit – go to:
https://search.informit.com.au/search;action=doSearch
and copy the paper title into the search box.

## *October 2017 EHA Mildura Conference – List of All Papers Presented.*

ASPDEN, Rob – Mr Hay – Please Report

BAKER, Keith – From Aesthetics to Function, History to Rarity: the Significance of Windmills.

BALLINGER, Dr Robyn – The Nature and Culture of Water in Victoria's North

BEAUCHAMP, David – From Finest Reinforced Concrete Construction to Historic Ruin in 100 Years – The Barwon Ovoid Sewer Aqueduct

BUSH, Fiona & Mark – Cape Leeuwin Lighthouse – A Guiding Light in the West for East Coast Shipping

EVANS, Peter S. – Water Turbines of the Woods Point Goldfield 1866-1867

GLENCROSS-GRANT, Rex & BERGER, Ian – The Role of Opening Bridges for River Traffic on the Murray-Darling River System in New South Wales, 1878-1925

GLENCROSS-GRANT, Rex – Punts, Pontoons and Ferries: Temporary and Transient River Crossings of the Murray-Darling River System in New South Wales to 1925

HALLOWS, Peter J. – The History of Irrigation in South-Eastern Australia

HARTWELL, David J. – Chowilla Dam, A Case Study of How We Studied Groundwater Problems Before Computers.

HOPE, Jeanette – Locking the Murray: the Heritage of Engineering Process

JORDAN, Bill & CAMPBELL, David – William Clark, the Forgotten Hero of Colonial Hydraulic Engineering

JORDAN, Bill – Reducing Risks to Historical Buildings From Ground Vibrations

KUTAY, Cat & LAWRENCE, Christopher – Enduring Engineering for Our Water Resources

LINDSAY, Merv – Sarrans Hydro Electric Dam, France – is Heritage Destroyed Or Locked in A Time Capsule?

McINNES, Ken G. – Engineer David John McClelland (1873-1962) and the Reinforced Concrete Campaspe River Syphon.

McINNES, Ken G. – Benjamin Hawkins Dods (1829-1892) and the Audacious *Grand Victorian North-western Canal, Irrigation, Traffic, and Motive Power Company* Scheme of 1871

MIERISCH, Robert – The History and Future of High Efficiency Steam Engines

NOICOS, Leo & RAVENSCROFT, Alistair – Morgan Wharf – Improving Public Access and Amenity to the Structure that established South Australia's role in trade along the Murray River

PEAKE, Owen – Black Cats – Catalina Flying Boats in Australian Service

PEAKE, Owen – Pigs Do Fly – the F-111 in Australian Service

PEAKE, Owen & VENUS, Richard – Chaffey Brothers Irrigation Works in Australia

PIERCE, Miles – Cable Trams in Melbourne – A Major Nineteenth Century Engineering Achievement

SPRATT, Peter – the Conservation of Australia's Oldest Masonry Bridges

SYNAN, Peter – Public Water Supply, Sale, Victoria – An Historian's Perspective

VENUS, Richard – Powering the Mantle of Safety

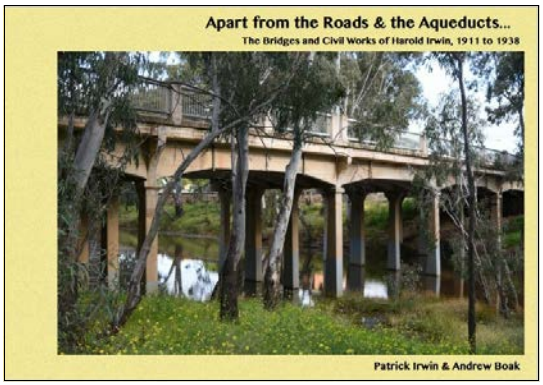
VINES, Gary – Mills of the Plenty

All these papers can be found on Informat – go to:
https://search.informit.com.au/search;action=doSearch and copy the paper title into the search box.

# Connections

## *Apart from the Roads & the Aqueducts*

### *The Bridges & Civil Works of Harold Irwin, 1911 to 1938*

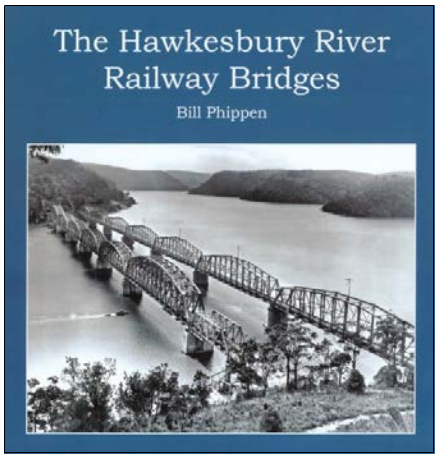



Some readers may remember reading, in the July 2017 EHA Magazine, the story *Ghosts of Bridges Past – the civil works of Harold Beresford Irwin, 1882-1962*. Only room there for a brief taste of Harold Irwin's engineering career, but it was a great story, with a wealth of vintage images from his construction sites. The author, Harold's grandson Patrick Irwin, with co-author and researcher Andrew Boak, have now presented us with the book about Harold they promised us would be coming. Patrick introduces it with:

*The book tells the story of the bridge and water supply projects constructed by contractor [and engineer] Harold Irwin before the Second World War. A 150 page work, rich with historic photographs and period documentation including drawings. Twenty nine projects are covered in total. Notable bridges include Mordialloc, Carisbrook and Charlton. This is a high quality publication priced at just $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.

## *The Hawkesbury River Railway Bridges*




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 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 to the Queensland border, change trains and be in Brisbane a couple of hours later – but the Sydney link was still incomplete. The besetting problem was the wide and immensely deep drowned valley of the Hawkesbury River, requiring a bridge of a size which had hardly been envisaged before. But it had to be done. Work began on the first Hawkesbury Bridge (at right in the photo) 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. This large, handsome, 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://www.railwaybookshop.com.au//default.asp

## *The National Trust of Australia (Victoria) Advocacy Toolkit.*

The National Trust Advocacy Toolkit has recently been launched. It is a free online resource to assist individuals and communities to advocate for the protection of heritage places across Victoria. The Advocacy Toolkit will continue to grow and evolve, along with the challenges we face in the recognition and conservation of our heritage places. The Toolkit contains 5 Advocacy Guides which aim to provide clear guidance to non-experts about how to nominate a place to the state heritage register, how to object to planning permits for inappropriate development affecting heritage places, and how to participate in Planning Scheme Amendments. While the Toolkit is specific to the state of Victoria, it is based on general principles which can be applied across other jurisdictions. It is available online at https://www.nationaltrust.org.au/advocacy-toolkit/

## *RMS Timber Bridge Manual*

In 2008 the NSW Roads and Maritime Services Department produced an online Timber Bridge Manual. I've been rather late in catching up with this one. I used a NSW DMR Timber Truss Bridge Maintenance Handbook, a paper version, for many years. It was invaluable in my heritage work. This much younger work dispenses with much of the historical material, but could still be useful to heritage officers trying to assess timber bridges – a rapidly vanishing species! The free Manual comes in eight sections (as 8 separate PDF files): Timber Bridges - General; Timber Substructures; Timber Truss Bridges; Timber Girders, Decking & Sheeting; Stress Laminated Timber Systems; Timber Concrete Overlay Bridges; Timber Concrete Composite Bridges; Preservative & Protective Treatments. See: http://www.rms.nsw.gov.au/business-industry/partners-suppliers/document-types/guides-manuals/timber-bridge-manual.html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