

Gone but not forgotten

Hydraulic Power in Sydney 1890 – 1975, Part 1

J.W. Gibson MA, BSc, CPEng.

The predominant sources of energy in Sydney by the 1870s for industry were coal, and gas. Coal had been a source of energy since the early days of the colony, mainly as a source of heat and later to raise steam in industrial boilers. Gas was introduced in 1841 by the Australian Gas Light Co (AGL) primarily as a source of light for streetlamps and homes.

While the application of steam to produce mechanical power (linear and rotative) was reaching its peak in the middle of the nineteenth century, the development of gas powered engines was still on the horizon. Petroleum was relatively unknown, and whilst experiments with electricity were producing new applications, industrial power from electricity was still far in the future.

The continued application of steam posed two significant problems to the industrialists (i) it could not be readily reticulated over large distances and (ii) it was polluting the town “...*The thickening smoke which hung in the humidity of Sydney’s long summers signalled the death of the old ... More and more chimneys would climb skyward in the next decade ... colonising it so completely that in photos of Sydney from that time the most striking feature is the amazing number of smoke stacks befouling the air.*” (Birmingham, 2000, 197)

What was needed was a new, readily reticulated, reliable power source from a centralised supply. As pointed out above gas could be reticulated but the engines for it to power did not exist. Steam could be reticulated but only to a limited extent as in hospitals and within factories, as with mechanical rotating power.

The solutions available at the time were centralised power stations producing compressed air (pneumatics), or water power (hydraulics) with either power source being reticulated throughout the streets of the town. Each could be easily controlled and used in machines to produce linear or rotative mechanical power. Either of these solutions would see a significant reduction in the number of small steam boilers and hence a reduction in pollution, and a theoretical rise in overall efficiency.

Even though the prominent Australian engineer, Mr. Norman Selfe, prepared a strong case in support for compressed air in 1886, claiming it would be 1/10 the price of hydraulic power, the NSW government supported the establishment of a public hydraulic power system as they had previously set up a hydraulic plant for the Bullock Is. dock cranes at Newcastle (NSW) in 1877.

Experiments using hydraulics to power machinery had been carried out as early as 1802 in the United Kingdom. By the mid 1800s it was possible to supply water at pressures of 700 psi (4.8 MPa) upward over distances of up to 15 miles (24 km). The first public hydraulic power system commenced operation in Hull in 1876 and this was followed by London in 1884.

It is interesting to note that by 1878, only 2 years after the commencement of the Hull system, Edward Moriarty had produced a hydraulic system for the Newcastle dockyard (Bullock

Island) in Australia. “*On 19 March 1878, the first shipment of coal loaded by hydraulic crane left aboard the ship Downiemount*“ (Bairstow, 1986). Subsequent systems included London (1884), Newcastle UK (1878), Liverpool UK (1885), Boston USA (1894), Wellington (NZ) and in Australia commenced in Newcastle NSW (1877), Melbourne in 1889 and Sydney in 1891.

Extant remains of Hydraulic Power in Sydney.

A recent research project has uncovered a range of extant remains of hydraulic power in Sydney. In fact, parts of 9 independent systems have been located.

These remains are from the following;

- Naval Stores on Garden Island (1893)
- Royal Edward Victualling Stores, now Channel 7, Pyrmont
- Argyle Stores in The Rocks (1878)
- Walsh Bay System
- Railway Workshops, Eveleigh (1886)
- Railway Workshops, Chullora
- Dockyard, Cockatoo Island. (1915-1918)
- Birt's Wharf, Pyrmont.
- Sydney and Suburban Hydraulic Power Company (SHPC) (1891).
- Sydney and Suburban Hydraulic Power Company - Consumers

Naval Stores, Garden Island.

The most significant remains by far is the hydraulic system in what was the Naval Victualling Stores building at Garden Island – building 89. The original equipment was supplied and installed by Mort’s Dock & Engineering Co in 1893. Before it was shut down water pressure was raised by a three stage reciprocating pump driven by electric motor through a worm and wheel drive. Working pressure was approximately 1200 psi (8.3MPa) and this pressure was maintained by an accumulator with a 17.5” (445 mm) diameter cylinder and 16’ (4.88 m) stroke. Pressure was supplied to 5 whip cylinders on the inside of the building connected by cables to the jibs on the northern face of the building.

Most of the equipment is still in-situ, and due to the work of Industrial Archaeologist, Don Godden much of it has been well conserved. With some relaxation of public access to the north end of Garden Island it may be possible to see the whip jibs on the north face of building 89 from near the new Naval Heritage Centre.



Naval Stores Building , Garden Island

This equipment played a major role in Naval Storage between 1894 and its closure in the 1970s.



3 Cylinder HP Pump, Garden Is.

Royal Edward Victualling Stores, now Channel 7, Pyrmont

An accumulator from a small hydraulic system is located outside building A, and just inside the main entry gates to 38 Pirrama Rd, Pyrmont. The weights for the accumulator are cast iron blocks about 1 m sq x about 50 mm thick. There are 10 of them. There is some pipework, and remains of a safety valve. There are no identifying marks on the exposed equipment, and there is no other evidence of an high pressure system within the building. There is, however, evidence of a small electrically driven lift – 1 of 4 installed around 1906 – complete with motors and controllers.

Argyle Stores, Argyle Pl, The Rocks

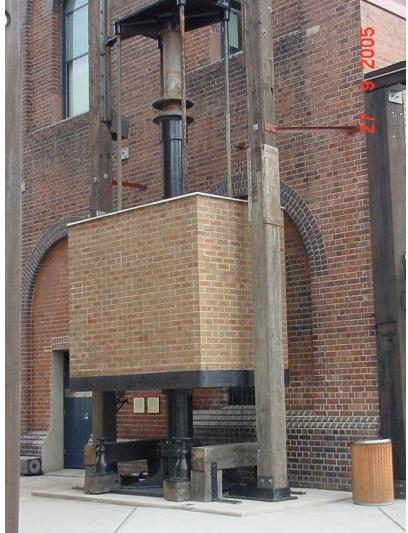
The whip that remains in the courtyard of the Argyle Stores building was part of a small private system that supplied power for lifts and a whip. The whip was made by Tannett Walker (Leeds) in 1885 and was installed by Mr. Isaac Ellis Ives following the rebuilding of the south wing c.1878. Isaac was Mayor of Sydney between 1897 and 1898.

The system comprised a small gas engine driving a 3 cylinder pump. Pressure was controlled by an accumulator and fed to the whip on the wall of the south wing, and at least one, possibly two, other lifts inside the north wing. The whip is all that remains of the system and it has recently had significant conservation work carried out by the author for its owner, Sydney Harbour Foreshore Authority.

Walsh Bay, Darling Harbour

Another independent hydraulic plant served the wharves of Walsh Bay, off Hickson Rd. The system supplied hydraulic power to lifts, wool presses, and possibly to wharf conveyors. The conveyors that remain on the redeveloped wharf were electrically driven by the end of their life.

A twin cylinder double acting reciprocating pump driven by a 65HP (48.5 kW) electric motor is still in-situ as a feature in the Ventuno cafe on ground level in the Central Wharf Stevedoring building (wharf 8/9). The accumulator is outside this same building but is not in its original position as an early photograph shows the accumulator closer to the water on wharf 7/8. A hydraulic wool bale lift with its adjustable loading table has been relocated to this building as well. The remains of an in-situ hydraulic goods lift is at the western end of the same building.

 A photograph of a reconstructed brick hydraulic accumulator. It is a large, rectangular brick structure with a metal frame and pipes attached. The date '2005' is written vertically in red on the side of the brickwork.	 A photograph of the original site of the accumulator, showing a tall metal frame structure with various mechanical components and pipes. It is located in an industrial area with other buildings in the background.
Reconstructed Accumulator, Walsh Bay	Accumulator, original site, Walsh Bay Photo: MJ Doring

Two HP pumps, the remains of two accumulators, the Davy Press and Intensifier, and numerous supply pipes remain located within the NSWGR workshops, now Australian Technology Park, at Eveleigh. Whilst the Davy press and its intensifier are in public space, the two pumps are in a pump-house near to the set of steam boilers on the south side of the workshop buildings. One is a twin cylinder steam driven Fielding and Platt engine/pump in excellent condition. The other is an electrically driven 3 cylinder Hathorn pump. A pressure gauge on the wall suggests a red-line hydraulic pressure of 2500 psi (17.2 MPa).



Fielding & Platt Pump, Eveleigh

There are also a number of hydraulically powered machines (strikers, presses, spring formers) conserved within the building.



Hydraulic Powered Allen Striker, Eveleigh

Railway Workshops, Chullora

The pneumatic and hydraulic powerhouse for the railway workshops at Chullora still stands. The building is red brick with a galvanised steel gable roof and a galvanised steel wall on the

southern side. There is an hydraulic accumulator on the western side of the building and a water tank and 4 compressed air storage cylinders on the eastern side. The building is located at S $33^{\circ} 53.104'$, E $151^{\circ} 3.670'$. Inside the building there are three air compressors, each electrically driven. Also, there are three electrically driven HP hydraulic pumps labelled 1, 3 and 4. Pump 1 is a two cylinder horizontal Worthington pump (2.75" (698 mm) bore and 7.5" (190 mm) stroke driven by a 50HP AGE motor. Pump No. 3 is a 3 cylinder vertical pump made by Henry Berry of Leeds. Pump 4 is a 3 cylinder vertical Henry Berry pump of 2.25" (57 mm) bore and 5" (127 mm) stroke.



Pumphouse, Railway workshops, Chullora



3 cylinder, Henry Berry Pump, Chullora

Cockatoo Island Dockyard.

The hydraulic system on Cockatoo Island operated at 1500 psi (10.3 MPa) and this was reticulated throughout the island to power presses and other machinery rather than whips and lifts. Hydraulic pressure was supplied from two 3 cylinder Ruwolt Pumps driven by 170 BHP (127 kW) electric motors. Pump bores were 4" (102 mm), with a stroke of 8" (203 mm). The only remains of the system on Cockatoo Island are two HP Pumps and electrical controllers located in the powerhouse which is not public space.

Birt's Wharf, Pyrmont

The only remnant of hydraulic power from Birt's wharf that has been located is an engineering drawing by Mr. E. G. Stone of the Sydney Harbour Trust dated 29 August 1903. The drawing shows the location of the 50HP (37 kW) electric motor, the accumulator, two intensifiers, a single and a double wool press.

Gone but not forgotten

Hydraulic Power in Sydney 1890 – 1975, Part 2

J.W. Gibson MA, BSc, CPEng.

The Sydney and Suburban Hydraulic Power Co. (SHPC)

The NSW government passed an Act of Parliament in 1888 authorising the establishment of an hydraulic power company to serve the central business district. The company was headed up by substantially the same group who started the Melbourne Hydraulic Power Co. some twelve months earlier. It commenced supply of power in January 1891 with Mr. George Swinburne as company engineer. By 1894 about 200 machines were connected to the system. Gradually the system expanded to cover roughly the area bounded by Pyrmont, Woolloomooloo and Broadway. The system supplied power for dock cranes, whips, wool presses, strong room doors, passenger and goods lifts.

The company supply dam was located between *Mt. Rennie and Waterloo* an area on the north west corner of South Dowling St. and O'Dea Ave. A steam powered Worthington pump pumped water along 2.5 mile (4 km) of cast iron main to the Company pump-house at Pier St. This building still survives today, with its water receiving tank on its roof, and hydraulic accumulators inside.



SHPCo Pier St. Pumphouse

The engine house contained three steam powered Armstrong patent high pressure pumps with two capable of supplying 475 gal/m (2160 l/m) at 750 psi (5.2 MPa) when running at 50 rpm. The other was capable of supplying 200 gal/m (900 l/m) at the same pressure and 60 rpm. The pumps were manufactured by Abbott & Co., Gateshead-on-Tyne, UK. The pump output was fed to two accumulators, each with rams of 20" (508 mm) diameter and a stroke of 22 feet (6.7 m). The output was fed through 6" (150 mm) mains, and 3" (75 mm) and 4" (100 mm)

sub-mains to consumers throughout the city. Control valves enabled sections of the mains to be closed down for repair/maintenance, as did valves at the entry to customer's premises.

 A rectangular metal cover with a grid pattern and the letters 'HPCo' embossed in it. A small rectangular valve is attached to the center of the cover.	 A circular metal cover with the letters 'HPCo' embossed in it. A circular valve is attached to the side of the cover.
Cover and valve – type 6	Cover and valve – type 2

About 150 of the covers to these valves (with the valves underneath) are still visible in the city streets. They are readily identifiable in several different types and have an identity code (HPCo, or SHPC) cast into the cover. The best streets to look for extant remains are Kent, Clarence and Sussex Sts. Two examples of the 7 different types are shown below with the cover removed to show the valve spindle below;

Water was sold to consumers after metering their output.

With many less boilers and chimneys polluting the city, even the SHPC came in for criticism: *“On the summons side of the Central Police Court this morning, Frederick Hartley, engineer in charge of the furnaces of the Sydney Hydraulic Power Company, Pier Street, city, was fined £5, with 6s costs, or one month, for the breach of the City Council's smoke nuisance regulations* (The Evening News, Sydney, NSW : Friday 20 March 1908 p 4).

In 1920 the pumping station at Pier St was electrified with three centrifugal pumps each capable of 10 000 gal/hr (45 kL/hr) at 750 psi (5.2 MPa). Only the Pier St building, two accumulators and the rooftop water supply tank remain of this part of the system.

Competition from gas, and later diesel engines and electrical installations, together with the high cost of replacement and maintenance led to the final closure of the system in three stages between 1974 and 1975. Since then, many valve covers, and most of the consumer appliances have been removed as a part of the city redevelopment phases over the years.

Consumers of the Sydney and Suburban Hydraulic Power Co.

It is not known how many consumers were connected to the SHPC system at its peak, however, it was reported that by 1894 there were 149 lifts, 22 whips, 7 wool presses, 20 dock cranes and 2 motors connected – and this was just 3 years after commencing supply! The NSW Dept. of Labour and Industry reported that in 1903 it had registered 522 hydraulic lifts, and only 3 electric lifts, by 1919 this had risen to 2369 lifts and whips in the metropolitan area, most of which were operated hydraulically. It is also reported that SHPC had laid some 50 mile (80 km) of supply pipe throughout Sydney CBD at its closure.

Records suggest that the peak period for hydraulic power, under threat from diesel and electrical power, was in the mid 1930s and that the profit and loss break even point was reached in 1965. By 1968 there were no more than 150 customers on the system which ceased operation in 1975.

In 1957 the 150' (45.7 m) height limit on buildings was removed and many ‘tall’ buildings were demolished to make way for taller buildings. Improved design for electrically operated lifts, and the requirements of safety laws for lift systems meant that, for practical purposes, all hydraulic lifts have been replaced.

When the SHPC system closed, many businesses retained hydraulic equipment by replacing the reticulated water with a small electrically driven oil hydraulic plant known as the Hydraglide. It should be noted that some of the large bronze doors of the Commonwealth Banks in Pitt St and Martin Pl, and Westpac in George St are still hydraulically operated from systems such as this.



Commonwealth Bank, Martin Pl.

Failures in the SHPC system were actually quite rare when one considers the size of the system and the number of consumers connected to it.

“... The failure of the system which resulted in the 20' high, 6” thick door at the Commonwealth Trading Bank, Martin Place, opening in the middle of the night was a rarity in a city wide service that lasted from 1891 to 1975.” (State Bank, 1988).

“... I was once nearly killed as the cylinder burst and the door fell.” (Ivan Turner, 2006 pers.. comm.).

Whilst there are remains of goods lifts, wool lifts and bank bullion lifts in the city, there is very little evidence of passenger lifts from the hydraulic age. There are some lift shaft cages such as in 2 Martin Place, and the Strand Arcade. However, Mark Foys Building, now the Downing Centre in Liverpool St. had several banks of lifts for the public, and these, like others in the city, have been modernised and electrified. But in one lift shaft on level 1, now used as a service duct, there remains a set of lift doors from the hydraulic period proudly exhibiting the Mark Foys logo.



Lift Doors, Downing Centre

Lend Lease (AGL Building, Gas Lane)

Another customer of the SHPCo. was a passenger lift in the Lend Lease owned AGL building at the western end of Gas Lane. This building has the remains of a passenger lift servicing four floors. The lift shaft has been covered at each floor level, but the timber slatted surround for the hydraulics and the ram remain. The lift car is still in place at the Hickson Rd level. This is the only hydraulic ram located in Sydney that has its manufacturer's name cast into the cylinder – “Sydney Hydraulic Power Co Ltd”.



Lend Lease, Gas Lane

The State Theatre, Market St.

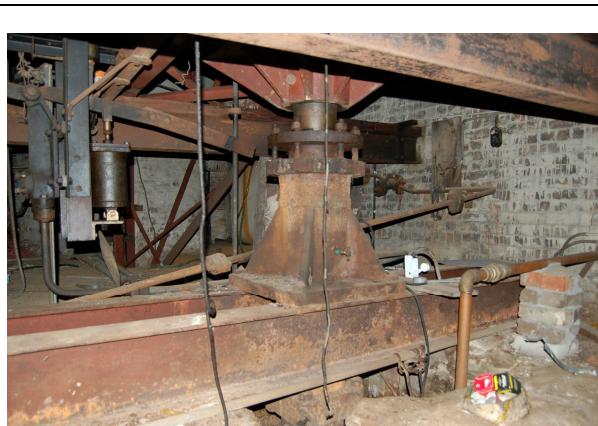
One jewel discovered during this research project was the mechanisms for the Organ lift and orchestra platform within the State Theatre. Both were operated from the SHPC mains. The organ lift ram is 3 ½" diameter (89 mm) with a lift approximately 14' (4.3 m). The orchestra platform is 12' x 30' (3.6 m x 9.1 m) with a curved front decorated with a beautiful pressed metal panel.



State Theatre Orchestra Platform

The steel support frame under the orchestra platform, and the frame to support the cylinder were made of Dorman Long Steel , as supplied to the Sydney Harbour Bridge.

The cast iron cylinder is some 13 ½" diameter (343 mm dia) with a stroke of about 12' (3.6 m). The cylinder is located in a small shaft cut into the sandstone below the basement.



Orchestra Platform Ram



Orchestra Platform Cylinder Pit

Campbell's Stores, The Rocks

The remnants of two hydraulic whips can be seen on the face of the Campbell's Stores buildings on the western side of Circular Quay. These were originally connected to the SHPC mains when they were operational.

Remains of Other SHPC Customers

There are some remains of hydraulic whips and lifts in public space in the atrium of No. 1 Kent St (not in-situ), the foyer of the Sydney Theatre Co., behind 397 George St, and outside Moore's Wharf in Towns Pl. (not in situ, as the building has been moved from its original location). In semi-public space in the Windmill St level of Publicis Mojo Advertising there are the remains of a passenger/goods lift, a wool bale drop, and a wool bale lift.

Another significant set of remains are the intensifiers and wool presses located in the Dalgety Apartment building in Jones St, Ultimo – originally Dalgety's Wool Stores. These were fed from the SHPC main, and are still in their original location. The rams were manufactured by The Austral Otis Engineering Co. (Melbourne), and the steelwork was from Dorman Long and Co.



Intensifier (front) and Wool press, Dalgety's, Ultimo

Heritage Protection of Hydraulic Remains

Many remnants of hydraulic power in Sydney are recognised for their value, and well protected due to their location in recognised heritage space or within classified buildings such as Garden Island, Walsh Bay, No. 1 Kent St, the Commonwealth Banks in Martin Pl and Pitt Sts, the Argyle Stores and Campbell's stores in the Rocks, etc.



Remnants of bullion lift, George St.

However, some remnants have been located in buildings that are significant buildings, where there is current, or likely, refurbishment to be undertaken. In fact one bullion lift was located behind a recent partition wall in one of the old bank buildings in George St. This had only been discovered by building management some weeks before this research project started. As the era of hydraulic power has been mostly forgotten it is essential that remains such as this are identified and recorded by heritage professionals so that they are not inadvertently destroyed in refurbishment projects.

The big question – is that all there is?

Because hydraulic mechanisms are most likely located in the basements of building, and because they are no longer operative, there could well be some excellent examples of cylinders, whips, control mechanisms, stop valves and electro-mechanical control components still extant.

Selected Bibliography

Bairstow D. (1986) Hydraulic power and coal loading in Newcastle Harbour. *Australian Journal of Historical Archaeology*, 4:57-66.

Balint, E., Howells, T. and Smyth, V (n.d.) *Warehouses and Woolstores of Victorian Sydney*. Oxford University Press: Melbourne. Pp 120 - 134.

Barker R. M. (1989) *Vertical Transport in Sydney c.1880-1915 – The Era of Dominance of Hydraulic Lifts in the Central Business District*. Thesis submitted in Partial Fulfilment of the Requirements for an MA (Pass) in History. University of Sydney.

Barry, R. (1975) The end of an Era. *The Link*, Lend Lease Newsletter No. 85, July- August 1975.

Birmingham, J. (2000) *Leviathan, the unauthorised biography of Sydney*. Random House: Sydney. P197.

Cowan, H.J. (1997) *Hydraulic power as a public service from 1891 to 1975*. Reprint from the Transactions of the Institution of Engineers, Australia, Mechanical Engineering Transactions Vol. ME22, Nos. 3 & 4, pp107-116.

Dickinson T. (1893-4) *Notes on Hydraulic Power Supply in Sydney*. Minutes of Proceedings of the Engineers Association of NSW, IX:38-58.

Doring, M J (2016) Carrington Pumping Station in Newcastle. Engineering Heritage Australia, V2 No. 2, pp15-20.

Doring C & M J, 1988, *Heritage Study of the Newport Workshops*, for Victorian Railways (V Line).

Focom Communication (1993) *Investigation into available SHPC mains Whitlam square to Royal Botanic gardens*. Focom: Sydney.

Gibson, A.H. (1952) *Hydraulics and its Applications*.

Godden , D et al (1979) *Heritage Significance of the Sydney and Suburban Hydraulic Power Company Building Pier Street, Sydney. Preliminary Draft*. Godden and Associates for Centrepac Ltd., Sydney.

Holland, R.(1999) *Conservation Plan, State Theatre Wurlitzer Organ*. Scimus Consultants: Sydney.

HPE&HL (1923) *Job specifications*. Hydraulic Power Co.: Sydney. Pp10-250.

Jeremy, J (1998) *Cockatoo Island*. UNSW Press: Sydney

Longworth, J. (2008) *Boilers, beauforts and bogies*. ARHS: Sydney.

Martin, E.J. (c1970) *Listing proposal for Hydraulic Whips on Garden Island*. Institution of Engineers Engineering Heritage Committee: Sydney.

Pierce, M. (2008) The Melbourne Hydraulic Power Company and public hydraulic power systems in Australia. *Australian Journal of Mechanical Engineering, Online*. February 2008.

Pugh, B. (1980) *The Hydraulic Age*. Mechanical Engineering Publications: London. Chapters 3 and 4.

Pugh, B (1974) Copy of letter to D. Smith of Hydraulic Power P/L, Sydney re his proposed book.

Mead, D. (1987) *Archaeological investigation of the Pier St. Hydraulic Pumping Station*, Sydney. Don Godden & Assoc.: Sydney.

National Trust (NSW) web site – <http://www.nsw.nationaltrust.org.au/sydneylifts.htm> opened on 4 February 2007. *Sydney's Historic Lifts and Escalators*.

National Trust (NSW) (1979) *Listing proposal: Hydraulic pumping station, Pier St. Sydney*. National Trust: Sydney.

NSW Government (1888) *An Act to facilitate the supply of motive power on the high pressure hydraulic system*. NSW Government: Sydney.

O'Brien, F. (1993) *Sydney Hydraulic Power Co. Investigation into available mains Whitlam Sq. to Royal Botanic Gardens*. Study report prepared for the Water Board.

Reflections, The National Trust Quarterly. Restoration of the Argyle Stores Whip, August-October 2006, p 17.

Selfe, N. (1888) Hydraulic Lift Machinery. *The Building and Engineering Journal*. October 27, 1888.

Selfe, N. (1893) Hoisting and Lifting Machinery. *The Building and Engineering Journal*. March 25, 1893.

Selfe N. (1893-4) *Rise and Progress in Lift Construction in New South Wales*. Minutes of Proceedings of the Engineering Association of NSW, IX.

Smith, D (1975) Copy of letter to B. Pugh re Hydraulic Power P/L in Sydney in response to his letter of 3 Nov. 1974.

White, R and Clarke, C (n.d.) *Cheques & Balances; memoirs of a banker*. Viking. (p90).

..... (1891) Sydney and Suburban Hydraulic Power Company's Works. *The Building and Engineering Journal*. September 1891. pp147 – 150.

..... (1968) *The Link*, Lend Lease Newsletter, September-October, p5

..... (1989), quoted in Highlights from our History, 1889-1989. *The Building and Engineering Journal*, 25 July 1891. EPL-Kone Elevators: Sydney, pl.

..... (1989) Taking people to the top for 100 yrs. *Upfront*. Special commemorative issue to celebrate the Centenary. EPL-KONE: Sydney.

..... (1908) The Evening News, Sydney, NSW : Friday 20 March 1908 p 4.

..... (1992) Hydraulic Elevator Modernisation by EPL-Kone. *Elevator World*. April 1992. p23.

..... (2006) *Restoration of the Argyle Stores 'Whip'*. Reflections, The National Trust Quarterly. October 2006.

© J. W. Gibson
Heritech Consulting
PO Box 553
Balgowlah 2093
M: 0412 036 055
August 2010