

## 8.02 Galvanized Iron

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### *origins of galvanizing*

The process of galvanizing had its roots in the experimental work of Paul-Jaques Malouin in the eighteenth century,<sup>1</sup> and it became rather more economically viable with the introduction to Europe of the Chinese (or Indian) method of extracting zinc. One Chartier began producing cooking vessels plated in 'white alloy' consisting largely of zinc, but aroused the opposition of the Académie on the grounds that zinc might be poisonous. Louis-Guillaume De Lafolie, a physician and chemist of Rouen, who recollected Malouin's work, conducted experiments which showed that this was not so.<sup>2</sup> As Malouin had not published the details of his method of zinc plating, De Lafolie devised his own method, and then published it in 1778, not claiming it as his own invention, but seeking to encourage its general adoption.<sup>3</sup> Brief references to the work both of Malouin and of De Lafolie were made by Richard Watson, Bishop of Llandaff, in the fourth volume of his *Chemical Essays* of 1786,<sup>4</sup> and the principle of galvanizing became known,<sup>5</sup> and even used to a small extent, in England.<sup>6</sup>

Neither in Britain nor in France was there any real conception of the possibilities of galvanizing objects larger than cooking pots, though the principle which was for a long time thought to underlie the effect of it - the protection of a metal object by using a more electropositive metal to divert corrosive action - was used by Sir Humphrey Davy in protecting the copper sheathing of ships. This he did by placing the copper in contact, but

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1 'Sur l'Analogie qui se trouve entre le Zinck & l'Étain', *Histoire de l'Académie Royale des Sciences*, 1742 (Paris 1745), I, pp 44-7; Paul-Jaques Malouin, 'Experiences qui Découvrent de l'Analogie entre l'Étain et le Zinc', *Memoires de l'Académie Royale des Sciences*, 1742 (Paris 1745), pp 76, 90.

2 Colin Allen has suggested to me that it was probably not realised that zinc is amphoteric, in that it reacts with and dissolves in both acid of pH 5 and lower, and alkali of PH 12.5 and higher (and many foods are acidic). Moreover at temperatures above 65oC there is a reversal of electrochemical polarity and the iron or steel becomes anodic to the zinc coating, which has a reduced capacity to protect it.

3 L-G De Lafolie, 'Reflexions et Éperiences Concernant les Casseroles & autres Vases nécessaire à l'apprêt des Alimens', *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts*, December 1778, pp 438-441.

4 Richard Watson, *Chemical Essays*, IV (3rd ed, London 1800 [1786]), pp 177-8.

5 See, for example, A & C R Aitken, *A Dictionary of Chemistry and Mineralogy* (2 vols, London 1807), II, p 506; Abraham Rees [ed], *Cyclopaedia or Universal Dictionary of Arts, Sciences and Literature* (London 1819), sv Zinc.

6 *Builder*, III, 108 (1 March 1845), p 106.

not coating it, with other metals.<sup>7</sup> In 1836, however, the French chemist Stanislas Sorel<sup>8</sup> took out a French patent on the coating of iron with molten zinc, zinc paint or zinc powder - not claiming to have invented the process, but to have developed its use for a wider range of purposes.<sup>9</sup> He formed a joint stock company, the shares of which were in great demand and rose to high prices, and by means of patents he secured monopolies in most European countries, as well as America. Sorel appears to have reached an arrangement with Ledru and Company of Paris for the production of Galvanized iron, and interested the French navy to the extent that a commission was set up in 1838 to test the process.<sup>10</sup>

Sorel's process was similar in principle to those of Malouin and De Lafolie, and began with rubbing and scraping the surface clean, dipping it - for twelve to twenty-four hours, depending upon how rusted it was - in a weak acid such as dilute sulphuric, or the acid obtained as a by-product in purifying vegetable oil. Next the object was wiped and dipped rapidly in hydrochloric acid, completely dried, and dipped into molten zinc. Before it was dipped both the object itself and the part of the bath it was to occupy were sprinkled liberally with sal ammoniac. To prevent a dull layer of zinc oxide from forming, the newly zinked sheet, while still hot, could be dipped in cold water. However this made the iron brittle, and it was better to let it cool down in a layer of sand and sawdust, which was readily scrubbed off afterwards. In 1840 sheets were being produced by this method for Hallette's steam engine workshops at Arras.<sup>11</sup>

The first English patent was taken out in 1837 by Commander H W Craufurd, but subsequent improvements were patented in England by his agent the Comte de Fontainemoreau.<sup>12</sup> In May of 1838 the English, Scottish and Irish Galvanized Metal Company published a prospectus, accompanied by favourable reports from eminent British chemists,<sup>13</sup> and the company established itself first at Southwark and then at Millwall.<sup>14</sup> It is said that the patent rights were transferred in 1839 to the British Galvanization of Metals Company in consideration of a royalty of £3 per ton,<sup>15</sup> and it was reported at the time that the Crawshays and others of the leading ironmasters had interests in the company, and

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7 Report of J G Children & A Garden on the prospectus of the English, Scottish and Irish Galvanized Metals Company, *Mechanic's Magazine*, XXIX, 772 (26 May 1838), p 123.

8 Sorel, with the manufacturer Ledru, published *Procédé Électro-Chimique pour fixer du Zinc, de l'Étain ... sur les objets en Fer, en Acier ou en Fonte de Fer, afin de les préserver de l'Oxidation* (Belleville, no date). On his own account he produced *Rapports Scientifiques et Industriels et autre documents authentiques sur la Galvanisation du Fer, procédé Sorel, Société Carpentier et Cie* (Paris 1849), ref the Bibliothèque Nationale *Catalogue Général des Livres Imprimés*, CLXIV (Paris 1930), pp 851-2.

9 Prospectus of the English, Scottish and Irish Galvanized Metals Company, *Mechanic's Magazine*, XXIX, 772 (26 May 1838), pp 125-6.

10 *Revue Générale de l'Architecture et des Travaux Publiques*, II (1841), pp 300-301.

11 *Revue Générale*, II, pp 300-301. Colin Allen observes that such a period of pickling is excessive and would result in heavy etching or even perforation of the sheet. The drying process as described resembles that known in modern times as the 'modified dry process', which has the disadvantage of introducing more iron salts to the zinc bath, creating more dross, and wasting zinc. Sal ammoniac is still occasionally used today as a supplementary flux for difficult portions of the work, notwithstanding that it fumes badly and is undesirable environmentally.

12 *Mechanic's Magazine*, XXX, 811 (23 February 1839), p 366.

13 *Mechanic's Magazine*, XXIX, 772 (26 May 1838), pp 122-6.

14 P F B Alsop to the President of the Geelong Historical Society, 7 February 1971 (this is a commentary upon my own brief notes '71 Little Malop Street, Geelong' of 27 November 1970, and both documents were distributed in mimeograph by the National Trust).

15 Alsop, loc cit.

planned to apply the invention on an extensive scale.<sup>16</sup> However the patent remained in abeyance, and no galvanizing on a commercial scale was done in Britain until 1843 because of 'a dispute among certain capitalists'.<sup>17</sup> This appears to have been some complicated litigation over an infringement of Craufurd's patent, the details of which have not been preserved.<sup>18</sup> Meanwhile Frederic Pellatt experimented with electro-deposition of the zinc coating, by placing the object in a zinc sulphate solution, attaching a negative electrode to it, and immersing it with a zinc plate attached to a positive electrode. This resulted in a purer zinc coating, and avoided the amalgamation of the zinc and iron, but it is unclear whether this was of any advantage, and it does not appear that the process was taken up commercially.<sup>19</sup>

### *commercial galvanizing*

It was not until 1843 that the Patent Galvanized Iron Works began production at Southwark, with exclusive licences from the various owners of patents on Sorel's process in each of the united kingdoms and colonies.<sup>20</sup> The works were under the direction of J H Porter, who was already the proprietor of the Grove Iron Fence Works, Cornhill, but whether he was a principal, agent or licensee is not clear. Porter seems to have continued to galvanize on his own account<sup>21</sup> even after a new company was formed, claiming to have acquired the patents. This company was described as a union of three interests, 'the Iron and Coal Company of Porthcawl, Glamorganshire, the several patentees of the galvanized iron, and the patentee of wire rope (Mr Smith)'. It soon had a number of works, and was clearly engaged in many more activities than simple galvanizing.<sup>22</sup>

In 1849 it was reported that the Patent Galvanized Iron Company was being wound up, having failed due to 'want of knowledge on the part of the management', and it was to be replaced by a new company under the management of a Mr Tupper.<sup>23</sup> This was formalised in June 1850, when C W Tupper and G B Carr announced that they had taken over the Patent Galvanized Ironworks, and thus appeared the important firm of Tupper & Carr.<sup>24</sup> In 1851 they showed a wide range of galvanized products at the Great Exhibition - from rainwater pipe to garden furniture, though corrugated iron, iron tiles and complete iron buildings were conspicuously absent.<sup>25</sup> By 1852 Tupper and Carr had a branch in Birmingham at 6 Berkeley Street, off Broad Street,<sup>26</sup> which is interesting because it places them very close to J H Porter, their predecessor at the Patent Galvanized Iron Works. By

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16 *Mechanic's Magazine*, XXX, no 811 (23 February 1839), p 366.

17 *Civil Engineer and Architect's Journal*, VI (March 1843), p 106.

18 Alsop, loc cit.

19 *Mechanic's Magazine*, XXXIX, no 1048 (9 September 1843), p 195.

20 *Civil Engineer and Architect's Journal*, VI (March 1843), p 106; *Builder*, I, 8 (1 April 1843), p 100; no 19 (17 June 1843), advertisements, no page.

21 *Builder*, III, 148 (6 December 1845), p 592.

22 *Builder*, III, 137 (20 September 1845), p 456; IV, 161 (11 April 1846), p 178; V, 220 (24 April 1847), p 194; VI, 292 (9 September 1848), p 444.

23 *Builder*, VII, 353 (10 November 1849), p 536.

24 *Builder*, VIII, 383 (8 June 1850), p 276.

25 Great Exhibition of the Works of Industry of all Nations, 1851, *Official Descriptive and Illustrated Catalogue* (London 1851), p 654.

26 *Slater's General and Classified Directory of Birmingham, and its Vicinities for 1852-3* (Manchester 1852), p 105.

1857 this firm had become simply Tupper & Company, and was manufacturing galvanized tinned iron - the Morewood & Rogers type - in addition to plain galvanized iron.<sup>27</sup>

The alternative process, in which the iron was coated first in tin and then in zinc, was seemingly introduced in America in 1838 and secured in Britain by Morewood & Rogers in patents of 1841, 1843 and later. Morewood & Rogers successfully defended an action for patent infringement in 1845, and the large scale manufacture of their 'zinked tinned iron' seems to date from that time. Their activities are discussed in detail below. In 1850 the Patent Galvanizing and Corrugating Company of J Symonds & Co appeared in London,<sup>28</sup> and was immediately served with an injunction by the Sorel/Craufurd patentees. They made no attempt to resist it,<sup>29</sup> but announced that they had 'deemed it advisable to obtain a licence to work Craufurd's Patent, upon which they had made very considerable improvement'.<sup>30</sup> This marks the birth of another of the major manufacturers who exported to Australia. Although the term 'galvanized tinned iron' continued to be used by Morewood & Rogers and their successors for the rest of the century, it is doubtful whether the double coating process was persisted with. James Davies, writing in 1899, seems quite unaware of the distinction, and states that the term refers only to the presence of some tin in the spelter [zinc], which was required in any case to achieve the crystalline appearance usually desired, and produced by all manufacturers unless otherwise specified.<sup>31</sup>

It appears then that by 1850 at least two companies, J H Porter and Tupper & Carr, were galvanizing on the Sorel method, and at least two, Morewood & Rogers and J Symonds, were making galvanized tinned iron. It seems likely that there were other licensed manufacturers as well. For example Edward Davies was later claimed to have been the third in the industry<sup>32</sup> (though he may have been merely the employee or manager of one of the firms named). In America the McCullough Iron Works of Philadelphia claimed (at a much later date) to have introduced the manufacture of galvanized sheet iron in 1852,<sup>33</sup> which conflicts with the hypothesis that Morewood began using his process in America in 1838. However, it may be that Morewood confined his activities to England once the patent dispute was resolved in 1843.

In 1843 the *Builder* had enthused over galvanized iron as 'this grand revolutionizing agent in the matter of style in architecture'.<sup>34</sup>

A new world and a new people will spring up under the new regime.

Talk of the transmutation of metals and the ages of alchemy! We have surpassed the expectation of both, or rather we are in the advent of that which shall surpass them ...

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27 *Yorkshire Post Office Directory*, 1857, p 1767.

28 *Builder*, VIII, 401 (12 October 1850), p 492.

29 *Builder*, VIII, 404 (2 November 1850), p 521.

30 *Builder*, VIII, 409 (7 December 1850), p 588. For the patent of 4 November 1843, see *Mechanics Magazine*, XXXIX, 1059 (25 November 1843), pp 369-73.

31 James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), pp 90-91. Colin Alen advises that tin is rarely used in this way today, though lead in the zinc is a major initiator of spangles.

32 Davies, *Galvanized Iron*, p v.

33 D S Waite, *Architectural Elements* (New York, no date [1972]), no page.

34 *Builder*, I, 7 (25 March 1843), p 77.

The same journal wrote of the Morewood & Rogers iron as being 'very beautiful, presenting a bright crystalline surface', and galvanizing retained its glitter for some years. Charles Barry used the material to roof the Houses of Parliament at Westminster, and it was reported, of a prefabricated iron building sent from Liverpool to California in 1849, that it was 'nearly white' in colour and of 'a singular appearance'. Even now, however, there had been complaints of corrosion, and the *Builder* was beginning to modify its favourable views,<sup>35</sup> though Papworth's *Dictionary of Architecture* still insisted in 1851 that the material could not be corroded except by acids, even if some of the surface was rubbed away, regardless of whether it was exposed to the air, immersed in fresh or salt water, or buried underground.<sup>36</sup>

As the main patents expired, the differences between the products diminished. By 1857 Tupper & Co made galvanized tinned iron as well as plain galvanized iron,<sup>37</sup> and conversely Morewoods were soon making the plain as well as the tinned.<sup>38</sup> Apparently John Lysaght of Bristol made galvanized tinned tiles of the same form as Morewoods. A very large number of companies made corrugated galvanized iron, as will be discussed below, but fewer made flat sheets for export to Australia - in 1881 Davies, Gospel Oak, Lysaght's Queen's Head, and Redcliffe.<sup>39</sup> In the 1890s both Morewood and Co, and the Gospel Oak Iron and Galvanized Iron Co were liquidated and reconstructed. Another company, Morewood & Heathfield Ltd, whose precise relationship is unclear, not only was liquidated, but had its plant sold up.<sup>40</sup> Meanwhile it seems that there was competition from outside Britain. The main non-British galvanized iron was the Swedish, said to be used on the Continent for the best roofing work, with the edges merely turned up and folded over. It came onto the British market in about 1883, in four foot by two foot [1.2 x 0.6 m] 'plates' of 21 23 and 25 gauge [0.89. 0.71 and 0.56 mm], strongly galvanized with zinc.<sup>41</sup> It was reported to be 'the best article possible alike for roofing, gutters, water pipes, cisterns, tanks ...'<sup>42</sup> Swedish galvanized sheet iron has not been identified in Australia

### *galvanized iron in Australia*

The first references to galvanized iron in Australia occur in 1850. In February the Sydney ironmongers E C Weekes & Co advertised it in flat sheets measuring six by two or two and a half feet [1.8 x 0.6 or 0.75 m],<sup>43</sup> presumably for laying on boarding with rolls, like the

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35 *Builder*, VII, 318 (10 March 1849), p 113; 322 (7 April 1849), p 157.

36 Wyatt Papworth [ed], *Dictionary of Architecture* (London, published in parts 1848-92), sv Iron.

37 \*\*\* *Yorkshire Post Office Directory*, 1857, p 1767.

38 F W Laxton, *Laxton's Builder's Price Book for 1863* (43rd ed, London [1863]), advertisements, no page.

39 *Australasian Builder & Contractor's News*, 14 May 1887, p 5.

40 James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), pp 26-7.

41 Wyatt Papworth [ed], *The Dictionary of Architecture* (London 1853-92), sv Swedish Iron.

42 *Builder*, XLV (28 July 1883), p 132, quoted in Marian Bowley, *Innovations in Building Materials* (London 1960), p 118.

43 *Sydney Morning Herald*, 14 February 1850, p 3, reproduced in Ian Evans, *The Australian Home* (Sydney 1983), p 38.

more traditional metal roofing materials. In Adelaide *Dehane's Almanac* for 1850 carried this advertisement:<sup>44</sup>

Patent galvanised tinned iron and general metal stores  
(Hindley Street, opposite the Castle Inn).

Charles Gell begs to announce to builders, farmers, storekeepers and the inhabitants of Adelaide generally, that he has lately imported from England and has now on sale, a large quantity of Patent Galvanised Tinned Iron, in sheets, either corrugated for circular or lean-to roofs; likewise galvanised nails, screws, rivets, wire, O. G. and half round gutters, water tubing, shower baths, garden engines, milk dishes and pails, rain water pipe heads, etc etc.

This wonder material made its appearance in the Port Phillip District, in August 1850, when the Melbourne *Argus* was<sup>45</sup>

requested to call the attention of the parties interested, to a new building now erecting, under the direction of Mr. Wharton in Elizabeth-street, near La Trobe-street. The roof is covered with 'galvanized iron' being the first used in this district, and forms we understand, the cheapest and lightest covering for roofs that can be put on. It is pleasing in appearance, very durable, not affected by lightning or rust, admits ventilation, and is an admirable covering for verandahs, or for flat roofs. It is also well adapted for spouts and gutters of all kinds - and as Mr. H.W. Mason for whom the buildings are erecting has imported a considerable quantity, any one desirous can get it from him.

There is, as we shall see, reason to believe that Mason's iron was of the Morewood & Rogers zinked tinned type, like that in Adelaide, which is specifically referred to as being 'tinned'.

The Victorian import statistics do not distinguish galvanized iron in 1850 or 1851, but in 1852 as much as 1,600 tonnes was imported, worth £2,514, and by 1854 the value of imports was more than £60,000. Importation continued at high levels even after the material had lost its initial glamour, which was soon: in 1859 the Philosophical Institute of Victoria expressed the hope that locally produced slates would put a stop to 'the most objectionable use of galvanized iron'.<sup>46</sup> It is unclear when galvanizing was first carried out locally. Those who advertised 'galvanized iron works', from about 1859,<sup>47</sup> may to have been largely or solely fabricators. In 1861 Stacey & Bryant of La Trobe Street exhibited 'corrugated and

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44 *Dehane's Almanac for 1850* (Adelaide 1850), quoted in D W Berry & S H Gilbert, *Pioneer Building Techniques in South Australia* (Adelaide 1981), p 26.

45 *Argus*, 21 August 1850.

46 'Report on the Resources of the Colony of Victoria'; in *Transactions of the Philosophical Institute of Victoria*, IV, part II (September-December 1859), p 20.

47 A P Allen of Fitzroy and Thomas Warburton of 28 Little Bourke Street West: C B Mayes, *The Victorian Contractors' and Builders' Price-Book* (Melbourne 1859), pp xvii & xxii. See also p xxxix for F Rowden, fabricator of galvanized iron baths.

galvanized zinc, &c' of their own manufacture,<sup>48</sup> but at the 1866-7 exhibition it seems to be implied that they also were fabricators, not galvanizers.<sup>49</sup>

It appears that the first local galvanizing works were those set up in Sydney in 1863 by Simon Zollner, and in fact his was claimed to be the first such works outside England. He used imported galvanized sheet for making tanks, guttering, piping and so on, but bulky items which were locally made, such as buckets, tubs and baths, were galvanized at his factory.<sup>50</sup> He also had curving machines. A collection of galvanized iron which Zollner showed at the Sydney exhibition of 1870 was reported to be 'small, but of a very superior quality'.<sup>51</sup> By this time Sydney had another galvanizer, James Partridge of Bathurst street, who showed a variety of galvanized work, including sheet iron, tanks, ridge caps, gutters and nails, and he was reported to have gone to considerable expense in 'constructing new apparatus for galvanizing special articles'.<sup>52</sup>

In Melbourne by 1875, if not earlier, Rowden Brothers of Collins Street, Melbourne, described themselves, *inter alia*, as galvanizers.<sup>53</sup> By 1888 one W Hunter had the 'Archer' Galvanizing Works in South Melbourne, and exhibited 'galvansed iron goods, and galvanised ornamental cast iron work'. It seems clear that he was indeed galvanising, but equally clear that he was not dealing in corrugated or plain sheets, or other large items.<sup>54</sup> The situation was different in New Zealand, where Samuel Parker of Auckland is claimed to have both rolled and galvanized corrugated iron sheets from 1886.<sup>55</sup> Galvanized iron had an advantage in weight over many traditional materials, but nevertheless did not reach most areas until either rail or water access was established: thus it appears in Central Australia only in the late 1870s.<sup>56</sup>

### *pipes and gutters*

Soon after 1850, it would seem, galvanized iron pipes were used to carry water to Port Elliott, South Australia, from natural springs a kilometre and a half inland. They were used because cast iron pipes were too expensive, but no great trust was placed in them, as they were set in concrete so that when they corroded they would still leave an impervious conduit for water.<sup>57</sup> Circular downpipes and half round eaves guttering were amongst the first goods fabricated locally in galvanized iron. In 1856 galvanized sheet iron piping was advertised in Melbourne in diameters from half an inch to six inches (13 to 152 mm), made

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- 48 Victorian Exhibition, 1861, *Catalogue with Prefatory Essays* (Melbourne 1861), p 218. They are listed as 'Sparey & Bryant', but I take this to be a mistake for Stacey & Bryant, as below.
- 49 Intercolonial Exhibition of Australasia, Melbourne, 1866-67, *Official Record* (Melbourne 1867), p 24.
- 50 *The Industrial Progress of New South Wales* (Sydney 1871), p 354.
- 51 *Industrial Progress of New South Wales*, p 57.
- 52 *Industrial Progress of New South Wales*, pp 124-5. The Official Report of the exhibition, *ibid* p 354, refers to three exhibitors of colonial galvanized iron, but the identity of the third is not apparent.
- 53 Victorian Intercolonial Exhibition, Melbourne, 1875, *Catalogue* (Melbourne 1875), Official Catalogue Advertiser, p 34.
- 54 Centennial International Exhibition 1888-1889, *Official Record* (Melbourne 1890), pp 633, 736.
- 55 Geoff Chapple et al, *Corrugated Iron in New Zealand* (Wellington 1983), p 27.
- 56 Howard Pearce, *Homesteads of the Stony Desert* (Adelaide 1878), p 20.
- 57 W B Hays, *Engineering in South Australia* (London 1854), pp 39-40.

of English malleable iron lap welded and then galvanized inside and out,<sup>58</sup> and in that year 'galvanised spouting' was listed amongst the contents of the house 'Barwon Grange', Geelong.<sup>59</sup> In 1858 James Coop was making spouting locally from English galvanized iron,<sup>60</sup> and in 1859 John Carter's works were making downpipes and spouting of various sections.<sup>61</sup> Even so, the cost of galvanized spouting and downpipes in 1862 was much the same as that of cast iron.<sup>62</sup>

Half-round guttering of 145-160 mm diameter (probably a nominal six inches), which most likely dates from the 1850s, has been found at the house 'Don Bank', North Sydney. In the roof space of a former house/shop at 556 Lonsdale Street, Melbourne, is a 120 mm diameter half round wrought iron gutter which carried the water from the front gutter back through the roof to the north side of the building. It is impossible in this instance to tell whether the material was galvanized, but it may reasonably be presumed. All the physical evidence suggests that this gutter was built with the house in the 1850s, and this seems likely enough, as a somewhat similar arrangement of what is described as a 'lead lined open drain' passing through a roof space from a valley to the exterior, occurred in the Female Orphan Institution, Rydalmere, New South Wales, of about 1814.<sup>63</sup> A house at 58 Howard Street, North Melbourne, is thought to date from the 1850s, and has half round guttering on the north side which may be original, as it was built out by the adjoining house, possibly within a decade. The specification for a Victorian country parsonage in 1857 required the builder:<sup>64</sup>

To provide and fix securely round the eaves of the house best 4" Galvanized iron 1/2 round guttering with proper weathering at angles and at valley gutters and finished with one 2" galvanized down-pipe with large cistern head to be fixed as shall be directed.

The use of galvanized iron for valley and box gutters seems to develop only much later. In 1886 Mayes reports that 'Gal. iron valley and wall gutters are said to be common in Queensland', and describes, apparently as a novelty, the valleys of the King Street Arcade in Sydney. They were of 24 gauge sheet, about 450 mm wide, soldered into one length of 24 metres, but unsecured so that they could expand. They were laid to a regular fall, with no drops, and there were downpipes at regular intervals.<sup>65</sup>

### *galvanized roof decking*

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58 *Australian Builder*, 24 (14 August 1856) & 25 (21 August 1856), p 201.

59 *Geelong Advertiser*, 28 July 1856.

60 Victoria Industrial Society, *Catalogue of the Eighth Annual Exhibition* (Melbourne 1858), p 29.

61 *Australian Builder*, 24 December 1859.

62 C B Mayes, *The Australian Builders' Price-Book* (Melbourne 1862), p 93.

63 Robert Irving, 'The First Australian Architecture' (MARCH, University of New South Wales 1975), p 504.

64 Thomas James Crouch, architect, 'Specifications of work to be done in the erection of a cottage and outoffice at Kyneton for the Revd. J. Catteral, Wesleyan Minister', 17 June 1857 (WD REL 15, Melbourne University Architectural Collection, State Library of Victoria).

65 Charles Mayes, *The Australian Builders' Price-Book* (5th ed, Melbourne 1886), pp 125-6.

Preformed metal tray decking appears to be an American development, which reaches Australia late. The Garry Iron and Steel Roofing Co of Cleveland, Ohio, was established in 1870, when very little sheet iron roofing was being used, and claimed to be the pioneers of the industry. Within two decades they had developed an extensive range, and claimed to be the largest manufacturers of iron roofing in the world. 'Garry's Patent Cap Roll Roofing' was a sheet roll which was laid over boarded sheathing. The edges were turned up at right angles to a height of about 32 to 38 mm using the company's 'roofing tongs'. Cleats fixed to the sheathing rose up between the edges of adjoining trays and were folded down either way to secure them. Finally an inverted V-shaped piece was placed over the joint, squeezed tight with the tongs, and then riveted at intervals.

Garry's 'Adjustable Cap Roofing' was essentially the same but supplied with pre-formed upturns. It came in pieces two feet [600 mm] wide, and with the ends under- and overlapped so as to hook into each other and achieve the required length. For cheaper roofing there was the 'Crimped' form, rising in an inverted V profile at either edge, on two foot [600 mm] centres. It could be fixed directly to battens or rafters, without a layer of boarding, and it was said to differ from other similar products in that it did not require a triangular fillet of wood under the V, and that the sheets were supplied with the end locks already formed. A similar siding sheet was made with an additional V in the centre, intended to evoke the appearance of vertical boarding, and came in lengths of eight feet [2.4 m] less 25 mm to be allowed for overlap.<sup>66</sup>

The Porter Iron Roofing Company of Cincinnati, Ohio, similarly claimed to be pioneers in the industry, but offered less to substantiate the claim, and advertised a somewhat simpler range of otherwise very similar products - standing seam, 'Standard Crimped' and 'Center Crimp' roofing.<sup>67</sup> A third Ohio manufacturer was the Canton Steel Roofing Co of Canton, which claimed to have been founded in 1877. It offered a similar range again - folded lock seam (H W Smith patent), folded standing seam, roll and cap, pressed standing seam, and beaded standing seam roofing (the last much like a modern roofing tray), as well as sheets pressed in the form of shingles or tiles, corrugated sheets, spouting, ridges, finials, vents, and numerous accessories.<sup>68</sup>

In the early twentieth century Sears, Roebuck & Co were still marketing what they called 'Two and Three-V Crimp Steel Roofing', said to be 'perhaps more extensively used than any other kind of steel roofing', and used also for siding on barns and outbuildings. It was supplied in either a painted or a galvanized finish.<sup>69</sup> They also offered 'Pressed Standing Seam Roofing' in precisely the same dimensions, with cleats for fixing one edge to an underlying surface of sheathing boards. One seam locked over the next, and there was no cover strip. This material was 'Shipped direct from the Steel Mills in Central Ohio',<sup>70</sup> and may well have been a later version of the Garry or the Porter product though neither Cleveland nor Cincinnati can be described as central to the state. Presumably a variant

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66 Garry Iron Roofing Co, *Garry's Patent Iron and Steel Roofing* (Cleveland [Ohio], no date [c 1887]), passim; also *ibid* (1891).

67 Porter Iron Roofing and Corrugating Co, *Porter Iron Roofing and Corrugating Co.* [catalogue] (Cincinnati [Ohio], no date [c 1885-90]).

68 *The Canton Steel Roofing Co. Canton, Ohio, U.S.A.* [catalogue] (Canton [Ohio] 1899), passim.

69 Sears, Roebuck and Co., *Sears, Roebuck Home Builder's Catalog* (New York 1900 [Chicago 1910]), p 144.

70 *Sears, Roebuck Home Builder's Catalog* (1910), p 143.

form was made in Canada, for there was a 'Canadian pattern' decking being made in Britain by Frederick Braby & Co in the 1880s. It was a tray two feet [600 mm] wide, with a roll at the centre and lapping rolls at the sides (rather than V crimps), and was available in lengths of up to ten feet [3 m].<sup>71</sup>

In 1844 John Woolley of Manchester had invented a roofing system by which strips of tin, with the edges turned up, were fixed along the top of each rafter, and the roofing sheets were placed between, with their edges turned down over these strips.<sup>72</sup> Something very like this reappeared in the form of the 'New Patent Galvanized Iron or Steel Arc Sheets' shown at the Glasgow International Exhibition of 1888 and the Melbourne Centennial Exhibition of 1888-9. In this case cleats rose not from rafters, but from purlins. The roofing sheets ran down the slope at right angles the purlins, and were held in place by a roll or three quarter circle which clipped down onto the cleats and at the same time secured the edges of the roof sheets. The sheets were not corrugated but stepped up at either edge, and then were slightly concave in cross-section across the centre. They did not have to be parallel-sided, and a conical roof formed of wedge-shaped panels was illustrated.<sup>73</sup>

This sheeting has been found in one Australian building, a house in Bendigo, Victoria, of 1898. Although no clear explanation can be given for the isolated appearance of this product, it is certainly connected with the fact that the owner was a prominent local timber merchant, and a dealer in building materials. The main advantage of such systems is that the fixings do not have to penetrate the sheet.

### *Lysaghts in Australia*

The process of galvanizing was improved in 1888 when John Lysaghts of Bristol developed the four roll galvanizing machine,<sup>74</sup> and it was Lysaghts who first brought galvanizing to Australia on a substantial scale. John Lysaght himself had made three separate visits to the colonies, and the success of his business was attributed to this assiduity.<sup>75</sup> In 1879 he decided to establish a central selling agency in Melbourne, and branches in the other colonies soon followed. They began to engage in finishing operations, so as to take advantage of local tariff protection and of proximity to the markets. In 1883 a wire netting plant was established on the Parramatta River under the management of John Sandford, formerly the director of an ironworks in Bristol.<sup>76</sup> The netting was galvanized (after being woven), but there is no indication that anything other than wire goods was.<sup>77</sup>

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71 *Frederick Braby & Co. No. 9* [catalogue] (London 1883), p 34, inserted page, presumably somewhat later in date.

72 *Builder*, III, 104 (18 January 1845), p 53.

73 Made by the Iron & Steel Buildings and Fencing Company Ltd of Glasgow; *Australian Ironmonger*, November 1888, p 55. Also Centennial International Exhibition, *Official Record*, pp 633, 736

74 Anne Warr, 'The Technology of the Corrugated Iron Shed', in Peter Freeman & Judy Vulker [eds], *The Australian Dwelling* (Red Hill [ACT] 1992), p 86.

75 James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 16.

76 *Lysaght's Silver Jubilee, 1921-1946* (Sydney 1946), p 17, cited Helen Hughes, *The Australian Iron and Steel Industry 1848-1962* (Melbourne 1964), p 26.

77 *Australasian Builder & Contractor's News*, 11 June 1887, p 70.

By 1904 the Australian branch of Lysaghts had become a distinct company, with headquarters at Sydney controlled by Arthur Lysaght as managing director and Robert Wilkinson as general manager. It had extensive works on the Parramatta River, a Melbourne branch with a large wire netting works on the Yarra at Footscray, further branches in Queensland and New Zealand, and sub-agencies in South Australia, Western Australia.<sup>78</sup> However, as a wire netting manufacturer the company's relevance to the building industry is slight, and all the galvanized sheet iron continued to be imported from Britain.

Lysaghts corrugated iron was the 'Orb' brand, but this and other brands of corrugated galvanized iron used in Australia will be discussed below. When their Queen's Head brand flat sheet appeared in Australia is unclear, but it was certainly by 1887.<sup>79</sup> In 1907 the English Lysaght company was advertising locally its flat sheet galvanized iron, branded with a queen's head in a rectangle, with the letters J, L, L, B in the corners, clockwise from the top left.<sup>80</sup> By 1938 the letters of the Queen's Head brand were shown as L, N, W, L, with a figure such as '38' on the neck to indicate the year,<sup>81</sup> and it is not clear whether this may distinguish the imported from the local product. Galvanized iron sheeting which is branded as being made for Elder Smith & Co of Adelaide, is probably also by Lysaghts, as the decorative border is similar to that of the Queen's Head brand.<sup>82</sup>

[rectangular ornamental border containing  
MADE FOR  
ELDER SMITH  
& CO, LIMITED  
AUSTRALIA  
]  
26G

Lysaghts second grade and lighter weight flat sheet was sold under the fleur-de-lis brand. Although only the fleur-de-lis emblem itself is shown in the *Referee*, an actual brand of sheet at the John Kelly house, Beveridge, Victoria (presumably imported from Britain) is:

[crown]  
FLEUR DE LIS  
[fleur-de-lis]  
LYSAGHT

By 1938 the *Referee* shows:<sup>83</sup>

LYSAGHT  
[crown]  
FLEUR DE LIS  
[fleur-de-lis]  
AUSTRALIA

78 James Smith [ed], *Cyclopedia of Victoria* (3 vols, Melbourne, 1903, 1904, 1905), I, pp 534-5.

79 *Australasian Builder & Contractor's News*, 8 October 1887, p 348.

80 Walter Jeffries, *The Australian Building Estimator* (Sydney 1907), front endpaper.

81 John Lysaght (Australia) Pty Ltd, *Lysaght's Referee* (17th ed, Sydney 1938), pp 1, 14, 22, 236.

82 Information from Bill Nairn of Adelaide, May 1995.

83 *Lysaght's Referee* (1938), p 23.

From 1914 Lysaghts in England devoted more and more of their activity into the war effort, until by 1918 they were producing galvanized iron at just 7% of pre-war levels, and exports to Australia were slashed. However, just after the outbreak of war the company had prudently bought a site at Newcastle with a view to establishing Australian production. Nothing more was done until 1917, when the government sought to encourage the establishment of a local sheet rolling, corrugating and galvanizing industry by offering bounties and tariff protection as incentives. Now the company set about establishing a factory on another site at Newcastle, which had been swapped for the original one. The land required considerable reclamation work, but the sheet rolling and galvanizing works of the company, now known as John Lysaght (Aust) Pty Ltd, were able to commence production 1921.<sup>84</sup> In 1936 rolling mills and galvanizing plant at Port Kembla were bought from Australian Iron and Steel Limited, and seem to have been in production immediately, but a major new factory was also set in train for completion in December 1938.<sup>85</sup>

### *other processes*

The process of Sherardizing, discovered in 1900 by Sherard Cowper-Coles of England, has had only a limited application in the building industry. It was not used for sheet iron and steel but for items like roof bolts, door furniture and steel casements. Essentially the component is heated with zinc powder, which amalgamates with the surface as an iron-zinc alloy, and in some circumstances is more effective than galvanising.<sup>86</sup> The process was not firmly established in Britain until 1923, and it does not seem to have been extensively used in Australia.

There have been two major developments in the coating of iron in the twentieth century. 'Zincanneal' was introduced to Australia by Lysaghts gradually from 1936, for applications where ordinary galvanizing was unsuitable, such as in connection with sea water or refrigeration brines. It is a heat treated zinc coating, which is heat-resistant and has a matt finish which takes paints well without the pre-treatment or weathering required by galvanizing.<sup>87</sup> This appears to be similar to what is more widely known as Galvanneal, a continuously galvanized strip product, in which the zinc coating is heat treated immediately the strip leaves the coating bath. This causes iron-zinc intermetallics to extend throughout the thickness of the zinc coating, and is used mainly in the automotive industry.<sup>88</sup>

In 1972 the Bethlehem Steel Corporation of the United States developed a new product called 'Galvalume', a steel which is hot-dip coated in an alloy of 55% aluminium, 43.5% zinc and 1.5% silicon. This is claimed to resist corrosion two to four times as effectively as hot dip zinc coatings of equal thickness. British steel produce a similar coating under licence, as 'Zalutite' and John Lysaght (Australia) Ltd market it as 'Zincalume'.<sup>89</sup>

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84 *Lysaght Venture* (Sydney 1955), pp 3-5. See also Ambrose Pratt [ed], *The National Handbook of Australia's Industries* (Melbourne 1934), pp 138-9.

85 *Lysaght's Referee* (1938), p 4.

86 G Petrie & J C Mills, *Sherardizing* (Wolverhampton [Staffordshire] 1932), passim.

87 *Lysaght Silver Jubilee*, p 61; *Lysaght Venture*, p 73.

88 Information from Colin Allen, 2000.

89 Warr, 'The Corrugated Iron Shed', p 87.