

9.04 Water Supply & Plumbing

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a. wells & bores

Prior to European settlement there was a long Aboriginal history of conserving, developing and protecting natural sources of water. Waterholes and hollows were covered over, and sometimes deepened; new holes were laboriously sunk into rock, and relatively deep wells into soil or sand.¹ None of this had any particular influence on European settlement except in those cases where Aborigines told settlers, or their works suggested, promising locations to sink wells. On the Canning stock route waterholes were first established on the sites of Aboriginal soaks, and only later were bores sunk at more uniform intervals.²

European explorers and settlers often sank holes in the upper parts of sandy beaches and placed perforated casks in them to collect water, while in Sydney more substantial underground storages along the watercourse gave the name to the Tank Stream. Natural springs and wells were used by a minority of European settlers. By 1838 Joseph Pedlar was making his living sinking wells in South Australia,³ and in 1839 Sarah Brunskill of Adelaide recorded having one sunk a depth of six metres for £6, including 'sinking and stoning [steining]'.⁴ Sydney was exceptional in the extent to which natural wells continued in use through the early nineteenth century. In Melbourne, by contrast, most references to wells really mean underground cisterns or storage tanks. Deep sunk wells with rectangular timbered shafts became increasingly

¹ Hughes Trueman Ludlow, *Wells and Underground Tanks* [Heritage Council Research Study No 6] (?Sydney 1984), pp 8-9, ref W Charnley, 'Water in the Desert', *Walkabout*, XX, (1954), pp 29-30; G M Cunningham, 'Aboriginal Waterholes in the Cobar Area', *Australian Natural History*, XVII (1933), pp 365-96; D Goodhart, 'Desert Water Supplies', *Walkabout*, V (1939), pp 330-5; A T Margery, 'Aborigines' Water Quest in Arid Australia', in *Report of the meeting of the Australian and New Zealand Association for the Advancement of Science* (Brisbane 1895), pp 647-658; C Winnecke, 'Physical Features of Central Australia', in *Proceedings of the Geographical Society of Australasia, South Australian Branch*, II (1886-7), pp 1-8.

² Judy Birmingham, 'Sheep, Cattle and Maritime Industries', in Judy Birmingham, Ian Jack & Dennis Jeans, *Australian Pioneer Technology* (Richmond [Victoria] 1979), p 134.

³ Oswald Pryor, *Australia's Little Cornwall* (Adelaide 1969 [1962]), p 17.

⁴ Colin Kerr, *An Exelent Coliney* (Adelaide 1978), p 109.

important as the drier outback areas, such as the Mallee and Central Australia, were settled in the later part of the century. At Mount Macedon, Victoria, E S Whiting obtained water from natural springs higher up the mount, piping it through the state forest to his property 'Hascombe'. There it was ingeniously fed into four hundred gallon [1820 litre] tanks painted black so as to absorb heat, and take the chill off the contents, and thence to a four thousand gallon [18,200 litre] tank from which it was reticulated to the garden.⁵

Artesian wells could be used in those areas where strata containing water under pressure could be found, but they were at first uncommon. In February 1851 a letter was published in the *South Australian Register* describing a Chinese method of boring, now being copied in Europe. A heavy bar of six feet by four [1.8 x 1.2 m] - which makes little sense - 'armed at the lower end with a heavy cutting chisel, surrounded by a chamber to bring up spoil, was attached to the bottom of a suspending rope, when the apparatus acted as a screwdriver, working on its own weight.'⁶ In 1859, however, the Victorian Government Geologist, A R C Selwyn, advised against the use of artesian bores in South Australia, because he believed dams, wells, polders and reservoirs to be cheaper.⁷ Although the idea seems to have lapsed for a time, in 1879 a South Australian member of parliament with an interest in scientific agriculture, Friedrich Krichauff, read a paper on artesian and tube wells to the Chamber of Manufacturers in Adelaide. However its content was generalised and based mainly upon German sources, and it tells us nothing about the use of these things in South Australia.⁸ In 1880 it was announced that M Marwood & Co would demonstrate Pierce's artesian well drilling apparatus, which was expected to revolutionise outback life.⁹

By the 1860s the tube well invented by J C Norton of London was available, and could relatively easily penetrate sand, gravel, clay or other soil.¹⁰ Tube wells became prominent because of their use by British troops in Abyssinia during the 1868 war, when the engineers put them down at each camp site. The patent was held by Le Grand & Sutcliff of London,¹¹ but in Australia they were still associated with the name of Norton. Norton's tube wells, using 1½ inch [48 mm] malleable pipe, were advertised locally in 1883, but can have received nothing like the acceptance they met with in New Zealand, where by 1878 there were said to be 1,600, and two thirds of the houses in Christchurch were supplied by them.¹² The catalogue of McEwan's

⁵ 'Wanderer', 'Picturesque Macedon', *Gisborne Gazette*, 5 February 1895, quoted in Nigel Lewis & Associates, 'Alton and Hascombe, Alton Road, Mount Macedon' (South Yarra [Victoria] 1986), pp 92-3.

⁶ *South Australian Register*, 19 February 1851, quoted in Elfrida & Rolf Jensen, *Colonial Architecture in South Australia* (Adelaide 1985), p 119.

⁷ *South Australian Register*, 30 July 1859, quoted in Jensen, *Colonial Architecture in South Australia*, p 181.

⁸ *Australian Engineering and Building News*, 1 July 1879, pp 20-21; 1 August 1879 p 32. For Krichauff see Sally O'Neill, 'Friedrich Eduard Heinrich Wulf Krichauff (1824-1904)', in Bede Nairn et al [eds], *Australian Dictionary of Biography*, V (Melbourne 1974), p 443.

⁹ *South Australian Register*, 3 February 1880, quoted in Jensen, *Colonial Architecture in South Australia*, p 623.

¹⁰ *Cassell's Household Guide to every Department of Practical Life* (4 vols, no date [1869-71]), I, p 352.

¹¹ [Francis Young], *Every Man His Own Mechanic* (London, no date [c1882]), p 529.

¹² Charles Mayes, *The Australian Builders' Price-Book* (4th ed, Melbourne 1883), p 14.

ironmongery in Melbourne included instructions as to how to drive the tubes, rather in the manner of piles, with two men hoisting a weight, then dropping it to strike a clamp fixed onto the tube itself.¹³ Another brand which became available in Australia was that of C Isler & Co, sold locally by McBriar, Osborn & Co.¹⁴

Tube wells were useful only where the water was found in sandy or gravelly strata, and the tube could not penetrate rock of any thickness. The tube would be cut at a convenient height above ground and fitted with an iron pipe, and at first there was usually some difficulty because sand would get under the clack valves and make them leak, as well as wearing out the bucket leather. Over time, however, a small clear pocket would form at the base of the tube, and sand would cease to be drawn in.¹⁵ In Adelaide the engineer J H Horwood was by the 1880s a specialist in well boring, and one of the largest contractors to the Water Conservation Department. He claimed to have been the first to introduce the 'system of tubing in bored wells'.¹⁶ C E Mayes still listed Norton's Abyssinian tube wells in his price book of 1908,¹⁷ but he seems to have been merely repeating the entry of 1883, and this is no evidence that they were still in use. Nonetheless, the existence of a detailed account in an English text of 1954¹⁸ seems to suggest that they were still current.

Artesian wells were generally a later development, in those areas where strata containing water under pressure could be located, and a boom in artesian boring seems to have developed in the later 1880s. In 1887 the Queensland government accepted a tender for 7,500 feet [2,250 m] of boring in the western parts of the colony from J S Lochhead [Loughead],¹⁹ a leading boring contractor who had been successful in many parts of the world.²⁰ They were also negotiating a similar contract with Woodley & Co, in which the depth of any one bore was not to exceed about 600 metres, and the boring was to be done on the 'Canadian' or 'pole' system.²¹ The Canadian Pole Boring company - perhaps a name for either Lochhead's or Woodley's operation - by late 1887 had reached a contract depth of 500 feet [150 m] at the Castlemaine Brewery, Milton, with little success, and it was decided to bore a further 100 feet [30 m].²² At the Carlton Brewery, Victoria, the Ontario Rock and Earth Drilling Company had reached depth of a thousand feet [300 m].²³

The Canadian or pole system used a continuous series of rods of about 57 mm in diameter and 5.4 m long, commonly of canary pine, spotted gum or yellow wood. They were joined with straps and cylindrical screws, and the cutting apparatus - bit,

¹³ James M'Ewan & Co.'s *Illustrated Catalogue of Furnishing and General Ironmongery* (Melbourne, no date [c 1880]), pp 217-9.

¹⁴ *Australasian Ironmonger*, I, 7 (1 October 1886), advertisement p xix.

¹⁵ A C Martin & J H Henwood, *The Modern Practical Plumber* (3 vols, London, no date), II, pp 9-10.

¹⁶ D A Cumming & G C Moxham, *They Built South Australia: Engineers, Technicians, Manufacturers, Contractors and their Work* (Adelaide 1986), p 102.

¹⁷ C E Mayes, *The Australian Builders' & Contractors' Price Book* (7th ed, Sydney 1908), p 247.

¹⁸ G S Williams, *Plumbing, Sanitation & Domestic Engineering* (5 vol;s., London, no date [1954]), III, pp 282-5.

¹⁹ *Australasian Builder & Contractor's News*, 10 September 1887, p 201.

²⁰ *Australasian Builder & Contractor's News*, 9 February 1889, p 141.

²¹ *Australasian Builder & Contractor's News*, 10 September 1887, p 201.

²² *Australasian Builder & Contractor's News*, 29 October 1887, p 397.

²³ *Australasian Builder & Contractor's News*, 19 November 1887, p 445.

sinker and jar - was attached to the bottom. The necessity to fix and unfix the poles made this a cumbersome method for deep drilling, and it had largely gone out of use by the Great War, though not before C E Mayes had sunk a bore in the Moree district as deep as 1,225 metres. The cable system used steel rope, which allowed the tools to be extracted and re-lowered much more quickly, and also reduced the number of men per shift from three to two.²⁴

In 1888 G Kauffmann & Co of Melbourne showed artesian well drilling apparatus at the Centennial Exhibition,²⁵ though one may surmise that it would have been imported at this stage rather than locally made. In December 1888 the Queensland government called tenders for 25,000 feet [7,500 m] of boring at a number of localities, those in the first contract being west of Hughenden, some way north-east of Mackinly, and 100 km north of Boulia on the Cloncurry Road. Others were to follow north of Rockhampton, and at Emerald, Isisford, Muckadilla, Charleville, Thargomindah and Hungerford.²⁶ Meanwhile the owners of Uanda and Lammermoor stations had privately obtained boring plants and men who were on their way from England to prospect for water in their back country, though a bore at Lansdowne had reached 1,100 feet [330 m] without success so far.²⁷

In the same month there were reports of successes in New South Wales and South Australia. W W Davis of Kerribree station, Bourke, reported that the no 1 artesian bore was down 1077 feet [323 m], and water of the purest quality was flowing at the rate of 350,000 gallons [1,600,000 l] a day.²⁸ The Kerribree well had been sunk by Loughhead [or Lochhead], who had sunk sixty-four wells in Queensland and New South Wales over a year, and had found water in every case. He had his own 'world renowned well-boring apparatus', which used a steel rod rather than diamond drills, and would bore to any depth with a diameter of up to a 1 ft 6 in [450 mm] or even more.²⁹ Meanwhile a good supply had been struck on the far northern railway line in South Australia, for when the bore had reached only about 350 feet [105 m] the water rose to the surface and flowed out onto the ground.³⁰ Soon the South Australian government contracted with the Austral-American Well-boring Company for 10,000 feet [3,000 m] of sinking, beginning immediately east of Lake Frome, and a cable operated plant was on its way to Port Adelaide, presumably from America.³¹

b. pumps

Non-artesian wells could be pumped by hand, by a windmill, or by an engine. By the 1880s Darwin was obtaining its water supply from wells by means of windmills,

²⁴ C E Mayes, *The Australian Builders & Contractors' Price Book* (8th ed, Sydney 1914), p 327.

²⁵ Centennial International Exhibition, Melbourne, 1888-1889 *Official Record* (Melbourne 1890), p 615.

²⁶ *Australasian Builder & Contractor's News*, 8 December 1888, p 512.

²⁷ *Australasian Builder & Contractor's News*, 29 December 1888, p 587.

²⁸ *Australasian Builder & Contractor's News*, 22 December 1888, p 564.

²⁹ *Australasian Builder & Contractor's News*, 19 January 1889, p 55; 9 February 1889, p 141. The latter contains a plate showing Loughhead's apparatus as used at Barcaldine, similar to that used at Kerribree.

³⁰ *Australasian Builder & Contractor's News*, 22 December 1888, p 564.

³¹ *Australasian Builder & Contractor's News*, 24 January 1889, p 8.

taking advantage of the regular morning and evening breezes.³² Light windmills were developed in the 1870s, one of the earlier ones being the Victory Self-Adjusting Windmill by Munro & Walters of Melbourne.³³ The Victory, specifically described as being 'for pumping water', was shown by D Munro & Co at the Melbourne Exhibition of 1880, together various pumps and 'self-filling tanks, for squatters' use'.³⁴ Other windmills were shown by the Atlas Co of Engineers, John Danks, McLean Brothers & Rigg, and R Pitkeithly of Lake Boloke.³⁵ Danks's 'improved windmill, with self-regulating vanes', won one gold and three silver medals.³⁶ Meanwhile other light windmills were developed by James Alston of Ballarat in 1884,³⁷ J H Horwood of Adelaide before 1886,³⁸ and Sidney Williams of Rockhampton [the 'Comet' windmill] some time later.³⁹ Alston's mill, which had curved sails or vanes, was patented in 1886,⁴⁰ and was to be most successful of all. By 1890 Alston was able to abandon all his other products and concentrate solely on the windmill, which came to dominate the market not only in Australia, but in South Africa as well. In 1899 Alston moved to a new factory in Melbourne.⁴¹ Light windmills were to become ubiquitous in country areas, and not all were locally made. In 1880 it was reported that one Stephens, of the San Francisco firm of Stephens & Woodin, had moved to Melbourne to establish an Australian operation. the company manufactured windmills as well as rock boring and drilling machines, which were claimed to be in use in most of the American states.⁴² Other imported windmills included the 'Eclipse', sold by H P Gregory & Co.⁴³

Conventional pumps were used for larger private houses and for public purposes. A wooden pump taken to date from about 1830 was discovered in the excavations for the Australia Hotel, Sydney, in 1889. There were two wooden pipes of 250 mm diameter, one of them 8.0 metres and the other 1.8 metres long, and an ironbark plunger which had rotted away above the water level but was absolutely sound below it.⁴⁴ Such primitive devices were soon superseded by the metal pumps which became very common towards the mid-century. In 1861 A Maclean of Melbourne (probably Angus McLean, of column fame) was making three-and-a-half inch, four inch and five inch [88 mm, 100 mm, 125 mm] force pumps, an ornamental iron pump for use

³² Harriet Daly, *Digging, Squatting and Pioneering Life in the Northern Territory of South Australia* (London 1887), p 346.

³³ H M Franklyn, *A Glance at Australia in 1880* (Melbourne 1881), pp 296-7 & advertisement p xxxi.

³⁴ Melbourne International Exhibition, 1880, *Official Catalogue of the Exhibits* (2 vols, Melbourne 1880), I, p 50.

³⁵ Melbourne Exhibition 1880, *Catalogue*, I, pp 49-50.

³⁶ Melbourne International Exhibition, 1880-1881, *Official Record* (Melbourne 1882), p 655.

³⁷ George Parsons, 'James Alston (1850-1943)', in Bede Nairn et al [eds], *Australian Dictionary of Biography*, VII (Melbourne 1979), pp 48-9.

³⁸ Cumming & Moxham, *They Built South Australia*, p 102.

³⁹ H J Gibbney & A G Smith, *A Biographical Register 1788-1939* (Canberra 1987), II, p 346; Donald Watson & Judith McKay, *Queensland Architects of the 19th Century* (Brisbane 1994), p 207.

⁴⁰ Victorian patent no 4549A, quoted in David Yandell, '150 Years of Victorian Patents', *The Source*, 14 (May-June 2004), pp 10-11.

⁴¹ Parsons, 'James Alston', p 48.

⁴² Melbourne Exhibition 1880-1881, *Official Record*, p 673.

⁴³ *Australasian Ironmonger*, I, 7 (1 October 1886), advertisement p xvii.

⁴⁴ *Australasian Builder & Contractor's News*, 9 November 1889, p 456.

in gardens and farmyards, and a lift pump for household uses.⁴⁵ As no more is heard of these, it seems likely that Maclean succumbed to the competition of the imported pumps.

Prominent English pump manufacturers included Cottam & Hallen, Benjamin Fowler and John Warner, all of London. Warner had already been established for decades when he showed a range of pumps at the Great Exhibition, including his patent vibrating standard pump for household use.⁴⁶ In 1853 Fowler advertised farm and cottage pumps.⁴⁷ A specification for a pair of Melbourne houses in 1854 required the cisterns to be supplied by 'one of Warner's 3 brass barrel vibrating standard force pumps with 1½ lead pipe from the tank [that is, the underground tank] and inch lead supply pipe to the cistern.' Warners' advertised widely in the Australian colonies, and stated that their products could 'be obtained of any ironmonger or Plumber in Australia, or the Colonies.' The pump referred to was the three inch version of their no 69, a model designed for domestic use and which came in sizes from two to four inches.⁴⁸

Charles Mayes's price book was still carrying advertisements for Warner's pumps in the 1880s, together with the equally well-known ones of Tylor & Son, and other water lifting devices more applicable to general contracting than to domestic use.⁴⁹ In his text, however, Mayes in 1877 lists only Warner's brass barrel force and lift pumps, and centrifugal pumps,⁵⁰ along with American types - Douglas's American lift pumps, McComas's water lifters, and the contractor's pitcher pump.⁵¹ Three Douglas pumps have been identified in Victoria, one at 'Heronswood', Dromana, a house of 1871;⁵² another at 'Mount Rothwell' homestead, Victoria, of 1872, branded

W & B DOUGLAS. MIDD. CONN.

- that is, Middletown, Connecticut ; and a third, undated, at 'Ballam Park', Frankston. In 1890 a 'No 4 force + lift Douglas pump' was specified for a house in Melbourne.⁵³ It is known that the Douglas company manufactured fire engines between 1832 and 1888, though nothing further has been discovered about their pumps.⁵⁴

⁴⁵ Victorian Exhibition 1861, *Catalogue with Prefatory Essays* (Melbourne 1861), p 205.

⁴⁶ London, Great Exhibition of the Works of Industry of all Nations, 1851, *Official Descriptive and Illustrated Catalogue* (3 vols, London 1851), I, pp 332-3. A catalogue of J & R Warner of 8 the Crescent Jewin [?Jermyn] Street, London, of about 1830-5, is cited in Charles Wood, *Catalogue 108* (Cambridge [Massachusetts] 2001), p 27, no 83.

⁴⁷ *Builder*, XI, 530 (2 April 1853), p 222. Here Warner also advertises his patent vibrating pump.

⁴⁸ C Mayes, *The Australian Builders' Price-Book* (2nd ed, Melbourne 1862), p 152.

⁴⁹ C Mayes, *The Australian Builders' Price-Book* (4th ed, Melbourne 1883), pp 109-110

⁵⁰ Charles Mayes, *The Australian Builders' Price-Book* (3rd ed, Melbourne 1877), p 3.

⁵¹ Mayes, *Australian Builders' Price-Book* (1877), p 99.

⁵² The pump has been moved to its present position but can be seen in situ in an old photograph. It is branded 'W. & B. Douglas' on the spout, and elsewhere labelled 'no. 2'.

⁵³ Hyndman & Bates, 'Specification, &c, Villa Residence Tank +c / Camberwell / Arthur J Fuller Esq / Normanby Chambers Chancery Lane (Melbourne 1890), p 3.

⁵⁴ Research by Jeananne Wells, 2001.

In South Australia one D Fotheringham applied in 1878 for a patent for a pneumatic apparatus for raising water from deep wells,⁵⁵ the nature of which has not been established. However, at 'Martindale Hall', South Australia, of about 1878-80, a steam pump raised river water about forty metres, and it was then piped about four hundred metres horizontally to a reservoir, of about 410,000 litres capacity, from which pipes led to the house and the gardens. There was also a fresh water tank from which water was raised to the roof by a double action pump, then filtered and recirculated. As a result the house could be equipped with hot and cold water, showers and water closets.⁵⁶

In 1890 the *Building and Engineering Journal* illustrated Bailey's 'Aqua Thruster' steam pump, an English-made device consisting of two chambers which were alternately filled with steam. As the steam condensed the water was sucked in through a valve, and while the water was being drawn off one chamber the other would be refilling. The journal also illustrated a ram made by the same company,⁵⁷ which was called the 'Caliban'.⁵⁸

c. rams

The hydraulic ram was a device which used the force of the flow in a stream to raise a portion of the water to the desired height,⁵⁹ and was invented in 1772 by John Whitehurst of Derby, and then independently re-invented in a better form in 1796 by J M Montgolfier, one of the pioneering French balloonist brothers. Matthew Boulton, of Boulton & Watt, took out a British patent based upon Montgolfier's version in 1797, and the first American patent followed twelve years later, though it seems not to have been introduced in practice in the States until about 1843.⁶⁰ At the middle of the nineteenth century Easton & Amos of London claimed to have the rights to 'the English patent' derived from Montgolfier, presumably meaning that of Boulton, though it is difficult to see how it could have remained in force for so long, or how Easton & Amos could describe themselves as 'inventors and manufacturers'.⁶¹ Freeman Roe of London was another ram manufacturer of the period,⁶² and in France one de Caligny had developed an improved form which was especially suited to small streams of water.⁶³

⁵⁵ *South Australian Register*, 20 March 1878, cited in E & R Jensen, *Colonial Architecture in South Australia* (Adelaide 1980), p 575.

⁵⁶ Elizabeth Warburton, *Martindale Hall* (Adelaide 1979), p 68.

⁵⁷ *Building and Engineering Journal*, 9 August 1890, p 275; 30 August 1890, p 302.

⁵⁸ *Building and Engineering Journal*, 30 August 1890, p 302.

⁵⁹ For an account of the hydraulic ram, see Williams, *Plumbing*, III, pp 277-281.

⁶⁰ A C Downs, 'The Introduction of the American Water Ram, ca. 1843-1850', *APT Bulletin*, VII, 4 (1975), pp 56-103; and 'The American Water Ram, Part II', *APT Bulletin*, XI, 1 (1979), pp 81-94. Note, however, that Edward Cresy, *An Encyclopædia of Civil Engineering, Historical, Theoretical, and Practical* (London 1846, p 1161, attributes the French ram to Montgolfier junior. See also Martin & Henwood, *The Modern Practical Plumber*, II, pp 31-7, who credit the invention to a Bristol plumber.

⁶¹ Great Exhibition, 1851, *Catalogue*, I, p 227.

⁶² Great Exhibition, 1851, *Catalogue*, I, p 235.

⁶³ Great Exhibition, 1851, *Catalogue*, III, p 1176.

The ram could be used when there was a plentiful stream of fast-flowing water, and in effect raised a small proportion of the flow by exploiting the kinetic energy of the balance. As described in relation to the Easton & Amos version:

This machine, which is self-acting, is composed of an air vessel and three valves, two for water, and one for keeping up the supply of air. Upon pressing down the valve in the conducting tube, which opens downwards, the water escapes from it, until its momentum is sufficient to overcome the weight, when the valve immediately rises and closes the aperture. The water having then no other outlet than the inner valve, rushes through it, by its generated force, compressing the air in the air vessel until equilibrium takes place, when the air reacts by its expansive force, closing the inner valve, which retains the water above it, and driving it up the ascending tube. By this reaction, the water is forced back along the conducting pipe, producing a partial vacuum beneath the outer valve, which immediately falls by its own weight. The water then escapes until it has acquired sufficient force to close this, when the action proceeds as before.⁶⁴

Though common in the United States, it seems to have been little used in Australia, doubtless because of the scarcity of reliable fast-flowing watercourses. By the late nineteenth century John Blake was a leading British manufacturer,⁶⁵ and T & W Farmiloe of London also advertised a ram in the 1890s, recommending a ratio of fall to lift of 10:1 as being the most effective.⁶⁶ There is no specific evidence that either brand reached Australia, but there were local makers. In fact the ram reached Australia surprisingly late, though it was available from John Danks of Melbourne by 1877,⁶⁷ and was advocated by Charles Mayes in 1883 as a 'simple and effective machine for forcing a continuous stream of water by gravitation to a considerable altitude'.⁶⁸

At the Centennial Exhibition of 1888-9 one J Abraham of Ballarat showed a centrifugal pump and hydraulic ram,⁶⁹ and in 1889 J W McComas of Melbourne was granted a patent for 'Improved machinery for lifting water from running streams'.⁷⁰ Actual applications, however, are not common. One was installed at J C Smith's 'Yester', at Wentworth, to raise water for the house and stables from a spring in an adjoining hillside.⁷¹ A bizarre form of ram was proposed by the Sydney engineers Kirkwood and Sircom, who planned to use the power of ocean waves to raise seawater for purposes such as drain flushing, street watering and bathing. A funnel-shaped opening would face the sea at the bottom of a cliff. Waves would enter it and force their way into the pressure chamber, but as they receded a valve would close behind them. A pipe from the chamber led up to an open reservoir at the top of the

⁶⁴ Great Exhibition, 1851, *Catalogue*, I, p 227.

⁶⁵ See John Blake, *John Blake's Patent Self-Acting Hydraulic Rams, &c* (Accrington [Lancashire] 1886), cited in Elton Engineering Books, *Catalogue Number 13* (London 1998), p 99.

⁶⁶ T & W Farmiloe, *T. & W. Farmiloe's Miniature Catalogue* (London 1894), cited in Elton Engineering Books, *Catalogue Number 13* (London 1998), p 718.

⁶⁷ Charles Mayes, *The Australian Builders' Price-Book* (3rd ed, Melbourne 1877), p 158

⁶⁸ Mayes, *Australian Builders' Price-Book* (1883), pp 109-110

⁶⁹ Centennial International Exhibition, Melbourne, 1888-1889 *Official Record* (Melbourne 1890), p 614.

⁷⁰ *Australasian Builder & Contractor's News*, 21 December 1889, p 593.

⁷¹ *Australasian Builder & Contractor's News*, 8 June 1889, p 536.

cliff.⁷² Considering how little one hears of the use of hydraulic rams in Australia, it is surprising to find no less than nine Melbourne firms listed in 1928 as suppliers of them.⁷³

d. rainwater collection & disposal

Before the establishment of large municipal water supply systems there two main options for consumers. Only a few were lucky enough to have direct access to a suitable well or watercourse, and the others had to collect their roof water, or to buy supplies, or both. Neither option was as simple as it sounds. The more primitive roofing systems like thatch and bark are not good for collecting water, and certainly not good for the fixing of spouting. In fact, when it was not explicitly required for the purpose of gathering water, eaves guttering was used only on a minority of buildings in the early nineteenth century. Shingle roofs could be used to collect water, but in some cases they flavoured the water, or even poisoned it, as in the case of Norfolk Island pine. Corrugated iron roofs were ideal for the purpose.

Where there was a town water supply the householder might be more concerned with the disposal than with the collection of the rainwater. This could be done with agricultural pipes placed in a trench and surrounded with gravel, or simply a 'French drain', which was trench containing rough stone or broken brick, but no pipe.⁷⁴ These types would usually be used around the perimeter of the building to catch the water discharged from the eaves, but rather surprisingly a French drain passed right across the foundations of Charles McIntyre's house 'Darnlee', Toorak', of 1888-9.⁷⁵

Having water delivered by cart was an expensive procedure, and sometimes a risky one. The early water cart was a barrel placed upon a dray or, in the case of a purpose-made type a large barrel placed between wheels.⁷⁶ The latter type had a capacity of 680 litres, enough to fill three domestic water butts, and where there was no standpipe it could be filled by driving it right into the source and baling, as was sometimes done in the Yarra at Melbourne in the 1840s.⁷⁷ Joseph Elliott, in Adelaide, had to pay two shillings for fifty gallons [230 l] of water to fill the wooden cask or butt beside his back gate.⁷⁸ Regardless of the means used to collect the water, there was often a problem of pollution. In Melbourne, again, there were epidemics of serious disease in the 1840s, which can be attributed to this cause.

Once acquired, the water had to be stored, which might be done in a brick or stone underground tank (not to be confused with a well), in a water butt or barrel, in a circular corrugated iron tank, or in a rivetted plate iron tank. Water tanks and cisterns rarely survive from any very early period, and when they do they tend to be invisible

⁷² *Australian Engineering and Building News*, 1 April 1881, pp 188-9.

⁷³ J S Gawler, *The Architects' and Builders' Index (Victorian Edition)* (Melbourne 1928), p 44.

⁷⁴ A C Passmore, *Handbook of Technical Terms Used in Architecture and Building, &c* (London 1904), p 152.

⁷⁵ Photoprints of L J Flannagan's architectural drawings, SLV.

⁷⁶ Hugh McCrae [ed], *Georgiana's Journal* (Sydney 1934), p 28n.

⁷⁷ F Lancelott, *Australia as it Is* (2 vols, London 1852), II, pp 78-9.

⁷⁸ Joseph Elliott, *Our Home in Australia* (Sydney 1984), p 96.

or inaccessible. The corrugated iron rainwater tank was introduced in 1857⁷⁹ and immediately became popular, despite the announcement by Professor John Smith of Sydney University that he had found galvanized iron to be unsafe for water cisterns.⁸⁰

The riveted plate iron water tank, which is still a familiar sight, especially in country areas, is less precisely datable and so far as I know had not been documented before my own work on it,⁸¹ since expanded by Michael Pearson.⁸² The riveted storage tank, as Pearson has established, was patented by the Richard Trevithick, the Cornish engineer, and John Dickson, in 1808. Trevithick and Dickinson set up a factory in Limehouse, but when bankrupt in 1811, after which the patent was acquired by Henry Maudsley, and proved very profitable. However neither the shape nor the size was fixed, as was to be essential to the system developed for later trade, and the patent referred to rectangular, hexagonal prism and cylindrical forms.⁸³ Some of the buildings by Samuel Hemming of Bristol, which reached Australia in the 1850s, were provided with tanks to collect the roof water, and these seem most likely to have been of the plate iron type.⁸⁴ Riveted tanks were also used for shipping a variety of imported goods, providing a more durable alternative to the casks and kegs traditionally used for the transport of liquids generally and of many dry goods. This importation was to be systematised in the form of the recyclable 'ship's tank', discussed below. Riveting was also done in Australia, and plate iron tanks were a regular article of manufacture at least from the 1850s. The quoted prices were comparable on a weight-for-weight basis with those of built-up girders.

The underground tank is the most durable, and a cement-lined brick tank fitted with a pump seems to have become a standard element of the more substantial houses of Sydney at least by the 1830s.⁸⁵ Otherwise the tank might be unlined, but with the brickwork backed up with puddled clay to make it waterproof.⁸⁶ At Burra Burra and Kapunda, South Australia, where water was particularly scarce, the Cornish miners built underground tanks with masonry walls, lined not with lime or cement, but a mixture of tallow and sand, plastered on while hot.⁸⁷ At the Spring Hill Watch House, Tasmania, is an underground tank presumed to have been constructed with the building in 1842, to the design of James Blackburn. It is fed by a subterranean channel from a distant spring, and surrounded by what is described as 'an elaborate system of drains', presumably for overflow. The tank itself measures 3.6 by 3.6

⁷⁹ John Carter, of the Steam Corrugating Works in Little Bourke Street, Melbourne, received a patent for the application of corrugated galvanized iron to the manufacture of water tanks and buoys: Victorian patent application no 77, granted to John Carter, 31 December 1857.

⁸⁰ *Australian Builder*, no 38 (27 November 1856), p 320.

⁸¹ *** Miles Lewis, 'Australian Domestic Building Technology', in Peter Freeman & Judy Vulker [eds], *The Australian Dwelling* (Red Hill [ACT] 1990), p -.

⁸² Michael Pearson, 'From Ship to the Bush: Ship Tanks in Australia', *Australasian Archaeology*, X (1992 [1994]), pp 24-29.

⁸³ Pearson, 'Ship to the Bush', p 24, quoting F Trevithick, *Life of Richard Trevithick, with an Account of his Inventions* (London 1872), pp 285-6; H W Dickinson & A Titley, *Richard Trevithick: the Engineer and Man* (Cambridge 1934), pp 117-9.

⁸⁴ *Builder*, XII, 383 (8 April 1854), p 182.

⁸⁵ Barrie Dyster, *Servant & Master* (Kensington, NSW, 1989), p 105, refers to the tank at 'Lyndhurst' which collected run-off from the roof, and was completed when Frederick Peterson installed the pump in December 1834.

⁸⁶ Hughes Trueman Ludlow, *Wells and Underground Tanks*, p 21.

⁸⁷ Oswald Pryor, *Australia's Little Cornwall* (Adelaide 1969 [1962]), p 33.

metres and five metres deep, made of finely cut ashlar work with a wide capping, with evidence of a timber covering structure.⁸⁸ At a more rudimentary level J K Andrews recalled a pioneer house in which water collected from the shingle roof was stored in a 'water hole' about eighteen metres distant. This had been excavated by pick and shovel to as size of about 14 by 1.6 metres, and covered with saplings to keep it cool and reduce evaporation.⁸⁹

Some mysterious tanks have been found in the excavation of two houses built in the 1850s at Jolimont, Melbourne. They are at basement level immediately behind the kitchen fireplace / stove recess, and are of cement-lined masonry. In one house there are two tanks placed end-on, one of 1.05 x 1.65 m by 1.10 m deep, the other 0.75 x 1.65 x 0.93 m deep. In the second house are tanks of similar sizes but less regular forms. There are indications that pumps were located near them. It may be that one tank of each pair was intended to allow sediment to settle before the water passed into the next, and that a portion of this water then passed directly to the kitchen range to be heated.⁹⁰

Internal water tanks or cisterns are for more commonly found in the ceiling space, or in a tower, either to provide a gravity supply generally, or as header tanks for particular apparatus. Even when a reticulated water system was connected, such header tanks were often needed to cope with breakdowns in supply and inadequate or variable pressures. A specification for a pair of Melbourne houses in 1854 required 'over each Bath Room a cistern 7' x 3' x 3' [2.1 x 0.9 x 0.9 m] of Boiler plate with a man hole in the top and ³/₄" [19 mm] lead pipe with two brass taps to supply the bath room'.⁹¹ Each cistern was supplied by pumping from an underground tank.⁹² One country settler planned a tank over his bathroom:

I took the measurements for a tank to go in the corner overhead, as large as the place would admit of, with a douch valve at the bottom of it ... and with a small tube to fit onto a gutta-percha pipe to pass through above the door to the wash-hand stand with a tap over the basin. I intend having another pipe from the bottom of the basin to take the water to Mother's tank at the nearest end of the conservatory. And then I intend to make a lever valve to admit the water into the first tank from the spout above, so that in a storm when my Mother's tank was full, I could stop it or make it stop itself by a pully cord attached to a float in Mother's tank.⁹³

At 'Rouse Hill House', New South Wales, J H Hunt appears to have installed a marble bath in 1876-7 'with Shower supplied from a tank overhead - filled daily from the force pump'.⁹⁴

⁸⁸ Email 28 February 2006 from Brad Williams, Heritage Project Officer, Southern Midlands Council, on the Engineering Heritage Australia list.

⁸⁹ J K Andrews, 'History of Merrigum' (manuscript, Merrigum [Victoria] 1954, copy provided by Anne Tyson, 1997), p 53.

⁹⁰ Inspected 2003 with Jonathan Howell-Meurs, archaeologist, of Andrew Long & Associates.

⁹¹ Russell, Watts and Pritchard, 'Specification for ... Dwelling houses ... at Elwood ... for Joseph Docker', 13 December 1854, Docker papers, Manuscripts Collection, SLV, p 20.

⁹² C Mayes, *The Australian Builders' Price-Book* (2nd ed, Melbourne 1862), p 152.

⁹³ Edward Bucknall to Fred Bucknall, 21 April 1867, in Graeme Bucknall & Lorna McDonald [eds] *Letters of an Australian Family, 1827-1880* (Carisbrook [Victoria] 1984), pp 113-4.

⁹⁴ Peter Reynolds & Joy Hughes, 'Private Practice: Works 1869-1904', in Peter Reynolds, Lesley Muir & Joy Hughes [eds], *John Horbury Hunt: Radical Architect 1838-1904* (no place

Such tanks are sometimes of rivetted plate iron like those used externally, or occasionally are rectangular boxes of slate, or of wood lined with metal sheet. A wooden tank made of planks with heavy bolts running through survives at 'Barwon Bank', Geelong, Victoria. An English text illustrates such a cistern, implying that it was more elaborate than normally required for domestic purposes, and showing a more typical domestic form consisting of a wooden box with interlocking dovetailed corners, but no bolts, and designed to be lined with lead.⁹⁵ There are slate header tanks at Martindale Hall, South Australia, and one can get an idea of the construction of them from an English specification of 1898 (by which time such tanks were said to be almost obsolete):

The slate cistern in roof of scullery to be 6 ft. by 4 ft. and 3 ft. deep internal dimensions, with sides 1 in. thick and bottom 1½ in. thick, all sawn Valentia slate slabs, put together with rebated and grooved joints in red lead and oil cement, the grooved slabs pointed externally with weathered cement filleting. Put round same two sets of wrought-iron straps, 1½ in. by ¾ in., forged and screwed at ends with nuts and washers.⁹⁶

Cisterns made commercially by Ashton & Green of London were slightly different. The joints between slabs were reinforced with a plank of slate along the outside of the joint and the pieces were fixed to this with galvanised bolts. The instructions were to first paint all the grooves so as to exclude dust, place a layer of oil cement in them, then screw up the bolts (but not so tight as to risk fracturing the slate), and finally scrape off any cement which had squeezed out.⁹⁷

e. ships' tanks

Most of the plate iron tanks one sees on farms and in domestic situations, as well as many of those in public buildings, were not specially fabricated, but were recycled shipping containers of the form which seems to have become standardised at least by the 1850s. Even in the 1820s it was said in Van Diemen's Land that 'Those square, iron tanks that come from England filled with confectionery are in great demand as water tanks'.⁹⁸ Pearson records a paper label on a tank in the roof of the Mint Museum building in Sydney, 'Terry's Confectionery and Chocolates, Eight Prize Medals, York England'.⁹⁹ The sizes in use by about the middle of the century were 3 ft 2 in and 4 ft [0.96 m and 1.2 m] cubes, of which the latter was far the most common. Richard Dawson, of the Australian Iron and Brass Foundry in Sydney, advertised ships' tanks in 1851,¹⁰⁰ but we cannot be certain that he was referring to the

[Sydney] 2002), p 114. The dimensions given for the bath of '20 f x 8 f,' - assuming that this means feet - are difficult to believe, and the context does not suggest any abnormal size, so there is probably an error by Hunt in the latter quoted, or by the editors in transcribing it..

⁹⁵ P B Eassie, *Wood and Its Uses* (Gloucester 1874), p 73. See also Williams, *Plumbing*, III, p 349.

⁹⁶ Ashton & Green, *Slate, &c*, p 3.

⁹⁷ F R Farrow, *Specifications for Building Works and How to Write Them* (London 1898), p 36.

⁹⁸ William Thornley [ed J S Mills], *The Adventures of an Emigrant in Van Diemen's Land* (Adelaide 1973 [1840s]), p 158.

⁹⁹ Pearson, 'Ship to the Bush', p 26.

¹⁰⁰ Advertisement in Ford's *1851 Sydney Directory*, reproduced in Brian Turner, *Australia's Iron Lace* (Sydney 1985), p 45.

standardised type. One of the earliest documented examples is the 400 gallon [1820 litre] tank bought for his own house by the Geelong engineer, Edward Snell, in 1855. All he records is that it was of iron, and cost £12.12.0,¹⁰¹ but as the date is too early for a corrugated iron tank, there is little it could be made of other than rivetted plate iron. The 400 gallon capacity is that of the four foot size, and suggests that Snell's tank might be an early example of that modular type.

The first illustration (of what looks like the standard type of tank) was that at the police station at Palmerston (Darwin), shown in the foreground of a photograph of the building early in 1872. These tanks seem to have been especially popular in remote settlements and in mining areas, such as Hill End, New South Wales, where a four foot [1.22m] square tank can be found behind the English cottage. Though they are better documented in the eastern states, one example can be seen in a fairly late photograph of a stone cottage in Western Australia.¹⁰² They were used to impart an air of verisimilitude to the huts which, for the purposes of land selection, purported to be dwellings. Thus at Henty and Balfour's 'Round Hill' run in the Riverina in 1875:

I have put a good hut now on Jimmy Balfour's and Harry's selections - but as there is no permanent water near either of them, I think a tank (iron. 400 gals) should be at each hut. It would look much more like a genuine residence.¹⁰³

They were also commonly used for bona fide rural tasks such as wool scouring.¹⁰⁴ In 1882 the Victorian Education Department forwarded a 400 gallon wrought iron ships' tank 'with overflow complete' together with all the other materials for a portable school building at Green Hills (Emberton),¹⁰⁵ and other references to their use at country schools show that they had become a standard item. The plans for a large Victorian country house, 'Trawalla', in 1891, rather unusually show square 'iron tanks' at four positions around the perimeter, doubtless to collect the rainwater for domestic use.¹⁰⁶

J K Andrews wrote of the use of such tanks in the Goulburn Valley, Victoria. The large 400 gallon size was used by the local shire to store water at their public wells, and also at public buildings. Farmers used 200 and 100 gallon sizes (the latter is not confirmed from other sources). Andrews thought that the tanks came from England filled with clothing consigned to large warehouses,¹⁰⁷ which seems somewhat unlikely, though many other goods were certainly transported in them. It was stated by the London maker Frederick Braby, in 1883, that:

These Tanks are now extensively used as Packing Cases, they being found to convey goods more safely and free from damage by water, &c., than do

¹⁰¹ Edward Snell [ed Tom Griffiths], *The Life and Adventures of Edward Snell* (North Ryde [New South Wales] 1988), p 357.

¹⁰² Battye Library, reproduced in D I Stone & D S Garden, *Settlers and Squatters* (Sydney 1978), pp 42-3.

¹⁰³ Edward Webster to Henry Henty, 1875, quoted in Andrew Lemon, *The Young Man from Home* (Melbourne 1982), p 54.

¹⁰⁴ See, for example, G W Lilley, *Barcoo Saga* (Melbourne 1975), p 37.

¹⁰⁵ L J Blake [ed], *Vision and Realisation* (3 vols, Melbourne 1973), I, p 1507.

¹⁰⁶ Unsigned working drawings, apparently by James & Piper of Ballarat, held at the property: copy kindly supplied to me by Dr Kerry Jordan.

¹⁰⁷ Andrews, 'History of Merrigum', p 52.

ordinary wooden cases. The cover is hermetically fastened down after the goods are packed. They are readily sold at a good profit when they arrive abroad, especially in the Colonies, where they are eagerly bought up for use as water tanks, for which ultimate purpose they are appropriately made.¹⁰⁸

This explains why trade names are sometimes found painted on the side of the tanks, even in public buildings where one normally would not expect to find second hand materials. At the homestead on Churchill Island, Victoria, a number of these tanks used to receive rainwater from the roof, and the only one now surviving on the property is branded on two faces

[upward arc:
MURRAYS
]
[scroll ornament]
CARMELS

together with a separate message in two diagonal lines:

FOR INSULATED
HOLD STOWAGE

At the Kew Lunatic Asylum a 'Keen's Mustard' sign was found on one tank. At this institution there were originally 68 tanks, holding 1,670 litres each, but they were described by an engineer as 'old malt bins', and were replaced in 1885-6 with sixty-four 'new ships tanks'.¹⁰⁹ At 'Benvenuta', Melbourne, in 1891, a 400 gallon 'malt tank' was specified for the laundry,¹¹⁰ but it is not clear that this means a malt bin of the sort used at Kew, for the volume is that of a ship's tank. Tanks at 'Boisdale', Victoria, bear inscriptions 'Pears Soap' and 'Stow Away From Heat'.¹¹¹

Both 'Keen's Mustard' and 'Keen's Oxford Blue' signs are found on tanks at Ayrdale, near Candelo, New South Wales. Here the Scottish merchant and pastoralist W V Black accumulated scores of the tanks, and the present owner, Mr Charles Mueller, estimates that there are 220 there today. A part of the story of the Ayrdale tanks emerges from the diaries of J M Black in 1879-80, though some of the entries are rather enigmatic. In November 1879 Black records that Edward has returned from Merimbula (the nearest port) with one ton of flour and three tanks, with much of the flour apparently contained in the tanks. Two weeks later Edward takes a tank and a number of empty kegs back to Merimbula while obtaining more supplies. In the succeeding weeks more tanks are collected, but none seem to be returned, and on 19 December comes the first reference to their being installed on the property: 'Edward and Tom putting holes in tanks to connect with big tank.' In the following February a stand was built at the end of the house, and four tanks installed upon it. Next a tank

¹⁰⁸ *Frederick Braby & Company (Limited) London, Liverpool, Glasgow, and Deptford, &c* [catalogue no 9, London 1883], p 134.

¹⁰⁹ *** Miles Lewis & Overend, *Kew Lunatic Asylum*, pp 109-111.

¹¹⁰ W S Law, 'Specifications of Residence Drummond St. Carlton for Mrs. L. Abrahams' (Melbourne 1891), p 35.

¹¹¹ Reported by Paul Roser, March 2001, from inspection.

was installed to catch rainwater at the 'shingle house' - the original dwelling on the property, and a stand with four tanks behind the curd house.¹¹²

f. tank manufacturers

At 'Strathfieldsaye' homestead, Gippsland, is a tank, now built in and somewhat inaccessible, which bears a stencilled brand on the side:

[?MADE]
W B BAWN & CO
IN
ENGLAND

adjoining which is an unusual brand showing a sailor standing at a tiller, next to which is a pole carrying a flag with a St George's cross (though monochrome), with the waves of the sea below, and the words 'trade mark'. Overlaid on the label and the trade mark is a large stencil 'MORTON'.¹¹³ Morton's name is also reported to have appeared on at least one of three iron tanks removed from the mansion 'Raheen' in Kew, Melbourne, but he must have been the shipper of the contents whilst Bawn was the maker of the tank.¹¹⁴ His product was Epsom salts,¹¹⁵ and a tank at 'Ellasvale', Gippsland, bears a partly obscured brand:¹¹⁶

[broken circle crossed by the word:
MORTON
]
[....] LONDON ENGLAND
[E]PSOM SALTS
[PR]ODUCT OF
..] ENGLAND

The fact that the tank contained Morton's Epsom salts does not necessarily mean that Bawn manufactured it, and nor of course would Bawn's tanks be used solely by Morton. Bawn's name as manufacturer appears on tank lids at Warrock, near Casterton, both alone and as Lancaster & Bawn.

The brands on tank lids found to date are (where the sunk panel is used the text is italicised):

'W.B. BAWN & CO.¹¹⁷
BYRON/TANKWORKS
POPLAR LONDON E.'

¹¹² Photograph, and extracts from diary of J M Black kindly supplied by Mr & Mrs Charles and Carol Mueller of Ayrdale. A note at the end of the 1879 diary reads 'J.T.J. Toohey Iron Tanks £200-10-0', but unfortunately does not indicate whether Toohey is buying, selling, or simply transporting the tanks for this price.

¹¹³ Investigated by George Phillips, Anne-Marie Treweeke & Julie Willis, 1992.

¹¹⁴ As advised by Andrew Muir.

¹¹⁵ Mr Tom Cartwright of Rockhampton believes that he recalls seeing a Morton's Epsom Salts brand on the side of a ship's tank. Tom Cartwright to the author, 21 March 1994.

¹¹⁶ 'Ellasvale', Maffra Road, Gippsland, inspected 1994.

¹¹⁷ Warrock; also reported by Pearson at Mt Wood Station, Tibooburra, NSW, Broken Hill and Echuca.

BRABY & CO.¹¹⁸
LONDON'

[continuous circle of lettering:¹¹⁹
BURNEY & CO. MILLWALL DOCKS LONDON
]

[outer circle containing an upward arc¹²⁰
CALVERT LAW
and a downward arc
LONDON
]

[inner circle in the sunk panel containing an upward arc
LEONARDS ROAD
and a downward arc
POPLAR
]

JOHN BELLAMY¹²¹
BYNG ST.
MILLWALL
LONDON

or

JOHN BELLAMY
BYNG ST. LONDON

LANCASTER & BAWN¹²²
POPLAR LONDON

LANCASTER & CO¹²³
BOW
TANK WORKS
BOW LONDON

[upper arc two-thirds of a circle:¹²⁴

-
- ¹¹⁸ Ayrdale. Pearson reports 'F. Braby & Co., London' at Gulgong and at Peterborough, SA.
¹¹⁹ Mugga Mugga cottage, ACT; Ayrdale; Kew. Pearson reports them at Mt Wood Station; Tungkillo, SA; Clermont Museum, Queensland; Gulgong; Kingsdale limekilns, NSW; and Kapunda, South Australia.
¹²⁰ Yackandandah Bank Museum, Victoria, inspected 2005.
¹²¹ Ayrdale; Illawarra, Toorak; Warrock (both); 'Bishop's Lodge', Hay; 'Eeyeuk', Victoria; Ward's Mill, Kyneton; 'Boisdale' homestead (the shorter version). Pearson reports them at Tumbarumba, NSW; Macquarie Island (in an 1890s context), the Quarantine Station, Sydney; and Willandra station, NSW.
¹²² Warrock; 'Boisdale' homestead. Pearson reports one at Bowral, NSW.
¹²³ Ayrdale; shearing shed, 'Murndal', Western Victoria. Pearson reports the last line as 'Bow London E.', and finds them at Coolgardie, WA; Gulgong; the Quarantine Station, Sydney; and Blundells Cottage, ACT.

LANCASTER & CO (BOW) LIMITED
 BOW
 [central opening]
 LONDON

WANNOP & DAVIE¹²⁵
 LIVERPOOL

In fact these tanks had become quite standardised, and were of cubic form, rivetted, and with a circular lid, sometimes central in the upper face, and sometimes towards one corner. Frederick Braby & Company of London offered the two sizes which have been described above.

Some or all of the Burney tanks at Ayrdale have a small round plate near one of the corners on the top face inscribed

BURNEYS
 MADE
 WITH
 PATENT-CORNERS

and the corners terminate in a sort of knob.¹²⁶ At the Sydney Exhibition of 1879 Burney & Co showed a range of iron water and other tanks, which were available either painted or galvanised. All of them used the company's patent corners, and it was stated that the [British] Admiralty required these corners to be used on all tanks supplied to the Royal Navy.¹²⁷ A further British patent was taken out by G Burney in 1891 for 'rivets or corner pieces for metal tanks and cisterns ... shaped to fit into the recess formed by the overlapping of the plates,' but the advantages are not immediately apparent.¹²⁸

In the roof space of the house 'Illawarra', Melbourne, of 1888-9 have been found five or six tanks of the larger size but, it is believed, the lighter quality. They bear the brand of John Bellamy of Byng Street, Millwall, and also have the stencilled label of W H Lamond.¹²⁹ At 'Parlington', a mansion built in 1889 in the Melbourne suburb of Camberwell, are tanks labelled:¹³⁰

FROM
 W.H. LAMOND
 COAL, GRAIN & TANK
 MERCHANT
 [6]5 FLINDERS ST EAST &
 29 FLINDERS ST WEST
 MELBOURNE

¹²⁴ A galvanised tank, former stables, 'The Ridge', Boisdale, Victoria.

¹²⁵ Ayrdale. Pearson reports the second name as 'Davies' and finds one at Gulgong.

¹²⁶ Pearson reports the same label at Gulgong, Kingsdale and Kapunda.

¹²⁷ Sydney International Exhibition 1879, *Official Catalogue of the British Section* (London 1879), p 301.

¹²⁸ Great Britain, patent no 197 to G Burney, 25 January 1891.

¹²⁹ Ian Coleman, Ros Coleman & Anne Neale, 'Illawarra Conservation Analysis Report' [draft typescript report, 1990], p 52.

¹³⁰ Investigated in 1997 by Janet Beeston, who does not specify the number of tanks or their manufacturer.

The second address has been struck out of the stencil itself. This is the first indication of there being a specialist dealer in ships' tanks. At 'Boisdale' homestead near Maffra, Victoria, is a tank reportedly bearing the label of W H Lamond [? & Co], but now of 326 Flinders St, Melbourne (the numbering system having been changed at this time). In 1907 ships' tanks were being advertised by Anthony Hordern & Sons of Sydney.¹³¹

Pearson has searched Kelly's London Post Office directories from 1856 onwards for British makers of ships' tanks, and has found as many as fifty-six, but of these only five appear in the 1850s, whilst some appear for the first time in the 1920s or even the 1930s, after which the trade seems to die out. Of those brands found in Australia Burney & Co date from the 1860s, Bellamy from the 1860s to the 1930s, Lancaster & Bawn from the 1870 to 1890s, Braby from the 1870s to 1930s, Bawn from the 1890s, and Wannop & Davie, being Liverpool makers, are not listed.¹³² In the 1930s Braby's tanks were still rivetted boxes, but were galvanised and were not standardised in size as before.¹³³ In Australia McLean Brothers & Rigg of Perth and Kalgoorlie had available in about 1930 galvanised tanks in 100, 200 and 400 gallon sizes, with either rivetted or screwed tops, each with a manhole.¹³⁴ In Melbourne D & W Chandler's catalogue illustrates them until at least 1939, describing them simply as square iron tanks made in England, but giving no technical details or dimensions.¹³⁵

g. wooden pipes

Wooden pipes have a history going back to prehistoric times, and solid trunks of elm, alder or oak with the core bored out were traditional to most parts of Europe, though there were difficulties in joining them reliably. In England in the seventeenth century two metre lengths of elm, and sometimes of fir, were normally bored out with long augers, countersunk at one end and tapered at the other, so as to fit together. The socket end was usually reinforced with iron hoops to prevent it from splitting when the pipes were driven together, but even so the joints could not withstand high pressures. They were used for water mains, for which the limited diameters available in lead piping were not adequate. Even these wooden pipes could rarely exceed about 800 mm internal diameter, and it was not uncommon to lay up to four lines in parallel so as to achieve the required capacity. When Sir Hugh Myddleton built the first reticulated water supply system for London, from 1612, he laid about 640 km of wooden pipes, mainly of elm, though they decayed rapidly and burst under frost, and so were replaced in cast iron as this became increasingly practicable.¹³⁶ A wood pipe laid in Oxford Street, London, in the reign of Charles I, was taken up late in the

¹³¹ Walter Jeffries, *The Australian Building Estimator* (Sydney 1907), advertisements, no page.

¹³² Pearson, 'Ship to the Bush', p 28.

¹³³ J E Sears & J E Sears [eds], *The Architects' Compendium and Annual Catalogue* (London 1936), p 538.

¹³⁴ McLean Bros & Rigg Limited, *Catalogue: General Hardware &c* (Perth, no date [c 1930]), p 21.

¹³⁵ D. & W. Chandler Ltd., *General Hardware Catalogue Issue No 51* (Melbourne 1939), p 75.

¹³⁶ Samuel Smiles, *Lives of the Engineers* (3 vols, London 1862), I, pp 126-7; Wyatt Papworth [ed], *The Dictionary of Architecture* (London 1853-92), sv Water Main.

nineteenth century, and a section of it was displayed in the Technical Museum, Sydney.¹³⁷

One wooden pipe factory was that of the New River Company, which had its horse mills and boring yard at Dorset Stairs, northwest of Blackfriars Bridge, London. It is surmised that this company supplied the wooden pipes which have been discovered in recent times under Hampstead Road, and it may well have supplied pipes to Australia. The useful life of such pipes varied from four to twenty-five years, but when reticulated gas supply was introduced they were found to absorb leaking gas, and their death knell was sounded when Thomas Simpson invented the spigot and socket joint for cast iron pipes in 1784.¹³⁸ Nonetheless about seventy kilometres of wooden pipe were laid for the water supply of Philadelphia in about 1797-1801, and they are said to have been mostly in good condition when taken up a hundred years later.¹³⁹ They are described as bored pine logs with conical faucet and spigot ends, strengthened with wrought bands.¹⁴⁰ At about the same date the French laid the water mains of New Orleans in 5.4 metre by 550 mm diameter logs, with a 130 mm hole bored through them, and they were said to be in excellent condition when replaced a century later. A three kilometre length of three inch [75 mm] bored wood pipe laid in 1829 at Fayetteville, was said to be still in use about 1910.¹⁴¹

In Australia such pipes may have been common well into the nineteenth century, and an erratic pipeline made up of what are reported to have been bored-out ironbark logs was laid in Brisbane some time before 1839.¹⁴² The surprising aspect is not that such pipes were laid, but that so intractable a timber was used, and one must query whether this was really the case, or whether the pipes were imported ones made of a British species.

In the USA Wyckoff's Patent Pipe seems to have appeared after the mid-century, and certainly before the 1870s, and it may well be the last manifestation of the type bored out of a solid log. It was of white pine, and the joint was formed over what was rather misleadingly referred to as a 'thimble' - actually a small cylindrical piece of the same internal diameter as the pipe proper but only half the thickness. The two pieces to be joined were both rebated out to create sockets into which this piece fitted, so that the external diameter was also constant. The patent also provided for a spiral band of hoop iron around the outside of the pipe, to resist pressure, and for a coating of asphalt. These pipes were manufactured at Bay City Michigan, and had been used in a number of western towns, but it appears that they were similar in price to wrought iron pipes.¹⁴³

¹³⁷ The Australian Wood Pipe Co Ltd, *Catalogue of Wood Pipe No.3* (Balmain [New South Wales], nd [c 1911]), p 20.

¹³⁸ *CHS Newsletter* [Construction History Society], no 33 (June 1993), pp 7-8.

¹³⁹ C E Mayes, *The Australian Builders & Contractors' Price Book* (9th ed, Sydney 1927), p 398. The earlier date is from Fanning, *infra*.

¹⁴⁰ J T Fanning, C E Mayes, *A Practical Treatise on Hydraulic and Water-Supply Engineering, &c* (New York 1884 [1877]), p 491.

¹⁴¹ Australian Wood Pipe Co, *Catalogue No.3*, pp 8-9.

¹⁴² J G Steel, *Brisbane Town in Convict Days 1824-1842* (St Lucia [Queensland] 1975), figs 58, 115.

¹⁴³ Fanning, *Water-Supply Engineering*, pp 491-2.

In 1806, a British patent had been obtained by Eckhardt and Lyon for making pipes out of tongued and grooved wooden staves bound around by hoops, like an elongated barrel.¹⁴⁴ A further British patent by Harper, probably of the 1870s, represents no very obvious advance, but the pipes were put into production at Gloucester, in sizes up to 900 mm diameter, 75 mm thick, and 7.2 long.¹⁴⁵ I K Brunel's famous hospital at Renkioi in the Crimea, in 1855, had an extensive system of tarred wooden sewerage pipes,¹⁴⁶ which presumably were stave-built. Numerous American cities seem to have installed wood stave pipes from 1874, when a line of 1.8 metre pine wood stave pipe was built at Manchester, New Hampshire.¹⁴⁷ The Southern California Mountain Water Supply Company had over thirty kilometres of main in 0.0 and 1.05 metre diameter wood pipe under a maximum head of eighty-eight metres.¹⁴⁸

Nine hundred wood stave pipes were imported to Victoria from Great Britain in 1856; others were used for sewerage at the Fremantle gaol during the 1850s (though they were already leaking by 1859);¹⁴⁹ and in Adelaide stave pipes were used in 1860 to bring water from the Thorndon Park Reservoir.¹⁵⁰ In 1864 a Victorian patent was granted to B H Dods (probably of McKay, Dods & Co, plumbers) for 'an arrangement of timber, prepared or not, embedded in certain plastic cement, composed of bitumen, asphalte, silica, etc., and impervious to water and gases'.¹⁵¹ Regrettably, it has not been established whether McKay Dods & Co proceeded to market or to manufacture these. Nor do we know whether anything eventuated from a patent taken out in 1889 by Robert Barbour, timber merchant, squatter and member of the New South Wales Parliament.¹⁵² This was for an 'Improved wooden water-pipe or aqueduct for carrying water'.¹⁵³

A new patent for wooden stave pipes was taken out in Australia in 1908,¹⁵⁴ in which the novelty appears to have consisted in the fact that the pipes were wound spirally with galvanised wire, then coated with steam heated bituminous solution, wrapped with hessian, and then recoated to give a skin 6 mm thick. The range of pipes available was from three inches [76 mm] to fourteen feet [4.2 m] diameter. The smaller pipes, up to 600 mm diameter, were machine banded, but the larger were built

¹⁴⁴ British patent of George Eckhardt & Joseph Lyon, 18 December 1806: *Repertory of Arts*, X, (1807), pp 425-6; see also Abraham Rees [ed], *Cyclopaedia, or Universal Dictionary of Arts, Sciences, and Literature* (London 1819), sv Pipe.

¹⁴⁵ William Eassie, *Healthy Houses* (New York [?London] 1879), p 10.

¹⁴⁶ Pedro Guedes, *The Macmillan Encyclopedia of Architectural and Technological Change* (London 1979), pp 148, 205.

¹⁴⁷ Australian Wood Pipe Co, *Catalogue No.3*, pp 10-12, 18.

¹⁴⁸ Australian Wood Pipe Co, *Catalogue No.3*, pp 11-12.

¹⁴⁹ References supplied by Michal Bosworth from the data base on Fremantle Gaol. BL ACC1156 C6 (Superintendent's Letterbook, 1857-1859), PD 330: Superintendent Lefroy, 12 September 1859. BL ACC1156 C23 (Comptroller General's Letterbook,), PD 1391, 15 September 1859.

¹⁵⁰ Ken Nelson, *Water Resources* (Melbourne 1979), p 70, quoted by James Doulgeridis, University of Melbourne 1992.

¹⁵¹ Victorian patent no 718 to Benjamin Hawkins Dods, 2 June 1864.

¹⁵² Clarence Karr, 'Robert Barbour (1827-1893)', in N B Nairn et al, *Australian Dictionary of Biography*, III (Melbourne 1969), pp 88-9.

¹⁵³ *Australasian Builder & Contractor's News*, 16 March 1889, p 263.

¹⁵⁴ In C E Mayes, *The Australian Builders & Contractors' Price Book* [8th ed, Sydney 1914], advertisement p 8, the pipe illustrated is marked, and in Australian Wood Pipe Co, *Catalogue No.3*, cover it is captioned Patent No 11398 30/4/08 (the last digit of the patent number is clear in the latter, not the former).

up on the designated site on the 'continuous stave principle'.¹⁵⁵ These were marketed under the 'Pioneer' brand, advertised in 1911 by the Australian Wood Pipe Co, with works at Booth's Wharf, Balmain, Sydney, and agents in Victoria, South Australia, Queensland and Western Australia.¹⁵⁶ In the same year the company took a stand at the Sydney Show to display its pipes and its patent service connectors or 'knock down couplings'.¹⁵⁷

In 1908 wood pipes, presumably of this type, were used for the first time in modern Australia to bring the waters of the O'Shannassy River into the Melbourne water supply network,¹⁵⁸ and seven kilometres of 200 mm pipe were used by the Metropolitan Board of Water Supply and Sewerage, Sydney, for the water supply of Camden, New South Wales.¹⁵⁹ In 1910 the Melbourne & Metropolitan Board of Works installed a length of six inch [150 mm] pipe, and in the following year a length of 900 mm.¹⁶⁰ In 1911 the company supplied 19 km of 300 mm pipe to the Horsham Water Works Trust to take water from Burnt Creek to Horsham, Victoria,¹⁶¹ and in 1911 the pipes were used at the Port Kembla works of the Electrolytic Refining and Smelting Company of Australia.¹⁶² The company was able to cite a number of other customers amongst mining companies, pastoralists and irrigation authorities in all states of Australia and in New Zealand.¹⁶³

The company now claimed to have considerably expanded its Balmain works and improved the product, notably by covering the pipe with saturated hessian outside the bitumen layer (as indicated in the patent). The staves were of oregon timber, and the pipe *could* be manufactured to resist 500 ft [150 m] head.¹⁶⁴ By 1914 there were additional works at Footscray in Victoria, and Port Adelaide, South Australia. The pipes must have been used at Broken Hill, where on 1 January 1915, Alf Millard, said to have been a long standing employee of the Wood Pipe Company, was killed in the only action of World War I to take place on Australian soil. This was when two Muslims, in an icecream cart flying the Turkish flag, opened fire on the train going to the MUIOOF New Year's Day picnic.¹⁶⁵

In 1910 the New South Wales Public Works Department laid fourteen inch [350 mm] wood stave pipe as a main for the water supply of towns north of Wollongong, and in 1911 eleven kilometres of four and six inch [100 7 150 mm] pipe was laid by the Metropolitan Board at St John's Park. The pipe had already been used successfully in

¹⁵⁵ *Town and Country Journal*, 19 April 1911, p 34.

¹⁵⁶ *Building*, 12 December 1911, p 24. The agents were Wm Adams & Co, Melbourne; F M Whitney, Adelaide; E S C A Co, Brisbane; and Harris Scarfe & Co, Perth. The company's catalogue (as quoted by Mayes) states that its pipes were first used in 1908).

¹⁵⁷ *Town and Country Journal*, 19 April 1911, p 34.

¹⁵⁸ Tony Dingle & Caroline Rasmussen, *Vital Connections* (Melbourne 1991), p 118.

¹⁵⁹ C E Mayes, *The Australian Builders Price Book* [1927], p 399; *Building*, 12 June 1911, p 102.

¹⁶⁰ *Building*, 12 June 1911, p 102.

¹⁶¹ *Building*, 12 June 1911, p 102; Ambrose Pratt [ed], *The National Handbook of Australian Industries* [Melbourne 1934], p 557. Pratt dates this to 1909, but the *Building* report uses the present tense.

¹⁶² Mayes, *Australian Builders Price Book* (1914), advertisement p 8.

¹⁶³ *Building*, 12 June 1911, p 102.

¹⁶⁴ Australian Wood Pipe Co, *Catalogue No.3*, p 3.

¹⁶⁵ Steve Packer, 'The Odd Angry Shot', *Good Weekend*, 3 January 1998, p 14, ref Christine Stevens, *The Mosques and Ghantowns: a History of Afghan Cameldrivers in Australia* (1989),

other parts of New South Wales including Namoi and Wakool.¹⁶⁶ In 1925 a length of twenty inch [510 mm] stave pipe was laid within the Sydney water supply system proper as a temporary connection spanning the Parramatta River, between Pipe Head and Ryde, though it proved less than satisfactory.¹⁶⁷ In 1926 the Australian Wood Pipe Co's 46 inch [1.17 m] wood stave pipe was used to connect Upper Canal to the Pipe Head and Potts Hill reservoirs. The choice was made because the connection was urgent, and steel piping would have required a greater delay.¹⁶⁸ In 1927 the company's New South Wales headquarters were at Lane Cove, and its only other branch appears to have been that at Footscray. Its 1926 catalogue described the pipes as 'constructed of staves of selected oregon timber accurately dressed both sides with double "V" joints bound with No. 4 gal. mild steel wire and coated with asphaltum'. In salty marsh, or in acid soil, they were further wrapped in hessian and asphalt. The pipe was made in diameters from ten inches [250 mm] to fourteen feet [4.2 m] and always built on site.¹⁶⁹

The 'patent non-corrosive wood pipes' which were sold in Tasmania by the local agents A E Evershed & Co of Launceston,¹⁷⁰ were presumably also of the Pioneer brand. In Tasmania they were extensively used in mining, but they were also put to urban uses. In the upgrading of the Waddamana hydroelectric power station, Tasmania, in about 1920, stave pipes of up to four metres diameter were designed by J H Butters to circumvent a shortage of steel pipe caused by industrial disputes on the mainland. They were designed for a pressure of 1400 kilopascals, and remained in use for more than twenty-five years.¹⁷¹ The pipes were also utilised for water supply in Melbourne suburbs up to the Great War, and in 1922 a ten inch [250 mm] wooden pipe was laid as part of the Grampians water supply system in Western Victoria.¹⁷² Some of these were salvaged in the 1930s by Walter Zumstein and laid at his settlement in the Grampians, known as Zumsteins, where they survive today.¹⁷³ In 1931 wooden pipes were used in the new water supply system at Beaufort, Victoria.¹⁷⁴ A section of small diameter piping from Trentham water supply system is held in the local museum at Kyneton, Victoria.

In 1933 the company established a factory at Victoria Park, Western Australia, where it used the local karri timber exclusively, and orders were obtained for 24 and 30 inch [600 mm and 750 mm] pipe for the Kalgoorlie water supply.¹⁷⁵ By now, however, the days of the wood pipe were numbered. In 1928 thirty inch [750 mm] machine banded stave pipe was used in the Manly scheme,¹⁷⁶ in 1938 a fifteen inch [380 mm] wood

¹⁶⁶ *Building*, 12 June 1933, pp 102-3. W V Aird *The Water Supply, Sewerage and Drainage of Sydney* (Sydney 1961), p 98, appears to date the Wollongong pipeline to 1915, but *Building* in 1911 reproduced a photograph of the pipes actually in transit to Wollongong on a lorry.

¹⁶⁷ Aird, *Water Supply of Sydney*, p 70.

¹⁶⁸ Aird, *Water Supply of Sydney*, pp 43, 47-8.

¹⁶⁹ Quoted in Mayes, *Australian Builders Price Book* [1927], p 398.

¹⁷⁰ *Leatherwood*, I, 3 (Winter 1992), p 64.

¹⁷¹ Brian Carroll, *The Engineers* (Barton [ACT] 1988), pp 113-4. For an illustration see Brian Carroll, *The Builders* (North Ryde [NSW] 1981), p 75.

¹⁷² Donald Garden, *Hamilton* (Melbourne 1984), p 216.

¹⁷³ Some are in situ and others can be seen in the creek: information from Jenny Gardner, 1997.

¹⁷⁴ Hugh Anderson, *The Flowers of the Field: a History of Ripon Shire* (Sydney 1961), p 164.

¹⁷⁵ Pratt, *The National Handbook of Australian Industries*, p 557.

¹⁷⁶ Aird, *Water Supply of Sydney*, p 82.

main was laid to supply the Illawarra suburbs,¹⁷⁷ and in 1939 another was laid for the Engadine and Heathcote districts.¹⁷⁸ After this time no new mains were laid in the Sydney system, and those in existence were progressively replaced, because the pipe was no longer regarded as satisfactory.¹⁷⁹

A Canadian engineer, H N Macpherson, developed a form of stave pipe which seems to have been quite independent of the Australian version. The staves were shaped out of two by four inch [50 x 100 mm] douglas fir, white pine or hemlock (or any softwood capable of absorbing creosote). Each piece was tongued and grooved in a profile which allowed for the construction of pipes from twelve to thirty inches [300-750 mm] diameter, according to the number of staves. The pipes were held together by steel hoops of a T cross-section, tightened by bolts.¹⁸⁰

h. lead pipes

Lead pipes are of interest because of the problem of lead poisoning. There was a surprisingly active lead pipe manufacturing industry in Melbourne, fostered by the establishment of both the water and the gas supplies, and of course sustained by the government policy of protection for native industry. The traditional way of making lead pipe had been to cast a squat cylinder, and then draw it out, for to form it by extrusion would involve a line of weakness where the opening was bridged to support the core of the die. However, this problem had been solved by Joseph Bramah's patent of 1797, in which the molten lead was pumped into the funnel-shaped end of an otherwise cylindrical tube. The tube contained a core, but this was supported only by a bridge across the funnel end. As the funnel was kept hot, the lead passed the bridge whilst still in a molten state, and no trace of the bridge was left. At the other end of the tube the pipe was discharged into a cistern of hot water.¹⁸¹

James Coop established a lead works in 1854, began making pipes three years later,¹⁸² and in 1859 announced that he had installed a hydraulic pipe-making machine incorporating an improvement of his own invention (which does not appear to be of much significance).¹⁸³ The Scottish plumber John McIlwraith opened a lead works in 1855 and began making pipes in 1858. Some of these hydraulic machines were worked simply by mains water pressure from the new Yan Yea reservoir, and in 1861 Joseph Ballinger exhibited 'One foot of 3/4 inch Lead Pipe, part of the first pipe made by hydraulic power of Yan Yean. B H Dods, another lead worker, showed hydraulic apparatus and machinery.'¹⁸⁴

¹⁷⁷ Aird, *Water Supply of Sydney*, p 89.

¹⁷⁸ Aird, *Water Supply of Sydney*, p 92.

¹⁷⁹ Aird, *Water Supply of Sydney*, p 120. Aird dates the change of policy to 1934, but this is inconsistent with the information above.

¹⁸⁰ Francis Lockyer, 'Timber as a Building Material', in John Madge [ed], *Tomorrow's Houses: New Building Methods Structures and Materials* (London 1946), p 106.

¹⁸¹ Abraham Rees [ed], *The Cyclopædia, or Universal Dictionary of Arts, Sciences and Literature* (45 vols, London 1819), sv 'Pipe'.

¹⁸² Intercolonial Exhibition, Melbourne, 1866-7, *Official Record* (Melbourne 1867), p 327.

¹⁸³ C B Mayes, *The Victorian Contractors' and Builders' Price-Book* (Melbourne 1859), p liii. For the nature of Coop's invention see Miles Lewis, 'Tradition and Innovation in Victorian Building' (3 vols, PhD, University of Melbourne 1972), II, p 363.

¹⁸⁴ Intercolonial Exhibition, *Official Record*, p 203.

It is not clear who supplied the Commissioners of Water Supply and Sewage with what became known as 'the poison pipe',¹⁸⁵ but it seems that while the contract specified a content of 95% lead and 5% tin, there was a provision for variation, whereby the contractor was permitted to supply lead pipes with a tin lining. It proved that the tin coating was washed off by electrolytic action, and the commissioners had to ask consumers to run off the first water each morning so as to get rid of the dangerous lead salts which it had accumulated overnight. At first it was proposed, on the advice of Dr Macadam, to insert a spiral of zinc in the pipes already laid 'by which means the voltaic action upon the two metals in the presence of water ... is entirely prevented',¹⁸⁶ but in the event it was recommended that all the pipes be taken up and melted down.¹⁸⁷ In Britain there was a similar re-evaluation of tin-lined pipes, and in the 1860s Professor Frankland asserted that 'soft water, circulating through leaden pipes, is soon entirely protected by the formation of an insoluble coating on the interior of the pipes', whereas 'tinning the interior of the pipes is dangerous, inasmuch as abrasions would cause the formation of a voltaic circuit and cause the rapid solution of the lead.'¹⁸⁸

The paradoxical aspect of all this is that tin-lined lead pipes had first been developed and patented in 1804 by George Alderson in England,¹⁸⁹ and later by Burr in 1836 and by Seville, in Paris, in 1853, specifically to overcome the poisoning problem.¹⁹⁰ Subsequently, towards 1863, one Bennett developed his own method of tinning lead pipe, and manufacture on his system began in New York in 1867. Then Haines's lead-encased block tin pipe was introduced in England towards 1869,¹⁹¹ and specimens of it were shown at the Sydney exhibition of 1870 by A Chisholm of Pitt Street.¹⁹² This was not simply a lining of tin inside a lead pipe, but a block tin pipe surrounded by a lead pipe, the two being so closely united that no joint was visible and no amount of bending or twisting would separate them. The pipe could be drawn out from a short casting, just as was done with a pure lead pipe, and the two metals would stretch together. However, soldering was difficult because tin melted at a lower temperature than lead, and mechanical joints were preferable.¹⁹³ As late as

¹⁸⁵ Victoria, *Votes and Proceedings of the Legislative Assembly 1859-60*, II, pp 237 ff, D26, 'Progress Report of Select Committee upon the Tariff', pp 128-130.

¹⁸⁶ R C Seeger, 'The History of Melbourne's Water Supply - Part 2', *Victorian Historical Magazine*, XXII, 1 (June 1947), pp 29, 31-2, ref Victoria, *Votes and Proceedings of the Legislative Assembly 1858-9*, D27, 'Report of Select Committee upon water from the Yan Yean Reservoir'.

¹⁸⁷ Victoria, *Votes and Proceedings of the Legislative Assembly 1859-60*, II, D63, 'Report of Select Committee on the Yan Yean Purification', p vi.

¹⁸⁸ *Cassell's Household Guide to every Department of Practical Life* (4 vols, London, no date [1869-71]), I, p 163.

¹⁸⁹ George Alderson, patent of 26 January 1804, given in *Repertory of Arts*, V, 2nd series, 30 (1 November 1804), pp 413-5; see also Rees, *Cyclopaedia*, sv Pipe.

¹⁹⁰ Wyatt Papworth [ed], *The Dictionary of Architecture* (London 1853-1892), sv Tinned Lead Tube or Pipe. Reference is made to Séville in the *Australian Builder*, 26 November 1859, p 377.

¹⁹¹ Papworth, *Dictionary of Architecture*, sv Tinned Lead Tube or Pipe, referring, for Bennett, to the *Building News*, X (1863), p 81, and for Haines to *Building News*, XVII (1869), p 353, and *Architect*, 27 August 1870. For Haines see also *The Technical Educator* (4 vols, London, no date [in parts c 1870]), III, p 245.

¹⁹² *The Industrial Progress of New South Wales* (Sydney 1871), p 79.

¹⁹³ *Notes on Building Construction, part III, Materials* (London 1879), p 329.

1888-9 tin lined lead pipe was exhibited in Melbourne by Quirk, Barton & Co of London.¹⁹⁴

i. paper pipes

Not only are paper pipes largely forgotten today, but most people find it difficult to believe that they ever existed. For this reason alone some discussion of them seems justified, notwithstanding the fact that their uses appear to have been far more industrial than domestic. They were invented in Paris in about 1859, and were made by melting bitumen with a proportion of chalk, passing paper through the liquid, and then rolling it onto a pipe mandril of the required size. The whole assemblage was then dipped in a cauldron of pure bitumen, the mandril removed, and the inside also dressed with bitumen.¹⁹⁵ They were a quarter the weight of iron pipes, and could withstand a pressure of over 1500 kilopascal, equivalent to a head of 150 metres of water. Others used in Switzerland, however, had proved susceptible to insects.¹⁹⁶ In 1861 the English excise duty on paper was lifted,¹⁹⁷ and soon afterwards a coarse brown paper pipe began to be made at Bow, by dipping the paper in tar and then rolling it around a cylindrical core.¹⁹⁸ Already, in 1860, the Melbourne *Argus* had quoted an English report of the supposed invention of the pipes by one John Kennedy,¹⁹⁹ whose patent had been extended to Victoria by an agent.²⁰⁰ This agent was probably Charles Lyon of Ballanee, who received a Victorian patent in March 1860,²⁰¹ though another was issued in July to Charles Newbold.²⁰² Lyon's patent describes pipes of paper or linen with a coating of waterproof varnish, and a further coating externally of bitumen and sand. Newbold's pipes were similar.

In 1860 Captain N W D Anderson, who apparently held rights to one or other of the patents, began building a paper pipe factory in Melbourne,²⁰³ and he was producing the pipes in time to show them at the 1861 exhibition.²⁰⁴ His company was the Patent Bitumenized Pipe Company, managed by H A Doulton,²⁰⁵ and it sold pipes in two light grades intended for gas and drainage work, to be subjected to little pressure, and two heavier grades for force and lift pumps, and water supply mains.²⁰⁶ On 29 April

¹⁹⁴ Centennial International Exhibition 1888-1889, *Official Record* (Melbourne 1890), pp 468, 985.

¹⁹⁵ *Mechanic's Magazine*, 29 April 1859, p 289.

¹⁹⁶ Papworth, *Dictionary of Architecture*, sv Pipe.

¹⁹⁷ J R McCulloch [ed H G Reid], *Dictionary of Commerce and Commercial Navigation* (London 1871 [1832]), sv Paper.

¹⁹⁸ Papworth, 'Pipe', ref *Builder*, 31 March 1866.

¹⁹⁹ *Argus*, 20 August 1860.

²⁰⁰ C B Mayes, 'Essay on the Manufactures more immediately required for the Economical Development of the Resources of the Colony', in *Victorian Government Prize Essays 1860* (Melbourne 1861), p 346.

²⁰¹ Victorian patent no 319 to Charles Hugh Lyon, 13 March 1860. The patent is listed, with Lyon's address as Ballanee, in C B Mayes, *The Australian Builders' Price-Book* (Melbourne 1862), p 144.

²⁰² Victorian patent no 353 to Charles Newbold, 9 July 1860.

²⁰³ F A Corbett to Alexander Tolmer, 18 December 1860, in Alexander Tolmer, *Reminiscences of an Adventurous and Chequered Career* (2 vols, London 1882), I, p 299.

²⁰⁴ Victorian Exhibition 1861, *Catalogue with Prefatory Essays* (Melbourne 1861), p 10.

²⁰⁵ *Tarrangower Times*, 5 July 1861.

²⁰⁶ C B Mayes, *The Australian Builders' Price-Book* (Melbourne 1862), p 112.

1861 the pipes were tested by a government committee, which reported favourably.²⁰⁷ Meanwhile other Victorian patents were sought unsuccessfully for pipes of paper, cloth, wire gauze or thin metal soldered with waterproof cement; of vegetable fibre combined with bitumen; of fibrous material and bituminous substances manufactured under hydraulic pressure; and of caoutchouc (india rubber or gum elastic).²⁰⁸ This last was probably little more than a rubber hose, and indeed the would-be patentee, Daniel Tallerman, had exhibited a waterproof hose of his own invention in 1861.²⁰⁹

j. plumbing fittings

The history of the bathroom in Australia is not well documented. For much of the nineteenth, and even the early twentieth century, many people must have bathed in a tub brought out for the occasion into a bedroom, kitchen or laundry, and filled by hand with water heated on an open fire or by means of a boiler. In Sydney the house 'Roslyn Hill' at Rushcutter's Bay, designed by Ambrose Hallen in the early 1830s, had baths sunk below floor level in the bedrooms, though it is not absolutely certain that they were original.²¹⁰ At John Verge's 'Camden Park', Menangle, of 1831-3, a 'bathhouse' was constructed, possibly as a detached structure,²¹¹ which was not unusual on larger properties. By 1855, when Oswald Bloxsome was selling 'The Ranger's Estate' on the North Shore, his house included a dressing room 'fitted with hot and cold bath'.

There can have been very little innovation in plumbing fittings in Australia, for the majority were imported until well into the twentieth century. There were numbers of plumbers and coppersmiths making pipes, cocks and small fittings, and occasional larger articles, but more for industrial than domestic purposes. William Hutchinson of Melbourne was making kitchen sinks, as well as Kennedy's patent stench traps, in six and nine inch (152 and 229 mm) square sizes.²¹² In Britain one Chrimes had developed a form of tap which was reported in the 1860s to be favoured by architects because it was liable than others to leakage,²¹³ and this seems much closer to the twentieth century type than those of the well-known makers Jennings and Tylor.²¹⁴ However, Chrimes's tap is not mentioned in Australia, whereas London makers like J Tylor & Sons,²¹⁵ John Warner & Sons,²¹⁶ and Hayward, Tyler & Co exhibit and

²⁰⁷ C B Mayes, 'Essay on the Manufactures more immediately required for the Economical Development of the Resources of the Colony', in *Victorian Government Prize Essays 1860* (Melbourne 1861), p 346.

²⁰⁸ Victorian patent applications, not granted: no 322 to Alexander Joske, 31 March 1860; no 374 to Paul Joske, 31 August 1860; no 398 to Alexander Joske, 22 August 1860; no 491 to Daniel Tallerman, 1 May 1861.

²⁰⁹ *Catalogue of the Victorian Exhibition, 1861* (Melbourne 1861), p 219.

²¹⁰ Morton Herman, *The Early Australian Architects and their Work* (2nd ed, Sydney 1959 [1954]), pp 114-5.

²¹¹ Herman, *Early Australian Architects*, p 179.

²¹² Melbourne, Intercolonial Exhibition of Australasia, 1866-67, *Official Record* (Melbourne 1867), p 328.

²¹³ E S Eyland, Francis Lightbody & R S Burn, *Working Drawings & Designs Architecture and Building* (Edinburgh, no date [c 1863]), essay 3, p 29 & pl xxxi, fig 13a.

²¹⁴ Eyland, *Working Drawings & Designs*, pl xxxi.

²¹⁵ Sydney Exhibition 1879, *Catalogue of British Section*, p 103; Melbourne, Centennial Exhibition 1888-9, *Official Record*, p 831.

²¹⁶ Mayes, *Australian Builders' Price-Book* (1862), advertisement p 152.

advertise prominently.²¹⁷ Lambert & Sons of Lambeth specialised at mid-century in taps and fittings of vulcanized caoutchouc and India rubber,²¹⁸ of which nothing is heard in Australia.

A city building of 1890 had Tyler's 'lavatories' (ie washbasins), urinals, sinks and slop sinks, and urinals fitted with 'patent treadle tiled platform and waste not valve.'²¹⁹ One ingenious imported fitting is a lavatory basin by Shanks & Co, the 'Patent Perfection', found at 'Titanga', Victoria, of about 1870-3: although there are stopcocks on the top surface, the water is discharged from two rows of holes at the back of the basin. A stage beyond this is a basin installed at 'Blackwood', Penshurst, Victoria, in 1891-2, bearing the local brand of Wilson, Corben & Co, though almost certainly not made by them. The stopcocks are located at the side of the wash stand, and the water discharges at the back of the basin from behind a ceramic scallop shell. The British 'Ideal' brand used scallop shells in this way,²²⁰ and this example was probably one of theirs, supplied under the brand of the local agent. For the rest we are dealing with standard British fittings, some of which were fairly opulent, as at Martindale Hall, South Australia, in 1880:

two 14 in. Duke of Edinburgh pattern tip up basins in veined marble top ... recessed soap & brush trays ... 9 gns. ea. less 20% disc.; ...

5 ft. 6 in. copper bath, enamelled sea green inside, with hot & cold cocks, pull up standing waste & overflow, engraved plates, unions & French polished mahogany enclosure, top & panelled front & 2 ends £26.5s. ...²²¹

By 1866 James Scott had designed and was locally manufacturing his 'Portable Self-heating Galvanised Iron bath, of novel construction, for Hot, Cold and Shower, with Self-acting Supply and Overflow.'²²² A type of shower which is not well-known today had horizontal sprays virtually surrounding the occupant, sometimes with a central shower head as well. Two early examples were the *lavatoria* of the Turkish baths in Bligh Street, Sydney, as rebuilt in 1860-61 to the designs of Weaver & Kemp. Each had

a framework of lead pipes perforated at very short intervals and forming imperfect rings, so arranged that when the bather stands within them the water is thrown with considerable force upon every part of his body.²²³

²¹⁷ Mayes, *Australian Builders' Price-Book* (1862), advertisement pp 148-9.

²¹⁸ London, Great Exhibition, 1851, *Catalogue*, I, pp 235-6.

²¹⁹ Wright, Reed & Beaver, 'Specification for Erection of Premises for the National Mutual Life Association of Australasia. Corner of Collins & Queen Streets Melbourne' (Melbourne 1890) p 30.

²²⁰ T & W Farmiloe, *T. & W. Farmiloe's Miniature Catalogue* (London 1894), pp 313-5. This catalogue, pp 326-343, illustrates a number of other fittings using scallop shells in same way, which are probably also the 'Ideal' type, though not so identified. Unidentified examples also appear much earlier in J R Welsman, *Trade Prices of British and Foreign Plate and Window Glass, &c* (Bradford [Yorkshire] 1880), pp 38-9, 44.

²²¹ Elizabeth Warburton, *Martindale Hall* (Adelaide 1979), p 141.

²²² Intercolonial Exhibition, *Official Record*, p 31.

²²³ *Sydney Morning Herald*, 15 March 1861, quoted in Ian Sansom, 'The Life and Work of William Edmund Kemp' (BArch, University of New South Wales, no date), part I, p 79.

A later shower on a similar principle, perhaps of Edwardian date, survives at the mansion 'Fortuna' at Bendigo. The sitz bath, popular in continental Europe, is hardly known in Australia, but there is one example at 'Rippon Lea', Victoria. It possibly dates from renovations in the 1930s, but it is much the same as Morrison's Sitz Bath, advertised in a British catalogue of the 1890s.²²⁴ The overwhelming dominance of enamelled iron or steel baths and glazed ceramic basins was challenged in the 1950s when Naco advertised fixtures of acrylic plastic. They were heat moulded from 3/4 inch [19 mm] sheets of methyl methacrylate, a material which had been developed by ICI in England.²²⁵ By now, too, metal framed glazed shower screens were common.²²⁶

A locally invented dishwasher seems to have come onto the market in about 1935. Fredk W Tod & Sons of Sydney claimed to be the sole proprietors, inventors, patentees and manufacturers, but it is difficult to understand their relationship with the Klensington Machine Co Ltd, which in the same advertisement announced the appearance of the machine, which was indeed named 'The Klensington Combination Dish Washer and Crockery Cabinet'. Demonstrations were to be arranged, by courtesy of the Sydney City Council, at the Strand Building Centre. The device was an upright porcelain enamelled cabinet with chrome fittings, not unlike an old-fashioned refrigerator but with a glass door. Through this door could be seen the crockery leaning outwards from racks which probably rotated on a vertical axis. It would accommodate thirty-six pieces of crockery, plus cutlery, and they would remain there in store when the wash was complete.²²⁷ It is unclear whether this came into use, but other more conventional dishwashers, presumably of overseas origin, had already made their appearance at an earlier date. One was installed in about 1930 in a house in Canberra.²²⁸ Kitchen waste disposal units were never widely accepted, but by September 1959 Waste master (Australia) Ltd had branches in both Sydney and Melbourne.²²⁹

k. laundries

Laundries²³⁰ in the nineteenth century were fitted with troughs of pine or kauri. One example of 1891 was specified to be of two inch [50 mm] clear pine, tongued and grooved at the ends and bolted right through with iron bolts and nuts. The joints were 'stopped with brown paper and white lead',²³¹ which was not a cheap expedient, as

²²⁴ Farmiloe, *Miniature Catalogue*, p 437.

²²⁵ F W Ware & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (3rd ed, Melbourne 1954), §34/1.

²²⁶ *Ramsay's Catalogue* [1954], pp §34/6, 34/7.

²²⁷ J P Brogan, *101 Australian Homes* (Sydney, no date [c 1935]), p 114: a Commonwealth patent, no 24461-10-35 had been applied for.

²²⁸ Mildenhall Collection no AA4182, Australian Archives, reproduced in Peter Freeman [ed], *The Early Canberra House* (Fyshwick [ACT] [1997]), p 75.

²²⁹ *Architecture in Australia*, September 1959 p 29.

²³⁰ The term is used in the modern sense, meaning the room in which clothes are washed. In the late nineteenth century a larger house might have a 'wash room' containing troughs and a copper for washing, and adjoining it a 'laundry', presumably for ironing, and perhaps also for mending and related activities.

²³¹ W S Law, 'Specifications of Residence Drummond St. Carlton for Mrs. L. Abrahams' (Melbourne 1891), p 26.

might appear, for the house was a grand one. Attached to the trough would be a mangle for wringing the water out of the clothes. Early in the twentieth century vibrated reinforced concrete troughs were introduced by companies such as Buckland's Reinforced Concrete Works of Brunswick, Victoria, with the reinforcement designed to allow for the attachment of wringers and rotary driers.²³² The washing copper was commonly a tub, literally of copper, built into a square brick casing, with a fire below it and a flue behind, located if possible in a corner of the room. But there were also portable coppers, and in 1878 a prime cost item of £4 was allowed for one 'with iron case, furnace, stand, iron pipe, flue, elbow, damper &c, complete.'²³³ By the mid-nineteenth century there was a range of other laundry devices, such as the 'clothes wringer and starcher', a variant on the mangle; the Universal Hand Clothes Washer and Wringer; and the Portable Linen Presser.²³⁴ Most of all, however, there was a very varied assortment of washing machines.

Most clothes washing was done in troughs with the aid of a washboard and a mangle, and the use of a washing machine would have been the exception. Nevertheless there were such machines in the Australian colonies by the 1840s, albeit bearing little relation to what we would call washing machines today. Washing machines of sorts, such as the Yorkshire 'maiden', had long been in use, and in the late eighteenth century one Beetham invented a type which was said not to destroy the linen at the same time as washing it, which must have been a considerable advance.²³⁵ In about 1810 Charles Sylvester designed washing machines for the Derby General Infirmary based upon those developed by his friend William Strutt for the processing of textiles.²³⁶

As early as 1842 the Rev J R Wollaston at remote Picton, Western Australia, mentioned quite casually that he and his wife used a washing machine for their heavier laundry,²³⁷ but little is known of the machines available at this time. At the Great Exhibition of 1851 Benjamin Marsden of Leeds showed a 'washing, wringing, and mangling machine', which was apparently a cylinder containing oscillating frames and springs, designed to simulate the action of human hands.²³⁸ In 1849 the Sydney ironmonger Arthur Graveley announced that he had completed a clothes washing machine which would save half the labour but could handle the most delicate fabric, and he had a demonstration model working at his Pitt Street premises.²³⁹ By 1854 there was even a steam operated machine²⁴⁰ working on a commercial basis at

²³² F W Ware & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (Melbourne 1949), § 10/1.

²³³ Reed & Barnes, 'Specification of Work to be done and Materials to be used in the Erection of Banking Premises at "Kooringa S.A." for the Bank of Australasia' (Melbourne 1878), pp 12-13.

²³⁴ *Cassell's Household Guide to every Department of Practical Life* (4 vols, London, no date [1869-71]), IV, pp 72-3.

²³⁵ G S Howard, *Encyclopaedia Londinensis* (London, no date, c 1788), svv Machines, Maiden.

²³⁶ Charles Sylvester, *The Philosophy of Domestic Economy, &c* (Nottingham 1819), cited in Elton Engineering Books, *Catalogue Number 13* (London 1998), pp 57-8.

²³⁷ A Burton [ed], *Wollaston's Picton Journal* (Nedlands [Western Australia] 1975), p 65.

²³⁸ London, Great Exhibition, 1851, *Catalogue*, I, p 297.

²³⁹ *Sydney Morning Herald*, 15 November 1849, p 1.

²⁴⁰ The government returns of manufactories &c show a steam washing machine at Collingwood in 1854, a steam washing machine at some unspecified locality in 1855, a steam laundry in Melbourne in 1858, and a steam laundry in the County of Bourke in 1859. Barrett's reference, below, would seem to confirm that these are one and the same establishment.

the Melbourne Laundry, in the suburb of Collingwood,²⁴¹ which was said to be the first such establishment in Australia.²⁴² In 1856 there was a 'patent washing and mangling machine' at 'Barwon Bank, Geelong,²⁴³ and it may well have been of the Marsden type.

In about 1853 or 1854 Christopher Hollingsworth, an Indiana farmer, had devised a new type of machine which consisted, in its simplest form, of a wooden trough about 600 to 900 mm in length by 380 mm deep, into which were put water and soap suds, together with two or three hundred elm wood balls, each the size of an orange. The dirty linen was fastened to a frame and dipped in and out on a lever, so that the balls pounded, rubbed and squeezed it, and were said to clean it in a very short time. In larger and more expensive versions of the machine the motion was imparted by turning a wheel. Hollingsworth sold the patent rights to another American, one Moore, who retailed them in London and displayed one at the Paris Exposition of 1855.

The *Australian Builder* published a description of the machines in 1856,²⁴⁴ and by 1858 Chamney Leicester, of Bourke Street, Melbourne, who must have obtained the local patent rights, was making both the lever and the wheel types. He claimed that the smaller model, the 'patent lever floating ball washing machine', did the work of five or six people, while the larger 'patent fly-wheel floating ball' machine did the work of twenty. The action of the floating balls was said to be such that it would not endanger even the most delicate tissues.²⁴⁵ The machine was 'calculated to wash from six to twenty-four dozen clothes per hour, with a saving of half the soap, water and firing.' By 1859 Leicester's machines were already in use at the Melbourne Hospital, the Benevolent Asylum, the Immigrants' Home, the St Kilda Sea Bathing Company, and the private house of the veterinary surgeon John Miscamble.²⁴⁶ Simple enough, as the machines undoubtedly were, it seems remarkable that they should be being actually manufactured in Australia within four years of being invented in America, and almost as remarkable that they should have found such rapid acceptance amongst institutional users.

A popular British machine around 1870 was that made by Bell Brothers of Dean Street, London, which looked like an inverted metal bucket with a mangle on top, but was said to be 'so arranged as not to injure the finest description of material requiring washing.'²⁴⁷ At the Sydney exhibition of 1870 a 'Bradford's washing, wringing and mangling machine' was shown by A Chisholm of Pitt Street, a 'portable laundry boiler' by F R Robinson of George Street and an 'apparatus for washing, mangling, &c.' by F Lassetter & Co.²⁴⁸ The Bradford in question was Thomas Bradford & Co of Salford, Manchester of whom more will be said below, and the other machines were also presumably imported. Whitney Chambers & Co of Melbourne were selling

²⁴¹ Bernard Barrett, *The Inner Suburbs* (Melbourne 1971), p 22

²⁴² Isaac Selby, *The Old Pioneers' Memorial History of Melbourne* (Melbourne 1924), p 146.

²⁴³ *Geelong Advertiser*, 28 July 1856.

²⁴⁴ *Australian Builder*, no 40 (11 December 1856), p 336.

²⁴⁵ Victoria Industrial Society, *Catalogue of the Eighth Annual Exhibition* (Melbourne 1858), p 28.

²⁴⁶ William Fairfax [ed], *Handbook to Australasia* (Melbourne 1859), advertiser, no pagination.

²⁴⁷ *Cassell's Household Guide to every Department of Practical Life* (4 vols, London 1869-71), p 180.

²⁴⁸ *Industrial Progress of New South Wales*, pp 52-3.

Chambers's Eureka Washing Machine,²⁴⁹ also presumably imported, and the *Town and Country Journal* illustrated what it described as a washing machine, but which was officially captioned 'Mrs Lang's Economic Domestic Washing Table', in which a roller moved within a tray.²⁵⁰

The Talbot Arts and Historical Museum, Victoria, holds two undated machines, one of which is lined throughout with barley sugar shaped pieces of wood, presumably designed to rub the washing.²⁵¹ This is reminiscent of two local patent applications of 1875, which were allowed to lapse. One by C J Robinson involved the use of corrugated rollers between which the clothes were fad, and the other, by S S Whitehouse, used a corrugated roller and or more grooved rollers.²⁵² A Victorian patent was granted in 1875 to John Baker of South Melbourne for the 'Excelsior washing and wringing machine',²⁵³ which may or may not be a local development, and another was granted to Hans Echberg and Frederick Wolter, Melbourne cabinetmakers,²⁵⁴ who certainly put it into local effect. Wolter & Echberg's was one of three locally made washing machines awarded bronze medals at the Melbourne International Exhibition of 1880-1881, the others being those of R G Ford of East Brighton, and John Wall of Camperdown, Victoria.²⁵⁵

An F Wolter & Echberg patent machine (no 11177), is preserved in a private museum, and it has elaborately modelled interior surfaces to assist in rubbing the contents. Another unidentified machine in the same collection has an ingenious mechanism whereby continuous turning of a handle agitates the contents in alternating directions.²⁵⁶ Another and presumably later Wolter & Echberg machine preserved at the Pioneer Settlement, Swan Hill, is on a quite different principle, and consists of a galvanized iron cylinder with conical ends, one of which can be removed to load it up. This container, which looks like some kind of military projectile or torpedo, pivots on a transverse axis and can be rocked back and forth or spun right over. It is labelled:

WOLTER & ECHBERG
PATENT
COMPRESSED AIR
WASHING MACHINE
6 RUSSELL ST.
MELBOURNE

²⁴⁹ *Bailliere's Official Post Office Directory 1871-2* [GET PUBLICATION DETAILS], advertisement.

²⁵⁰ *Town and Country Journal*, 7 December 1872.

²⁵¹ The other machine, from Glenmona Station, is unremarkable. Information from Bea Brewster, 1996.

²⁵² Victorian patent no 2090, lapsed, to Charles James Robinson of Melbourne, for improvements in clothes washing machines; no 2113, lapsed, to Samuel Siviter Whitehouse of Melbourne, for improvements in washing machines.

²⁵³ Victorian patent no 2053 to John Baker, 5 May 1875.

²⁵⁴ Victorian patent no 2115, granted in part to Hans Echberg and Frederick Wolter, 5 May 1875. Excluded were those aspects which resembled Baker's patent or another granted in 1872 to Donald Macpherson.

²⁵⁵ *Melbourne International Exhibition 1880-1881 Official Record* (Melbourne 1882), pp 85-6, 436.

²⁵⁶ Collection of Mr J D Wilson, 'Puunyart', near Camperdown, Victoria.

The same type is on display at the Powerhouse Museum, Sydney, and it seems to have been advertised by 1889.²⁵⁷ By 1886 Greenall's Steam Washer was being sold by Neave & Co of Sydney,²⁵⁸ and in 1888-9 a number of machines were shown at the Centennial Exhibition - by G Hardley of North Melbourne, W F Manson of Melbourne, Wolter & Echberg [given as 'Walter'] of Melbourne, and R J F Willson of Collingwood, in addition to a steam washing machine actually in operation, shown by S Lowe of Little Collins Street, Melbourne.²⁵⁹

We have seen that Bradford's machines were exhibited in 1870, as they were also in 1879 and 1880, including one intended to be powered by steam. They were branded 'Vowel'.²⁶⁰ In 1911 Lassetter & Co of Sydney advertised Bradford's patent machine, as well as Marsh's Lilywhite Washer, made in East Maitland, which was very similar: both of which were essentially barrels, rotated by means of cogged gears and a handle at one end, and with a hatch opening in the side.²⁶¹ One of the latter is preserved at Samson House, Fremantle. It is called the 'Vowel' washing machine, and bears a plate with the name of Thomas Bradford & Co of London and Manchester, and the patent no 76767. Another plate bears the name of F Lassetter & Co of Sydney, and the instructions:

Open the ventilator for half a minute. Put the clothes in separately side by side & press together not one upon another. Use as little water and soap as possible with the "Vowel" washing machine. Soap jelly 1 gall water to pound of soap boiled.

In 1910 Henry Brittingham of Melbourne had advertised the Vacuum Washing Machine, and demonstrated its operation at the exhibition organised by the Australian Natives Association.²⁶² At the homestead on Churchill Island, Victoria, there survives a washing machine, apparently of 1930, consisting of a galvanized cylindrical bin, with a hinged arm across the top which serves to raise and lower a piston bearing an irregular cone. The base of the cone faces the washing within the bin, which is apparently subjected to a sucking action as the cone moves up and down. It is branded:

[oval containing:
THE
LEHMANN
COMPRESSED AIR AND
VACUUM WASHING MACHINE
PATD NO 30614/30
]

²⁵⁷ The Powerhouse display refers to Wolter & Echberg's advertisement in the *Australasian Ironmonger* of 1889, but unfortunately does not specify the date more precisely, nor cite any evidence that the advertisement refers to this specific model.

²⁵⁸ Charles Mayes, *The Australian Builders' Price-Book* (5th ed, Melbourne 1886), advertisements, p xxvii.

²⁵⁹ Centennial International Exhibition, Melbourne, 1888-1889 *Official Record* (Melbourne 1890), p 616.

²⁶⁰ Sydney Exhibition 1879, *Catalogue of British Section*, p 108; Melbourne Exhibition 1880, *Catalogue*, II, p 301.

²⁶¹ *Lassetter's Commercial Review*, no 26, 1911, reproduced in *Australia in the Good Old Days* (Sydney 1976), p 178.

²⁶² *Sixth Australian Exhibition Souvenir Catalogue* (Melbourne 1910), p 17.

Another relatively modern-looking 'vacuum' machine survives at 'The Briars', Victoria, branded:²⁶³

ZWAR
PATENT
VACUUM WASHER

A vacuum machine of this character, branded 'Trader Horn' appears in the catalogue of D & W Chandler of Melbourne by about 1936, but in the same catalogue is still an extraordinarily primitive hand-operated machine, like a broad tub, into the centre of which is suspended a wooden disc with four downward projections, like a squat stool, and this is turned by cranking a handle at the side.²⁶⁴

Elsewhere in the same Chandler catalogue an electric machine appears for the first time: a vitreous enamelled metal drum on legs, with a mangle over it, branded 'Maxwell'. It required to be filled with hot water, and could then be left as long as required with an electrically operated agitator in motion.²⁶⁵ Three years later the tub machine has disappeared entirely, the vacuum machine remains, and the Maxwell has been replaced by a more streamlined but broadly similar electric machine, the brand of which is not stated.²⁶⁶ At the Napier Waller house in Ivanhoe, Victoria, is a very solidly engineered 'Rex'; washing machine, apparently dating from 1949 and made in Melbourne.²⁶⁷ It has a circular glazed front-loading door, and a very limited interior capacity. The 'Timesaver', advertised in the 1950s, was somewhat similar.²⁶⁸

1. plumbing cores

After World War II there was increasing interest in the idea of a prefabricated plumbing core, incorporating the fixtures of the kitchen, bathroom and laundry,²⁶⁹ as well as in prefabricated bathroom units and smaller prefabricated units such as shower recesses. Only the last were to become regular elements of domestic building. The plumbing core had developed in Britain as part of the general trend towards prefabrication, and had the advantage of allowing more work to be done in the factory as opposed to the site, a consideration of much less importance in a climate like Australia's. By 1946 the Experimental Building Station in Australia had designed a standardised kitchen suitable for large scale factory production and was planning soon to construct a prototype.²⁷⁰ There were also some prefabricated bathrooms, and one,

²⁶³ Inspected March 2003.

²⁶⁴ D. & W. Chandler Ltd., *General Hardware Catalogue Issue No 48* (Melbourne, no date [c1936]), p 114.

²⁶⁵ Chandler, *Catalogue 48* [c 1936], p 134.

²⁶⁶ D. & W. Chandler Ltd., *General Hardware Catalogue Issue No 51* (Melbourne 1939), pp 114, 134.

²⁶⁷ Inspected 2003: the maker is Edwards, and it bears a provisional patent no 25559/49.

²⁶⁸ *Ramsay's Catalogue* [1954], § 34/23.

²⁶⁹ Australia, Department of Works and Housing, Directorate of Housing, *Australian Housing, Bulletin 10* (Melbourne, September 1946), p 175.

²⁷⁰ For example the Arcon Kitchen unit: see Hugh Anthony, *Houses: Permanence and Prefabrication* (London 1945), p 27.

formed in moulded plastic, was used by Harry Seidler in the Sussman house, Kurrajong Heights, New South Wales, of 1951. The house also had an industrially produced two piece kitchen.²⁷¹

²⁷¹ Peter Blake, *Architecture for the New World. The Work of Harry Seidler* (Sydney 1973), p 248.