

8.04 Corrugated Iron

- a. development of corrugated iron
- b. corrugated iron in Australia
- c. water tanks
- d. verandah roofs
- e. curving and structural use
- f. corrugated tiles
- g. early brands
- h. later nineteenth century brands
- i. Lysaghts
- j. the Australian market
- k. variant types
- l. Lysaghts' Australian operation
- m. other twentieth century types
- n. protected metal

a. development of corrugated iron

Corrugated iron as we now know it results from the fusion of two ideas in the early nineteenth century. Systems of roofing using wrought iron rafters of small cross-section were known in Russia early in the nineteenth century, and one roof which Loudon had seen in 1814 consisted simply of iron rods, to which iron sheets were attached with copper wire.¹ By the 1830s Carter's cast iron roofing plates were in use in England, being of a square shape with an ingenious system of overlapping edges.² Wavy or corrugated sheets had been made not long after the technique of rolling flat sheets from puddled iron was first developed, but not for building purposes. It was the patent of H R Palmer of 28 April 1829 which first proposed the use of corrugated sheet iron for building purposes.³ Palmer was the engineer of the London Dock Company, and built his first corrugated iron roof there before the end of 1829.

Pedro Guedes has investigated the story in detail, and has found that Richard Walker was a carpenter who had done work for Palmer at the Dock from 1827 onwards, before becoming his assistant for a period of three months from January 1829.⁴ Walker acquired Palmer's patent, and began advertising as 'Richard Walker, Carpenter and

¹ Loudon, *Encyclopaedia of Cottage, Farm and Villa Architecture*, §419, pp 205-6, in part quoting the *Supplement to the Repository of Patent Inventions*, 1832, XIII, p 409.

² Loudon, *Cottage, Farm and Villa Architecture*, §153, pp 72-3.

³ Great Britain, patent no 5786, to Henry Robinson Palmer, 28 April 1829. For the technical history of corrugating and galvanizing, see also H W Dickinson, 'A Study of Galvanised and Corrugated Sheet Metal', *Transactions of the Newcomen Society*, XXIV, 1943-1944 & 1944-1945 [London 1949], pp 27 ff.

⁴ Pedro Guedes, 'Corrugated Iron: H.R. Palmer, his Milieu and the Material before Galvanisation' (paper presented to the SAHANZ conference in Melbourne, 1998), pp 93-4. Guedes points out, p 100, note 46, that the system in the patent differs from that illustrated by Loudon.

Builder and Manufacturer of the Patent Corrugated Iron'.⁵ By January 1830 he was contracting to erect a further iron roof at the Docks, and it is this roof rather than Palmer's (according to Guedes)⁶ which appears on well-known illustration published by Loudon⁷ in 1832 (not 1833 as commonly stated⁸).

Palmer's patent was for the use of corrugated iron in building and not for the method of manufacturing it, which he referred to as being well-known, but a contemporary account refers to it's being passed through fluted rollers while red hot.⁹ The proposed uses of the material in building included walling and finely corrugated panels for doors, but the arched roof was far the most significant. The roof at the London Dock illustrated by Loudon measured 13 x 67 metres, with the 13 metre dimension in two spans, a full arch and a half arch which butted at its crown into a brick wall. At the base the arches were supported on two long cast iron gutters, in which the ends of the corrugated sheets rested, and these gutters in turn were carried on rows of cast iron columns. The spreading of the arch was contained by wrought iron tie rods extending from the column caps to the brick wall. The corrugated sheets were made structurally continuous by rivetting them together both laterally and longitudinally.¹⁰ As this roofing system came into wide use, the rule of thumb was adopted that a tie rod was required when the span exceeded 25 feet (7.5 m), but if it was smaller, and the sheets were joined by small nuts and bolts, no tie was needed. Where rods were used they were of about 13 mm diameter, spaced at three metre intervals along the roof, and often prevented from sagging by a king rod tying them to the corrugated iron at mid-span.¹¹

In the following years Walker charged so much that very little use was made of the material. He sold it for £5 to £7 a square, whereas the raw material was worth less than £1.¹² At the coal depot of the London Gas Works, Vauxhall, the engineer Stephen Hutchison actually opted in 1837 to build a roof of the same tied barrel vault form, but using 'corrugated' cast iron plates measuring 635 x 1143 mm, with a 90 mm angular zig-zag profile, and connected with small bolts.¹³ However Walker must have been the supplier of the had iron stores at both Adelaide and the original landing place, Port Adelaide put up by the South Australian Company in 1836,¹⁴ and of others

⁵ According to Gilbert Herbert, *Pioneers of Prefabrication* (Baltimore [Maryland] 1978), p 34, who does not give the source of this wording, but claims that the business was founded in 1829 on the basis of advertisements in 1879 by the successor company, the Patent Corrugated Iron Works of Morgan H Davies.

⁶ Guedes, 'Corrugated Iron', p 94.

⁷ J. C Loudon, *Encyclopaedia of Cottage, Farm and Villa Architecture* (London 1853 [1833]), p 207.

⁸ Loudon's encyclopedia bears the completion date, 1833, but it in fact came out in parts. The one reporting corrugated iron is cited in the *Mechanic's Magazine*, 24 November 1832, pp 114-6.

⁹ *Mechanic's Magazine*, 24 November 1832, p 114\.

¹⁰ Loudon, *Cottage, Farm and Villa Architecture*, pp 206-8.

¹¹ Papworth, *Dictionary of Architecture*, sv Corrugated Iron.

¹² *Builder*, I, 42 (25 November 1843), p 511.

¹³ *Architectural Magazine*, February 1838, pp 66-70.

¹⁴ T H James, *Six Months in South Australia* (London 1838), pp 28, 30, 58. Herbert, *Pioneers of Prefabrication*, p 40, note 3, cites a report in the *South Australian Record*, 8 November 1837, to four iron storehouses arriving on the *Africaine*. However, Capper's schedule of ships reaching South Australia shows the *Africaine* as having arrived on 2 November 1836, and having made no other visit up to the end of February 1838: Henry Capper, *South*

which followed. The first ones were said to make 'an impressive appearance,'¹⁵ or by another observer to be 'built of cast-iron, and look something like steam-engine boilers, but, of course, much larger.'¹⁶ Upon the expiry of Walker's patent in 1843 a correspondent of the *Builder* argued that the use of corrugated iron should be revived, especially as it could now be galvanized and (it was believed), would therefore be everlasting. He quoted as an example 'the most beautiful roof of the Eastern Counties Railway, Shoreditch, excelled nowhere in elegance, lightness and simplicity'.¹⁷

Philip Davies wrongly claims that John Porter's works at Southwark were the first to manufacture corrugated iron in the United Kingdom, in 1843, but it is possible that they produced the first galvanized corrugated iron.¹⁸ In 1844 Wood, Waygood and Company of London, exporters of iron houses, began to manufacture 'the patent corrugated iron'¹⁹ and the Phoenix Iron Works in Glasgow 'went into mass production'.²⁰ When it reached the United States is unclear, but corrugated iron buildings were sent to California during the gold rush, and by 1852 corrugated galvanized iron was said to be 'now being largely used'.²¹

There were three methods of manufacturing corrugated iron. In the late 1820s, as discussed, it was being passed between fluted rollers whilst red hot, but it could also be produced by hydraulic pressure of a moveable upper against a fixed lower block; or by the simple percussion of two such blocks.²² It was later claimed by Lysaghts, though it seems hard to believe, that steam power was not used for corrugating until 1854.²³ In 1844 John Spencer, on behalf of Thomas Edington of the Phoenix Iron Works, Glasgow, patented a machine for corrugating iron by passing a flat sheet between fluted rollers, the fluting of which ran longitudinally rather than circumferentially, as seems to have been the original method. Spencer's patent also included a curving machine in which three rollers could be adjusted to give the desired radius.²⁴

In 1845 Morewood & Rogers patented a corrugating machine which had circumferential grooves, the novelty of which is not immediately apparent, and in 1846

Australia (2nd ed, London 1838), facing p 46. See also Jensen, *Colonial Architecture in South Australia* (Adelaide 1985), p 44.

¹⁵ Herbert, *Pioneers of Prefabrication*, p 40, quoting a letter from Thomas Gilbert to one Trenow, 22 April 1837, published in the *South Australian Record*, 8 November 1837.

¹⁶ W H Leigh, *Travels and Adventures in South Australia 1836-1838* (London 1839), p 178.

¹⁷ *Builder*, I, 42 (25 November 1843), p 511.

¹⁸ Philip Davies, *Splendours of the Raj* (London 1985).

¹⁹ *Builder*, II, 84 (11 September 1844), p 475.

²⁰ Philip Davies, *Splendours of the Raj* (London 1985).

²¹ D S Waite, *Architectural Elements* (New York, no date [1972]), p 8.

²² W G Daunsey, 'Iron and Steel for Constructive Purposes', in *Australasian Builder and Contractor's News*, 26 September 1891, quoted in Brine, 'Victoria's Ferrous Metals Industry', pp 35-6.

²³ John Lysaght (Aust.) Ltd, *The Referee* (12th ed, Sydney 1921), p 7.

²⁴ Great Britain, patent no 10,399, 23 November 1844, to John Spencer, for 'Manufacturing or preparing plates of iron or other metals for roofing and other purposes', cited by Guedes, 'Corrugated Iron', p 37, who describes Spencer as the agent of the Phoenix Iron Works West Bromwich. Herbert, *Pioneers of Prefabrication*, p 37, has Spencer as agent of Thomas Edington of the Phoenix Iron Works, Glasgow.

another for stamping out the corrugations one at a time using dies.²⁵ Although they were not actually producing corrugated iron in 1851 (as discussed above) they must have been doing so by 1853, when they were exporting houses made of it. In 1856 or 1857 Morewood & Rogers took out New South Welsh and Victorian patents on a number of matters, including two means of corrugating iron. One was to pass it between circumferentially grooved rollers, and the other was to press it between a pair of dies large enough to take a complete sheet. Either of these methods might also be used to re-press sheets which had been made by other means, such as longitudinally grooved rollers, and were not entirely accurate or consistent.²⁶

By the 1890s most corrugated iron was made by pressing between dies, whereas rollers were used only rarely, and were thought by James Davies to be less effective.²⁷ When Lysaghts began manufacture in Australia in the 1920s they used a rotary corrugating machine for the lighter gauges, consisting of two fluted rolls supplied by an automatic feeding table, but a stamper for heavier gauges.²⁸ Iron for curving had to be of good quality, and the best Staffordshire brands were commonly used in gauges of 16 to 26 (in rises of 2), while the pitch of the corrugations was at first 5½ to 6 inches (140 to 152 mm). However, even in the 1850s nominal three inch (76 mm) iron seems to be more common in Australia than five inch, and by the 1860s the standard pitch was 3¼ inches (83 mm). As late as the 1890s the variation was considerable, from 76 to 83 mm pitch, and from 16 to 22 mm depth.²⁹ Though early iron is generally heavier than that used today, the range of gauges available in Victoria in 1862, 15 to 28 [1.78 to 0.40 m],³⁰ was similar to modern gauges, typically 14 to 26. Five inch [130 mm] corrugated sheeting is often referred to as 'Scotch iron', and there is some evidence to suggest that it was indeed produced more commonly in Scotland than in England. Whilst early uses of the phrase may indicate actual knowledge of Scottish origin in the case referred to, but not so later ones, such as a report in 1927 of a house actually bearing a London maker's brand.³¹

Richard Walker, the original manufacturer, retired in 1845, and the firm, which had been listed as Richard Walker & Son, now appeared in the directories as Richard & J Walker [in 1845 and 1850], though it seems also to have been known by 1849 as Walkers and Holland.³² In 1848 the prominent galvanizer J H Porter obtained a patent for the use of corrugated iron in beams and fireproof floors,³³ and Walkers and Holland quickly advertised that they were the patentees and manufacturers of corrugated girders, roofs and doors (though whether their patents were current is not

²⁵ Anne Warr, 'The Corrugated Iron Shed', p 87, citing patent no 10,859, Morewood & Rogers, 'Manufacture of Iron into Sheets, Plates etc., and Coating of Iron', 1845; no 11,476, Morewood & Rogers, 'Manufacture of Sheet Iron', 1846.

²⁶ Victorian patent no 9 to Edmund Morewood & George Rogers, 18 March 1857..

²⁷ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), pp 50-51.

²⁸ Ambrose Pratt [ed], *The National Handbook of Australia's Industries* (Melbourne 1934), p 139.

²⁹ W G Daunsey, 'Iron and Steel for Constructive Purposes', in *Australasian Builder and Contractor's News*, 26 September 1891, quoted in Brine, 'Victoria's Ferrous Metals Industry', pp 35-6.

³⁰ C B Mayes, *The Australian Builders' Price-Book* (Melbourne 1862), p 93.

³¹ *Argus*, 28 August 19827, p 7.

³² *Builder*, VII, 338 (28 July 1849), p 359.

³³ *Builder*, VI, 296 (7 October 1848), p 490; 304 (2 December 1848), p 588.

clear).³⁴ In the same year John Walker, Richard's son, succeeded to the firm, which was soon advertising corrugated sheets measuring eight feet by 3 ft 2 in (2.4 x 0.95 m), and had shipped a complete corrugated iron building to California.³⁵ Corrugated iron had not at first been galvanised, and in the early 1850s some black corrugated iron was still reaching Australia.³⁶ In the United States Mesker & Bro were still advertising ungalvanised corrugated iron with a painted finish, in the early twentieth century.³⁷

b. corrugated iron in Australia

Richard Walker, the original maker, was interested in the Australian market, and is said to have advertised in the *South Australian Record* of 1837 as the manufacturer of patent corrugated iron roofs, doors, shutters, park enclosures, verandahs, partitions, safety rooms and portable buildings for exportation.³⁸ In 1836 the South Australian Company had iron stores at both Adelaide and Port Adelaide,³⁹ probably made by Walker, and probably identical with corrugated iron stores which were otherwise reported to have been put up there in 1839.⁴⁰ There have been various other claims for the use of corrugated iron in Australia prior to the 1850s,⁴¹ none of which can be regarded as authenticated or even probable. A claim for the appearance of corrugated iron in New Zealand in 1843 can be even more summarily discounted.⁴²

³⁴ *Builder*, VII, 318 (10 March 1849), p 119.

³⁵ *Builder*, VII, 338 (28 July 1849), p 359.

³⁶ The Bellhouse house at the National Trust Iron House Museum, South Melbourne, is an example.

³⁷ Mesker and Bro., *Mesker and Bro. Manufacturers of Complete House Fronts* (St Louis [Missouri] no date [c 1904]), p 44.

³⁸ Anne Warr, 'The Corrugated Iron Shed', p 86, mentions an advertisement in the *South Australian Record*, but gives no reference.

³⁹ T H James, *Six Months in South Australia* (London 1838), pp 28, 30, 58. Warr, loc cit, cites a report in the *South Australian Record*, again unreferenced, to four iron storehouses being despatched on the *Africaine* in 1837. However, Capper's schedule of ships reaching South Australia shows the *Africaine* as having arrived on 2 November 1836, and having made no other visit up to the end of February 1838: Henry Capper, *South Australia* (2nd ed, London 1838), facing p 46. See also Jensen, *Colonial Architecture in South Australia* (Adelaide 1985), p 44.

⁴⁰ Letterbook of E W Andrews (in the possession of Mrs Bryce Andrews, Stonyfell, South Australia), entries for 23 September and 11 October 1839; Henry Capper, *Capper's South Australia* (3rd ed, London 1839), p 38; *South Australian*, 2 March 1841; G C Morphet, *Life and Letters of Sir John Morphet* (Adelaide 1936), p 106.

⁴¹ For example, it has been claimed that 'what appears to be a corrugated iron clad verandah' can be seen in a drawing of Mr Justice Dowling's house in Kent Street, Sydney, of 1830: Warr, loc cit. It has been stated that the shingles on the roof of St Thomas's church, Port Macquarie, were replaced with corrugated iron in 1833: E S Poole, 'St. Thomas' Anglican Church, Port Macquarie', *Heritage Australia*, VIII, 4 (Summer 1989), p 30. The corrugated roof of 'Walwa' homestead at Walwa, Victoria, is said to be original: information supplied to the National Trust, Victoria, by a Mrs De Steiger. So also the roof of 'Wooriwyrite' near Mortlake, of 1848 or 1849, though that was destroyed by fire in 1940; I corresponded with the late Miss Shaw when she was writing the book, and to the best of my knowledge the claim is quite unsubstantiated.

⁴² N P Bevin, 'Corrugated Iron: a New Zealand Perspective' (BArch, University of Auckland 1983), p 21, which seems to be based upon a misunderstanding of Hardwicke Knight & Peter Coutts, *Matanaka: Otago's First Farm* (Dunedin 1975).

Corrugated iron reached its peak of acceptance in Victoria in 1853, and very rapidly passed it. William Howitt, the peripatetic English journalist, commented on the arched-roofed iron stores he saw in Melbourne:

They are what they call corrugated iron - sheets of iron, fluted or channelled. These have been brought out from England, and look like huge caravans, the roofs being arched like them; or like great steam-engine boilers, or gasometers. These houses seem to have a vast demand, because they are rapidly put together; but they should send out iron constitutions with them, for the people who are doomed to inhabit them; for they will be very cold in winter, and in summer will just roast their tenants alive. They will prove admirable houses - for the doctors.⁴³

Before long Louisa Meredith was to remark on the ugliness of the same buildings, 'having no eaves, and, with their slightly elliptical roofs, looking very much like steam-boilers, with doors and windows cut in them; - and at home I have often seen boilers of bigger dimensions'.⁴⁴ During the 1850s pejorative terms like 'iron pot' come to be regularly used for everything from Coppin's Royal Olympic Theatre⁴⁵ in Melbourne (an elaborate building made by E T Bellhouse of Manchester) down to the iron school buildings made by Morton of Liverpool and Porter of Birmingham. The iron police lock-ups at Beechworth and Bendigo were each known as 'camp oven', and the latter was referred to as the 'iron hot house for baking unfortunate prisoners in'.⁴⁶

Meanwhile the material had not even reached the more distant or conservative parts of Australia. In the vicinity of Harvey, Western Australia, shingles were fairly universally used in the 1860s because corrugated iron was as yet unknown.⁴⁷ Often it was the opening of a railway which made the new material viable. At Warwick in Queensland the opening of the railway on 31 January 1871 reportedly brought the material onto the market, and resulted in galvanized tanks replacing water casks, and in iron spouting being installed.⁴⁸ In due course galvanized corrugated iron pervaded the continent, and its poor reputation was equally widespread amongst enlightened observers, such as James Nangle in 1895: 'Aesthetically considered, this custom of roofing with galvanized iron is the most abominable abuse that has crept into colonial architecture'.⁴⁹

William Archer was struck 'forcibly' at Rockhampton in 1876, by

the almost exclusive prevalence of corrugated iron roofs which glare hotly in the sun and from a distance give the town somewhat the appearance of one of our great factories where the work is carried on in separate buildings. This system of iron roofing has its advantages and disadvantages. In a climate like that of

⁴³ William Howitt, *Land Labour and Gold* (2 vols, London 1855), I, p 287.

⁴⁴ Louisa Meredith, *Over the Straits* (London 1861), p 95.

⁴⁵ *Australian Builder*, 4 February 1860, p 31.

⁴⁶ George Mackay, *Annals of Bendigo 1851-1867* (Bendigo, no date), p 49.

⁴⁷ A C Staples, *They Made Their Destiny* (Harvey [Western Australia] 1979), p 227.

⁴⁸ Thomas Hall, *The Early History of the Warwick District and Pioneers of the Darling Downs* (Toowoomba [Queensland] 1988 [Toowoomba, no date (?1920s)]), p 147.

⁴⁹ James Nangle, 'Roof Coverings', *Proceedings of the Engineering Association of New South Wales, 1894-5*, pp 88-96, quoted by L J Dockrill, 'Developments in Architecture in New South Wales during the Victorian Period' (6 vols, PhD, University of New South Wales, 1983), III, p 402.

Queensland it makes a house almost unbearably hot, whereas the ordinary 'shingle' roofing is several degrees cooler. But, on the other hand, an iron roof is always watertight, and affords a means of obtaining pure rain-water, which is by far the best for drinking water obtainable in Australia, the rain-water which comes from the shingles is always discoloured and has an astringent taste which renders it unpleasant, though not, I believe, unwholesome.⁵⁰

Old shingle and paling roofs, where they survive at all, have commonly been clad in corrugated iron fixed on new battens laid across the top of the shingles. This might be thought a slipshod practice, but there was usually little to be gained in removing the old material, for there was significant labour involved, the framing was often not strong enough to survive the process without shifting and distorting, and the insulating properties of the timber were lost. As James Graham put it:

we had a new roof of corrugated iron put on over the old shingle one, which will make, I am confident, a good and lasting job, and as the iron is fastened on battens laid down on the old wooden roof, a current of air consequently passes between the two roofs, which have [*sic*] the effect of keeping the house cool in the summer weather.⁵¹

Five inch iron could recently still be seen on the roof of a house at 21 Elm Grove, Richmond, Victoria,⁵² dating from the 1850s, and in fact five inch iron, when found in normal buildings, almost always dates from this decade. It continued to be produced in heavy gauge sheets into the mid-twentieth century, but mainly for industrial and engineering purposes.⁵³ Five inch iron survives at Murray Downs homestead, on the New South Wales side of the Murray opposite Swan Hill, and is believed to date from the 1840s,⁵⁴ though this seems most improbable. No early examples have been found which bear any brand, but one batch has been found with 'BA [?or PA] 22' embossed at the end of the sheet in 9 mm characters.⁵⁵

c. water tanks

In 1857 John Carter obtained a Victorian patent for an application of corrugated iron to the manufacture of circular tanks and buoys,⁵⁶ and though this does not prove that he was the actual inventor of the corrugated rainwater tank, it does provide a *terminus ante quem* for its appearance in Australia. In 1858 he exhibited it as the 'patent galvanized corrugated iron tank, made and patented in the colony'.⁵⁷ The corrugated

⁵⁰ William Archer [ed Raymond Stanley], *Tourist to the Antipodes* (St Lucia [Queensland] 1977 [c 1877]), p 18.

⁵¹ James Graham to C J La Trobe, 25 June 1875, in Sally Graham [ed], *A Man About Town* (Melbourne 1998), p 386..

⁵² Apparently recycled to this location, and finally removed in about 1992.

⁵³ *Lysaght Referee* (21st ed, Sydney 1961), p 10.

⁵⁴ Information from Bruce Day, Melbourne, 1992.

⁵⁵ Held by Andrew Muir of Collingwood, who has kindly provided me with a sample, March 1993.

⁵⁶ No 77 to John Carter, 31 December 1857.

⁵⁷ Victoria Industrial Society, *Catalogue of the Eighth Annual Exhibition* (Melbourne 1858), p 45.

galvanized tank was to become ubiquitous in rural Australia, despite the warning of Professor John Smith of Sydney University, in 1856, that galvanized iron was unsuitable for water cisterns because it produced zinc carbonate, which it would be imprudent to consume continuously in drinking water. A similar claim was made in South Australia in 1859, on the grounds that zinc was a poisonous substance, and that a horse had died after drinking from a well in which an old zinc cooler had been dumped.⁵⁸ At the Victorian Exhibition of 1861 Samuel McLelland showed two water tanks of his own manufacture,⁵⁹ though it is impossible to be certain that these were of corrugated iron.

An early reference to 'galvanised iron tanks', which seem likely to be of corrugated iron, is in an 1862 survey drawing of Alexander Brock's house 'Oak Hill', in what is now the Melbourne suburb of Preston.⁶⁰ One of the earliest illustrations of such a tank may be in the drawings of 1865 for a gatekeeper's cottage, by the Colonial Architect's Department of South Australia. These are reproduced by Stefan Pikusa, but they show only a cylindrical tank with a shallow conical top, and Pikusa does not say whether there is a specification or other evidence for assuming that it is made of corrugated iron.⁶¹ He certainly exaggerates when he says that corrugated tanks had come into general use (in Adelaide) in the late fifties, and is incorrect in supposing that they are of zinc annealed iron, which was not made at this time. W B Hays, writing about Adelaide in 1856, specifically refers to underground tanks as being common, and makes no reference whatever to iron tanks.⁶² Corrugated iron tanks normally have a flat bottom, and this usually rests on a timber base, but a conical base has the advantage of collecting sludge in one spot from which it can be drawn off. At 'Boisdale', Victoria, in 1892, there were to be '24 guage [*sic*] Galvanized corrugated (Blackwall brand) 60 gallon tanks with conical bottoms + No 2 draft off cocks including all connections + strong hardwood stand to each.'⁶³

d. verandah roofs

Another use of curved iron was in verandah roofs. Corrugated iron replaced canvas and duck for street awnings quickly in the cities, and later in country towns. In Melbourne American duck had been the norm⁶⁴ until in 1859 a by-law was adopted by the Council specifying the size of the timber framing members, and requiring the covering to be 24 gauge [0.63 mm], 2½ inch [64 mm] pitch corrugated iron.⁶⁵ At first verandah roofs were almost universally concave in profile, reflecting the Regency tradition of draped canvas oilcloth roofing, but Wynyard Terrace in Sydney had a

⁵⁸ *South Australian Register*, 24 June 1859, quoted in Elfrida & Rolf Jensen, *Colonial Architecture in South Australia* (Adelaide 1980), p 184.

⁵⁹ Victorian Exhibition 1861, *Catalogue with Prefatory Essays* (Melbourne 1861), p 216.

⁶⁰ 'Oak Hill, Parish of Jika Jika', survey of the land and house by William Malcolm, September 1862, Manuscripts Collection, La Trobe Library, kindly drawn to my attention by Michele Summerton.

⁶¹ Stefan Pikusa, *The Adelaide House 1836 to 1901* (Richmond, SA, 1986), pp 32-4.

⁶² W B Hays, *Engineering in South Australia* (London 1856) p 40.

⁶³ Guyon Purchas, 'Estimate for New Residence and Stabling Boisdale Estate near Maffra Gippsland for A.M. Foster Esqre' (Melbourne 1892), p 14.

⁶⁴ *Australian Builder*, 33 (16 October 1856), p 276.

⁶⁵ *Australian Builder*, 12 March 1859, p 77; 18 June 1859, p 185; 14 January 1860, p 8.

convex roof which may have been the original one of about 1850.⁶⁶ The use of curved corrugated iron became particularly characteristic of shop verandahs from the 1870s onwards, and these were sometimes convex in form even while the concave roof remained the norm for the domestic verandah.

It appears that the lean-to roofs for which Charles Hill advertised iron in Adelaide in 1850⁶⁷ were concave. Whether they were corrugated and whether Hill himself carried out the curving are unclear, but by June 1851 corrugated galvanized iron verandahs were available in Adelaide. Corrugated curving machines in both three inch and five inch sizes were advertised, to let or for sale, in Melbourne in 1856,⁶⁸ and in 1858 Morewood and Rogers were granted the Victorian patent already referred to, which included machinery for corrugating and curving.⁶⁹ That patent may be connected with the establishment in 1858 of the business of John Enticott, who was subsequently claimed to be the pioneer of the corrugated iron industry in Victoria.⁷⁰ However the existence of a separate business in Enticott's name is questionable⁷¹ and, as has been suggested above, a connection with John Carter seems more likely.

At 'Wood Cot Park', Victoria, of 1854-5, the verandah roof is of five inch pitch iron of an irregular concave profile, the radius decreasing at the bottom to give a flared effect. This is unsupported except at the hips, where there are bars of what is presumably wrought iron, curved in the appropriate form. It is not at all clear whether such work, especially the irregular curve of the iron, could have been carried out locally. Another exceptional form of concave verandah roofing is that of 'Ingleby' homestead in western Victoria, dating from 1860, for here the roof is carried on concave T-section wrought iron rafters. Smaller verandahs often had no intermediate supports at all, but spanned from the wall to the bressummer, especially when the profile was convex and therefore structurally strong. In one major house of the 1850s unsupported iron seems to have spanned a verandah 3.15 m deep

the corrugated iron which covers it in ... is not bolted or rivetted together, to tear to pieces as the weather contracts or expands the metal, but one end is simply tucked into a sort of groove supplied by a strong moulding in the wall, and the other is made fast to the outside rail.⁷²

In verandahs the roofing was often painted in stripes to evoke the fabric verandahs of the Regency period, but the slightly striped appearance of much old roofing is from another cause - the practice of laying sheets with alternate faces up and down, so that any difference in the quality of the galvanizing results⁷³ in a striped effect. The reason

⁶⁶ Max Kelly et al, *Demolished for the Public Good* (Glebe [New South Wales] 1988), p 88.

⁶⁷ Information from Peter Bell, 1991.

⁶⁸ *Argus*, 23 June 1856.

⁶⁹ No 9 to Edmund Morewood & George Rogers, 18 March 1857.

⁷⁰ James Smith [ed], *The Cyclopaedia of Victoria* (3 vols, Melbourne 1903, 1904, 1905), I, p 540.

⁷¹ Enticott does not appear in *Tanner's Melbourne Directory for 1859* (Melbourne 1859).

⁷² 'Rajpootana', St Kilda, Melbourne: *Argus*, 15 March 1867, p 6.

⁷³ Colin Allen, by email, 2000, explains this as follows: 'The sheets exited the coating machine so that one surface was in fairly intimate contact with a wire mesh conveyor that took the galvanised sheets away from the machine. The belt also served as a cooling down device and initiated the formation of spangles. Some machines were fitted with a 'studded' roll, the

for the practice is explained by Bill Nairn, of Adelaide, as follows. Modern corrugated iron sheets terminate on one side upon an upslope of the corrugation, whilst the other side finishes on a downslope. Nineteenth century iron finished on the downslope on either side, so that adjacent sheets would lap by one, two or more whole corrugations. As explained by an American manufacturer, a lap of one corrugation is satisfactory for wall cladding but inadequate for weatherproofing a roof, whereas a lap of two corrugations would be extravagant. By inverting alternate sheets a satisfactory lap of 1½ corrugations could be achieved.⁷⁴ A careful specification might prevent this being done, as in the case of a South Australian bank in 1878, which required 'two corrugations lap vertically, and 6" laps horizontally'.⁷⁵ Otherwise it might be condoned, as in early twentieth century specification which directs:

Cover the main roof, also balcony and verandah with 24 gauge corr. galv. iron of approved brand, laid with a 6" end lap and a flute and a half side lap every other sheet being reversed and secured to roof timbers every alternate flute, with galv, screws and burrs.⁷⁶

e. curving and structural use

In 1859 we know of curving and corrugating being done in Melbourne by only two firms, those of Carter and of Alex Rippingille,⁷⁷ while curving alone 'for verandahs, &c., &c.' was done by Walter Powell and Company.⁷⁸ Enticott's name does not appear. Carter's Steam Corrugating Works had apparently been established in that year, and they included a specially made patent corrugating machine weighing eight tonnes, which shaped the sheet by means of vertical pressure, and was supplied with dies in two, three, four and five inch corrugations. There was also a machine with three rollers shaped to match the corrugations, which could be adjusted to any given curvature; a spout machine for forming ogee, moulded and half round gutters, ridge caps and various kinds of piping; a piping machine for making circular spouting (presumably downpipes &c); and a machine for cutting sheet iron. These machines were said to be the first in the colony, and it has been suggested above that they were probably supplied by Morewood & Rogers. They cost between £800 and £900, and were worked by a five horsepower [3.7 kW] horizontal steam engine.⁷⁹ Zollner's galvanizing works, established in Sydney in 1863, also had curving machines.⁸⁰

studs serving to initiate the formation of spangles. Since the cooling rates were different on each side of the sheet it can be imagined that the surface finishes would also be different, but the difference is only slight.

⁷⁴ *The Canton Steel Roofing Co* [catalogue] (Canton [Ohio] 1899), p 19.

⁷⁵ 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), p 41.

⁷⁶ Specification for an unidentified building, from the papers of Tom [Thomas Higgins] Field of Middleton, South Australia, who worked from the late 1900s to the 1940s, and became the foreman to William Essery & Sons: possession of Ian Evans, Brisbane.

⁷⁷ C B Mayes, *The Victorian Contractors' and Builders' Price-Book* (Melbourne 1859), pp xxvii, xli.

⁷⁸ Mayes, *The Victorian Builders' Price-Book* (1859), p liii.

⁷⁹ *Australian Builder*, 24 December 1859, p 405, quoting the *Age*.

⁸⁰ R Irving, 'Early Galvanized Iron in Australia' (unpublished paper, October 1975), p 7, cited in Anne Warr, 'The Corrugated Iron Shed', p 88.

Corrugated iron was used as a structural material in its own right in the rainwater tank and the arched verandah roof, and occasionally in walling. One row of cabins in St Kilda, Victoria, known as 'Tin Pot Alley', was built of sheets with the ends driven directly into the ground.⁸¹ Some of the prefabricated buildings imported in the 1850s relied on the strength of sheets placed vertically,⁸² while those of E T Bellhouse required them to span a considerable distance horizontally between his patent stanchions. But the most dramatic use of the material was in the barrel vaulted roofs of imported buildings, such as stores, and the local ones which soon followed. These were not a novelty, for they resembled the roofs built at the London Docks in about 1830 by H R Palmer, the original patentee of the material.

The corrugated sheets at the London Docks had been made into a continuous surface by riveting them at the edges in both directions, and horizontal tie rods prevented the vault from spreading.⁸³ This principle continued in use, though for larger spans more complicated configurations of ties were used, and some engineers designed full trusses with top chords consisting of lightweight angles or other members curved appropriately. In 1849 John Walker advertised an improved method of making 'elliptical roofs' without the numerous joints, because he had machines which would strike 'Elliptical Sheets, by which means the numerous joints are avoided, and the roof of course rendered more sightly.'⁸⁴ This seems to suggest that the earlier roofs had been made up of straight sheets forced into shape. By the 1890s the general British practice was to use 3, 4 or 5 inch pitch (the latter generally preferred by engineers) corrugated iron of no 18 wire gauge, or 16 wg where great strength was required (only temporary roofs being of anything less than 22 wg). The curve was chosen to make the rise one quarter of the span, and if the span did not exceed 7.5 metres the roof could be supported by plain tie and king rods, whereas for larger spans framed principals were recommended. Generally the sheets were lapped and riveted together, as bolts and nuts were more expensive.⁸⁵

These arched roofs are particularly prevalent in South Australia, no doubt because the shortage of timber in many areas militated against conventional trussed structures. The Railway Superintendent's house, Goolwa, is a particularly interesting example, as it is reported to date from 1852-3, making it contemporary with the great flood of imported iron buildings, many of which also had arched roofs. The roof is also unusual in that two vaults meet each other at right angles, and that the section is semicircular, or nearly so, rather than segmental. The plan is a 'T' and so far as one can judge from the building in its present state, with replacement iron of the 1970s, the vault of the cross arm was complete, but that of the stem was butted into it and

⁸¹ J B Cooper, *The History of St. Kilda from its first Settlement to a City and After, 1840 to 1930* (2 vols, Melbourne 1930), I, p 53.

⁸² For example the building of James Officer & Co, Geelong, which was demolished round about 1970, though the components are held by the Geelong Historical Society. Details of the construction, and especially the gusseted frame, suggest that this was the work of John Walker.

⁸³ Loudon, *Cottage, Farm and Villa Architecture*, pp 206-8.

⁸⁴ *Builder*, VII, 338 (28 July 1849), p 359.

⁸⁵ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), pp 106-111.

trimmed to shape. Surviving sections of curved timber indicate that the roof was supported on arched wooden ribs.⁸⁶

A large farm barn with an arched roof was built at 'Poltalloch' in 1875. The iron is said to have been 'shaped' with 'rollers' which are still at the property,⁸⁷ but this is a reference to a curving machine, not one which actually formed the corrugations. The word 'rollers' is traditionally used in this way, and it is necessary to pass the sheet through at least twice, the first time being to 'break the grain', if a good finished result is to be obtained.⁸⁸ One of the grandest is that on the huge woolshed at 'Cordillo (or Cardilla) Downs' in Central Australia, built by the South Australia partners on their run in 1883. There are at least four other buildings with arched roofs on the same property, and others on the other runs held by the syndicate. Most were apparently constructed at the initiative of the managing partner N E Phillipson, such as the office and store at 'Murnpeowie'.⁸⁹

A very large woolshed of a similar character was built on the 'Teviot' station, New Zealand, in 1880, and it is believed that the whole of the arched roof structure (destroyed by fire in 1924) was imported from Britain.⁹⁰ This is more than likely, as by this time vaulted farm buildings, especially open-sided sheds, were a standard item being produced by British manufacturers for internal consumption. They are discussed in John Scott's *Farm Buildings* of 1881.⁹¹ The roof of the woolshed at Darr Rover Downs, Queensland (70 km north-west of Longreach) is unusual in that two barrel vaults intersect, something which most builders would avoid at all costs. An alleged date of 1884 has not been substantiated, and the first photograph dates from about 1910, but the trusses closely resemble those of the woolscour on the property, built in stages in 1883 and 1886. The trusses are of rods about 25 mm [1 in] in diameter and a curved top chord of 62 x 62 x 10 mm [2¹/₂ x 2¹/₂ x ³/₈ in] equal angle. At least one rod has embossed lettering, the first part of which appears to read 'NETHERTON'.⁹²

In Australia there was a further reason for the use of corrugated iron in remote areas, and this was defence. Whether or not it applied to woolsheds and farm buildings, it was specifically relevant to six telegraph stations projected by the Queensland government in 1885 'to be built of the best quality galvanised corrugated iron of heavy gauge, so as to be spearproof as well as fireproof' - and the latter was a reference not to natural disasters but to the possibility of firebrands being thrown onto the roof.⁹³ They

⁸⁶ Photographs and report of inspection kindly supplied by Peter Bell. The building is also illustrated in E & R Jensen, *Colonial Architecture in South Australia* (Adelaide 1980), p 132. I admit to some reservations as to whether it is entirely of the stated date.

⁸⁷ Stewart Game, 'Poltalloch, South Australia', in John Moore et al, *Historic Homesteads of Australia Volume Two* (Stanmore [NSW] 1976), pp 274, 276. Additional photographs kindly supplied by Peter Bell.

⁸⁸ Information from Bill Nairn, Adelaide, 1995.

⁸⁹ Ashley Cooper, 'Beltana, South Australia', in Moore, *Historic Homesteads Volume Two*, pp 204-222; Howard Pearce, *Homesteads of the Stony Desert* (Adelaide 1978), pp 104-5. Additional photographs kindly supplied by Peter Bell.

⁹⁰ Lois Galer, *Historic Buildings of Otago and Southland* (Wellington 1989), p 83.

⁹¹ John Scott, *Farm Buildings* (London 1881), pp 16-17.

⁹² Information and photographs from Michael Gunn, June 2003.

⁹³ Memo, Under-Secretary, Post & Telegraph Department, to Under-Secretary, Department of Public Works, 13 October 1885, Queensland Archives, WOR/A 1910/4654 Works

were built between Laura and Cape York in 1886-7, and had internal water tanks and stairways, and loopholed corner turrets.⁹⁴

f. corrugated tiles

A little known application of corrugated iron was in the form of so-called 'tiles' made by Tupper & Company, successors of Tupper & Carr.⁹⁵ These are 50 mm (about two inch pitch) iron, 1,120 mm long by 560 mm wide [44 x 22 in], and branded

[crown]
["TC' monogram]
TUPPER & COMPY.
MANUFACTURERS
LONDON AND BIRMINGHAM

The most striking feature is that three wrought iron straps are rivetted to one end. They are so designed that the top tile is laid first, and the straps protrude from its lower end. Fixing to the batten is through holes in these straps. The next sheet down the slope is pushed in under the end of the first sheet but over part of the straps, so that it conceals the fixing and is itself locked in place without any further fixing. Its lower end is again fixed through the straps, so that no fixing is required to penetrate the sheet itself (apart from the rivets which already connect the straps to it). The result of this system is that the roof is laid from top to bottom, rather than the usual bottom to top. These Tupper tiles have been found at five sites in Victoria.⁹⁶

Two inch iron in small sheets, though fixed with screws and washers, and lacking the rivetted straps of the Tupper tile, is found in the roofing of a loft at 'Rosedale', Portarlington, Victoria, probably before 1870. Given that no other maker of two inch iron is known, this is probably attributable to Tupper & Co.

Department, Cape York Post and Telegraph Office, quoted by Ian Evans in a letter of 4 June 1991.

⁹⁴ Peter Bell, *Timber and Iron* (St Lucia [Queensland] 1984), p 15, quoting the *Queenslander*, 31 October 1896, and drawings in the Australia Post Historical Section, Department of Housing and Construction, Brisbane.

⁹⁵ According to Gilbert Herbert, *Pioneers of Prefabrication* (Baltimore [Maryland] 1978), p 194, the firm became Charles William Tupper & Co in 1858, with a London address, and with a Birmingham address as well from 1864. This is deduced from directories, but in fact Tupper & Carr had a Birmingham address from 1852, and Tupper succeeded to the firm in 1857, as has been shown above.

⁹⁶ The tiles are on the stables at 'Campaspe Park' to the north of Bendigo; at the Maldon Bakery, found by Trevor Westmore, as advised by Nigel Lewis, 1988; on part of the main roof, an exterior water closet, and a store building, at 'Strathfieldsaye', Gippsland; and the house 'Sunnyside', Guthridge Parade, Sale. In the case of the Strathfieldsaye store they are clearly not the original roof covering, as a separate set of battens suitable for shingling is present, and in the homestead they appear also to have been re-used from some earlier position. At Sunnyside they survive on the rear wing, but have been taken off the main roof during the occupancy of the present owners, the Atkinsons. The house is believed to have been built in the 1860s by Philip McArdell, steamboat captain, sawmiller and timber yard owner. He seems likely to have been the supplier of the tiles used at Strathfieldsaye, not far away. The fifth location, as reported by Richard Aitken, 1993, is the homestead 'Mewburn Park' in Gippsland, though the brand was not legible.

g. early brands

The brands of iron available in Australia have not been sufficiently investigated to be a reliable guide in dating buildings. The original firm of Richard Walker (later Walkers & Holland, then John Walker) had by 1862 passed to W H Griffith,⁹⁷ none of whose iron has been identified in Australia. In 1859 the Melbourne ironmonger Walter Powell was offering three brands of iron, Morewood's, Tupper's and Hamilton's, either plain or corrugated,⁹⁸ and by this time, as we have seen, Tupper & Carr had been succeeded by Tupper & Co, and Morewood & Rogers by Morewood & Co. Morewoods were still prominent in the 1880s, when they were one of the two brands mentioned by name in Mayes's price book.⁹⁹

Tupper & Co, makers of the iron tiles, also made three inch [75 mm] corrugated iron of the conventional type, which has been identified by Peter Freeman covering the shingle roof of the first homestead at 'Hartwood' station in the Murrumbidgee district,¹⁰⁰ and found in a number of Victorian locations, probably of the 1850s and 1860s. The latest may be that with an emblem of crossed scimitars, at 'Kow Plains' in the Mallee.¹⁰¹

The Gospel Oak company owned by the Walkers, as has been discussed above, had formerly been the manufacturers of Morewood & Rogers's iron, and they came to manufacture corrugated iron as well as flat iron and tiles. A typical brand¹⁰² is:

GOSPEL OAK
G [anchor] O
FIRST QUALITY
GALVANIZED TINNED IRON

At 'Warrock', near Casterton, Victoria, these sheets are found mingled in the same roof¹⁰³ with what must be a second grade version, branded simply:

GOSPEL OAK
G [anchor] O

⁹⁷ *The Business Directory of the Manufacturing and Commercial Cities of England*, III, London 1862-3 (London 1862-3); J Steinhardt [ed], *The Illustrated Guide to the Manufacturers, Engineers, and Merchants of England, Scotland, Ireland and Wales* (London, no date [c 1869]), pp 141, 307, 424.

⁹⁸ C B Mayes, *The Victorian Contractors' and Builders' Price-Book* (Melbourne 1859), p liii. Hamilton's iron was that produced by Colonel Hamilton at the Hamilton Iron Works, of Garston, Liverpool, which was taken over by Francis Morton & Co in 1880: J M Swift, *The story of Garston and its Church* (Garston 1937), p 187.

⁹⁹ Charles Mayes, *The Australian Builders' Price-Book* (4th ed, Melbourne 1883), p 123; *ibid* (5th ed, 1886), p 139.

¹⁰⁰ Peter Freeman, *The Homestead: a Riverina Anthology* (Melbourne 1982), p 85.

¹⁰¹ Photo provided by Jocelyn Lindner, 2001.

¹⁰² Found at 'Strathfieldsaye' homestead, Gippsland, at the east end of the south verandah; the hayshed, 'Highbury', Soldiers Road, Hillside, Victoria (as reported by Neil Cox to the *Gippsland Heritage Journal* 1995); on the stables and elsewhere at 'Kow Plains' homestead near Cowangie, Victoria; and in the stables of the Ewin property near Blayney, New South Wales. This latter building is said (by its owner, the Rev Angus Ewin of Bathurst) to have been re-roofed immediately after World War II, but in that era of building material shortages this may well have been done using secondhand iron.

¹⁰³ The building is alleged to date from the 1840s, but the roof was replaced, after a fire at some unspecified date.

GALVANIZED TINNED IRON

The Great Western Store at Hill End, New South Wales, already had a corrugated iron roof when photographed by Beaufoy Merlin in 1872,¹⁰⁴ and the present iron may be that illustrated. It is branded even more simply:

G [anchor] O
GOSPEL OAK

Another brand is reported to have the letters 'GC' [but perhaps 'GO', for Gospel Oak?] with a crown:¹⁰⁵

GC
[crown]

h. later nineteenth century brands

It is impossible to lay down any precise chronology, especially as some brands persisted for many decades whilst others seem to have been short-lived. It can be said, however, that all the brands found in the nineteenth century are British. The number of them increases dramatically up to and during the 1880s, and, one may surmise, probably reduces again in the 1890s (so far as the Australian scene is concerned), due to the depression.

It is useful, therefore, to consider those brands which were shown at the 1880 Exhibition or the Centennial Exhibition, which appear in the current prices list of the *Australasian Builder & Contractor's and News*, in 1888, or are otherwise known at this time:

A1 Crown¹⁰⁶
AB Brand¹⁰⁷
Adams-Mars¹⁰⁸
BBB
Blackwall¹⁰⁹
Braby's Sun¹¹⁰
Davis' [sic] Crown Brand¹¹¹
Dolphin
Emu¹¹²

¹⁰⁴ Keast Burke, *Gold and Silver* (Melbourne 1973), pl 50.

¹⁰⁵ At 18-20 Fifth Avenue, St Peters, South Australia, 1880s: information from Bill Nairn, 1995.

¹⁰⁶ *ABCN*, date to be established.

¹⁰⁷ *ABCN*, date to be established.

¹⁰⁸ G Adams & Sons, Mars Iron Works, Wolverhampton: Centennial International Exhibition 1888-1889, *Official Record* (Melbourne 1890), p 466.

¹⁰⁹ *ABCN*, date to be established: Blackwall Galvanised Iron Co, London; Melbourne International Exhibition, 1880, *Official Catalogue of the Exhibits* (2 vols, Melbourne 1880), II, p 336; Centennial Exhibition, *Official Record*, p 466

¹¹⁰ *ABCN*, date to be established. F Braby & Co, Fitzroy Works, Euston Rd, London: Centennial Exhibition, *Official Record*, p 466

¹¹¹ *ABCN*, date to be established.

¹¹² *ABCN*, date to be established.

Globe¹¹³
 Gospel Oak¹¹⁴
 Guinea
 JCW
 Lysaght¹¹⁵
 Magpie
 MBIBA Crown
 MTR Crown
 Orb¹¹⁶
 Philip's "Stork"¹¹⁷
 Red Cross¹¹⁸
 Redcliffe Crown¹¹⁹
 Scales
 Staffordshire
 Sword and torch
 Walker's "3 Crown"¹²⁰
 Windmill

We have dealt already with the early history of the Gospel Oak brand, but by the 1870s there is a change in the labelling. Freeman has reported what he says is a Gospel Oak Three Crown brand on the woolshed at 'Coan Downs' on the Lower Darling,¹²¹ and Graeme Butler reports a specimen of 'T W & J W Walker' three crowns, of Wolverhampton.¹²² Clearly, the same company was the source of the iron branded

[crown crown crown]
 T.W J.W

found on an outbuilding at Koroit,¹²³ as well as on the verandah of Eeuyuk homestead, 1874,¹²⁴ where it is believed to be original. This is doubtless the Walkers 3 crowns brand known to have been imported in 1887.¹²⁵ It seems more likely than not that the Walkers who made the Gospel Oak three crown brand were the same Walkers who made the other, and the difference in the brands was mainly to distinguish the Wolverhampton from the Tipton product. There is another 'BBB' three crowns brand, but it is not known whether there is any connection.

¹¹³ Presumably the Globe Iron Works of W B Haigh & Co of Oldham, whose exhibit in 1889 is not particularised: Centennial International Exhibition 1888-1889, *Official Record* (Melbourne 1890), p 467.

¹¹⁴ ABCN, date to be established.

¹¹⁵ John Lysaght Ltd, Bristol, Wolverhampton & London: Centennial Exhibition, *Official Record*, p 467.

¹¹⁶ ABCN, date to be established.

¹¹⁷ ABCN, date to be established.

¹¹⁸ ABCN, date to be established.

¹¹⁹ ABCN, date to be established.

¹²⁰ ABCN, date to be established.

¹²¹ Peter Freeman, *The Homestead: a Riverina Anthology* (Melbourne 1982), p 84.

¹²² At Babinya, Greenhill Rd, Pakenham, Victoria: information from Graeme Butler 1995.

¹²³ J J & J S Murray property, Nine Mile Road, Koroit.

¹²⁴ The roofing iron, now covered over, is believed to be of the same brand.

¹²⁵ *Australasian Builder & Contractor's News*, 14 May 1887, p 5.

There are many other crown brands, including an 'A1 Crown brand' was imported exclusively by F Lassetter & Co of Sydney from an unnamed manufacturer,¹²⁶ and one produced by Davies Brothers, which is probably the same as the 'Davis Crown' brand reported in the *Australasian Builder & Contractor's and News*. In 1888 the Redcliffe Crown Galvanized Iron Company of St Philip's, Bristol, applied to register two trademarks in Victoria, the Redcliffe and the Redcliffe Crown.¹²⁷ Most reported examples are in Gippsland, Victoria, and the earliest is thought to date from 1887. Freeman reports this iron on the Woolshed at 'Til Til' on the Lower Darling.¹²⁸ This company may have been taken over by Lysaghts, who also originated in Bristol, and who by 1902 were marketing the Redcliffe brand as their second quality iron, using the version of the brand containing the words 'trade mark'.¹²⁹

Frederick Braby & Co, of London, Liverpool, Glasgow and Deptford, produced first and second quality sheets, sun and cedar brands respectively, from at least 1877 (when they won a medal at the South African Exhibition) to 1883.¹³⁰ In Australia only the sun brand has been identified so far. This brand was registered in Victoria in 1880,¹³¹ and this probably marks the beginning of imports. The court house at Broome, for which Brabys manufactured the columns, is likely to be clad in their iron.

The AB brand, comprising the letters the letters 'AB' within a six-pointed star formed of two equilateral triangles overlaid head-to-toe, has been found, in association with the dolphin brand mentioned below, at Briagolong, Victoria, apparently dating from 1902, and at other locations in Gippsland and elsewhere. The 'Emu' brand, obviously pitched specifically to the Australian market, was sold from at least the 1880s to 1908, but the maker appears to change from E R Harrington (apparently the earlier) to Wolverhampton Corrugated Iron Manufacturers. By 1908 Noyes Brothers of Sydney were advertising the 'Emu' brand, without specifying its origin.¹³² The precise interrelationship of the Wolverhampton factories is unclear, for in addition to Harrington Brothers and the Emu brand, and T W & J W Walker as discussed above, there were the works acquired by Lysaghts at Swan Garden and Osier Bed, and yet another manufacturer, Pinson & Evans.

The Crown Blackwall brand comes in a number of versions, and was the product of the Blackwall Galvanized Iron Co, which had works at Blackwall and offices in London.¹³³ This iron was used in the Melbourne Exhibition Building and the annexes

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- ¹²⁶ Charles Mayes, *The Australian Builders' Price-Book* (5th ed, 1886), advertisements p xiv.
- ¹²⁷ *Victorian Government Gazette*, LXXII, 80 (23 July 1886), p 2160, cited in Allan Willingham, *Blood's Cottage, 519 Station Street, Box Hill* (North Fitzroy [Victoria] 1992), p 89.
- ¹²⁸ Peter Freeman, *The Homestead: a Riverina Anthology* (Melbourne 1982), p 84.
- ¹²⁹ *The Metal Trades Referee* (2nd ed, Melbourne 1902), inside back cover.
- ¹³⁰ *Frederick Braby & Co.* [catalogue] No. 9 (London 1883), p 34.
- ¹³¹ Application of 12 March 1880, in *Victorian Government Gazette*, LIX, 28 (12 March 1880), p 635, cited in Allan Willingham, *Blood's Cottage, 519 Station Street, Box Hill* (North Fitzroy [Victoria] 1992), p 89.
- ¹³² Robert Haddon, *Australian Architecture* (Melbourne, no date [1908]), advertisements p xxxviii. An example which may be of about this date has been reported by Graeme Butler, 1995, at what he calls the 'Payne's Bon Marché' summer house at Beaconsfield, Victoria - the house dates from about 1910, and the iron is on an attached barn.
- ¹³³ J Sears [ed], *The Contractors,' Merchants,' and Estate Managers' Compendium and Catalogue* (15th ed, London 1901), p 131.

built for the 1880 Exhibition,¹³⁴ shown at the Melbourne Exhibition of 1888-9,¹³⁵ and advertised in Sears's *Compendium*, but there is no information as to the dates of the different brands.

The 'Stork' brand has so far been found only in undated examples.¹³⁶ The last of the brands listed in the *Australasian Builder & Contractor's and News* is the 'Red Cross' brand, a single example of which has been found in New South Wales, but many other brands appear to be of a similar age. A 'dolphin' brand in various forms has been identified in buildings apparently from 1880 onwards, one of which also bears the name 'Pontnewynydd'. Another brand is that of Skaiff and Co, who appear in the *Post Office London Directory* of 1889 as builders of portable houses (but were doubtless engaged in other activities as well. Something of a conspectus can be gained from the list of British exhibits of corrugated and/or galvanized iron at the Centennial International Exhibition in Melbourne of 1888-9. These comprised four or five major firms: G Adams & Sons ('Adams-Mars'); the Blackwall Galvanised Iron Co; F Braby & Co ('Sun'); probably W B Haigh & Co ('Globe'); and John Lysaght Ltd. Another exhibitor, W Bain & Co of Coatbridge, showed only corrugated steel fencing,¹³⁷ and was probably not a maker of the basic material.

The 'Adams-Mars' brand had come onto the local market by 1886.¹³⁸ It was made by George Adams & Co of the Mars Iron Works at Wolverhampton,¹³⁹ who were able by 1903 to claim that theirs was the best-known brand in the South African market¹⁴⁰ - whereas Lysaghts certainly led in Australia. Although Morewood & Co and the Gospel Oak Co had both been liquidated in the 1890s, as has been mentioned, they were reconstructed and presumably continued to trade. 'G.O.' corrugated iron, guttering and ventilators, with no other options, was specified for the Government Offices ['Treasury'] building, Brisbane in 1886 and 1890,¹⁴¹ and 'G O' and 'Anchor' are the two brands (actually the same brand) still listed as acceptable in a Queensland government printed specification of 1900 for a water tank.¹⁴²

The Globe Galvanized Iron Co of Great Bridge and the Staffordshire Galvanized Iron Co of Walsall (both said to have started in the golden age of the industry, probably the 1840s-1870s) were both liquidated and sold to private firms, who carried them on successfully.¹⁴³ W B Haigh & Co of Oldham appear to have acquired the Globe company, and examples of Globe iron have been found at least as late as 1910.

Unbranded iron continues to appear until at least the 1890s, though it might in theory be possible to identify it by metallurgical analysis. Mr Bob Boelen has analysed iron

¹³⁴ Melbourne Exhibition 1880, *Catalogue*, II, p 336.

¹³⁵ Centennial Exhibition, *Official Record*, pp 459 466, 737, 964.

¹³⁶ For example 'Cloverdale Cottage', Endeavour Hills, near Melbourne.

¹³⁷ Centennial Exhibition, *Official Record*, p 466.

¹³⁸ *Australasian Ironmonger*, I, 7 (1 October 1886), advertisements p xv.

¹³⁹ Centennial Exhibition, *Official Record*, pp 466, 736, 963.

¹⁴⁰ Gilbert Herbert, *Pioneers of Prefabrication* (Baltimore [Maryland] 1978), p 144, quoting Longhand's *Transvaal and Rhodesia Directory* (1903), p 11.

¹⁴¹ *Specification of the Materials and Works required in the erection of Public Offices, Brisbane, &c*, 1886 [held by the Historic Buildings Branch, Brisbane], pp 19, 31, 34; also specification for stage 2, 1890, pp 18, 30, 31, 33.

¹⁴² One of these specifications forms part of the contract for the Boggo Road Gaol, Brisbane.

¹⁴³ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 27.

used as cladding on piers 8 and 9, Walsh Bay, Sydney, with rather surprising results. The carbon content of 0.02% clearly indicates that the material is wrought iron rather than steel, but there is 0.22% of manganese, while silica, normally present in wrought iron, is undetectable.¹⁴⁴ It is difficult to say when most manufacturers converted from wrought iron to steel, but the leading steelmakers Dorman Long & Co were producing corrugated galvanised steel by 1901.¹⁴⁵

i. Lysaghts

Lysaghts manufactured over a long period, and their iron came to be the most extensively used in Australia, but the changes in the form of brand are not as yet fully documented and dated. It was well established in Australia by 1887, when the contract for a giant order of 500 tonnes of iron for the Melbourne Exhibition Building went to Lysaght's 'Orb'.¹⁴⁶ The simple 'Orb' brand was used, with or without the name 'Lysaght' and/or the word 'Australia' when it was locally made. Other versions must therefore be assumed to be of English make.¹⁴⁷ The use of the phrase 'galvanized tinned' is even more strongly indicative of the British product, but is probably not literally true, for the reasons discussed above.

John Lysaght began manufacture in Bristol in 1857 in the factory previously established by one Clarke,¹⁴⁸ and it is claimed that he used the Orb brand from the outset.¹⁴⁹ The works at first galvanised black sheets obtained from producers in the Midlands, but in 1880 Lysaght acquired the Swan Garden works at Wolverhampton, and the nearby Osier Bed works, with a total of twelve rolling mills.¹⁵⁰ At some stage the 'Guinea' brand (described below) was established for Lysaght's second quality iron, and this was being imported to Australia by the 1880s,¹⁵¹ and by 1895 the firm's total output had reached 40,000 tonnes a year, three-quarters of it destined for Australia.¹⁵² By 1876 John Lysaght was listed in the *Post Office London Directory* as a portable house builder, and by 1889 the company claimed to specialise in iron roofs and buildings, and operated from the St Vincent's Galvanized Iron Works in Bristol, the Swan Garden works and the Osier Bed works at Wolverhampton, with an office at 36 Gracechurch Street, London.¹⁵³

In 1880 John Lysaght of Bristol are said to have established a central selling agency in Melbourne under Thomas Davey, called the Victorian Galvanized Iron & Wire Co.¹⁵⁴

¹⁴⁴ Information from Mr R Bowline of Ferntree Gully, January 2000.

¹⁴⁵ Sears, *Contractors' Compendium*, p 338.

¹⁴⁶ *Australasian Builder and Contractor's News*, 8 October 1887, p 348.

¹⁴⁷ At the Briagolong Mechanics Institute, Gippsland, smoke/supper room added in 1910: information from Linda Barraclough 1994. Also in the roofing of the later parts of 'Warrock' homestead, near Casterton, Victoria, and in a number of the outbuildings. Also a water tank opposite the former John Kelly property, Beveridge, Victoria (this, interestingly, bears a faded inscription in painted script 'Clutterbuck Bros. / Melb. Sole Agents').

¹⁴⁸ *The Lysaght Century 1857-1937* (no date, c 1937]

¹⁴⁹ John Lysaght (Aust.) Ltd, *The Referee* (12th ed, Sydney 1921), p 7.

¹⁵⁰ Lysaght's Works Pty. Ltd., *Lysaght's Silver Jubilee* (Sydney 1946), p 16.

¹⁵¹ *Lord & Hughes' Monthly Circular* (Melbourne, 2 June 1884), p [5].

¹⁵² *Lysaght's Silver Jubilee*, p 16.

¹⁵³ *Post Office London Directory 1889* (London 1889), p 139.

¹⁵⁴ *Lysaght Venture* (Sydney 1955), p 2.

According to another account it was established in that year as Lysaght Brothers & Co, in William Street, Melbourne, with the sole colonial agency for the parent company's galvanized iron. Davey was chairman and manager, based in Melbourne, but the centre of operations was in Sydney where a very large establishment was opened on the Parramatta River in 1883. Its manager, Alexander Wilson, was also a director of the company, as was a family member, Arthur R Lysaght, in Sydney. Branches were opened in Brisbane and Wellington in 1886, though Wellington operated as a subsidiary of the English company. There were sub-agencies of the Australian firm in Adelaide, Tasmania and London.¹⁵⁵ This arrangement lasted until 1899, when the Melbourne-based operation became Lysaght's Galvanized Iron Pty Ltd, with a newly established branch at Sydney under H R Lysaght, responsible also for the Queensland market. The new company became the largest customer of the manufacturing company in England.¹⁵⁶

By the turn of the century John Lysaght's 'Orb' brand iron seems to have been by far the most popular in this country, and was particularly successful in Western Australia, where it was said in 1903 to have been in use for forty years, and to have established a virtual monopoly.¹⁵⁷ In 1887 John Lysaght Limited of England registered the following trade marks in Western Australia, for their various products:

1. 'Guinea'.
2. 'Globe'
3. 'Queen's Head with quadrangle ornamental border'.
4. 'Queen's Head'.
5. Orb, surmounted by Maltese cross.
6. 'Orb'.
7. The word and device 'Orb'.¹⁵⁸

In 1901 the corrugate iron brand was advertised in Australia to be, more simply than before:¹⁵⁹

[orb containing on the horizontal band:
ORB
]

The Redcliffe Crown Galvanized Iron Company of St Philip's, Bristol, which had been active in the 1880s,¹⁶⁰ appears to have been taken over by Lysaghts, who maintained the brand for some time, and in 1912 the *Referee* listed a version of their Redcliffe brand with a fleur-de-lys.¹⁶¹ Standard house patterns of about this time, offered by James Moore & Sons, the South Melbourne timber merchants, specify 'Redcliffe Iron'.¹⁶² Elsewhere Moore's advertised only three brands, Orb, Redcliffe and Globe,

¹⁵⁵ Alexander Sutherland [ed], *Victoria and its Metropolis* (2 vols, Melbourne 1888), II, p 610.

¹⁵⁶ *Lysaght Venture*, loc cit.

¹⁵⁷ Ian Kelly, 'The Development of Housing in Perth (1890-1915)' [MArch, University of Western Australia, 1991], p 206, quoting R M Hamilton, 'The City of Perth, Western Australia', *Journal of the Royal Institute of British Architects*, XI, 7 November 1903, p 18.

¹⁵⁸ *Australasian Ironmonger*, 1 July 1887, p 182.

¹⁵⁹ Walter Jeffries, *The Australian Building Estimator* (Sydney 1907), front endpaper.

¹⁶⁰ *Australasian Builder & Contractor's News*, 14 May 1887, p 5.

¹⁶¹ *The Metal Trades Referee* (Melbourne 1912), p 61.

¹⁶² Four sheets in the possession of the writer.

two of them by Lysaght.¹⁶³ Equally typical of this period were Colton, Palmer, of Adelaide, who claimed to stock all the standard brands, but actually listed only 24 gauge Orb, 26 gauge Orb, and 26 gauge Redcliffe.¹⁶⁴ By 1913 the Australian company, Lysaght's Galvanized Iron Pty Ltd, was handling 85,000 tonnes a year, or 70% of the Australian market,¹⁶⁵ and all of this was still of course being manufactured in Britain.

j. the Australian market

In 1887 it was reported that galvanised corrugated iron was now being manufactured by Sandford at the Fitzroy Ironworks, Mittagong, New South Wales.¹⁶⁶ If this is true it must have been short-lived, for no more is heard of it, though Australia remained a high consumer of the British product. 1894, when British exports amounted to 170,000 tonnes, Australia was the best customer, with 41,700 tonnes, followed by India, South Africa and the Argentine.¹⁶⁷ In 1886 attempts were made to standardise the size of corrugated iron supplied by British manufacturers. Macpherson & Co of Townsville complained of the differences in pitch, which it made it necessary for dealers to stock a number of brands, but the *Australasian Ironmonger* pointed out standardisation would be against the interests of those makers who would lose their niche markets.¹⁶⁸ In Queensland, for example, Gospel Oak is said to have been the preferred brand prior to the rise of Lysaghts.¹⁶⁹ The *Australasian Ironmonger* sent out a circular to canvass the opinion of merchants, and extensive correspondence ensued. Most of those who responded thought it a good idea, though there was some thought it would benefit the cheaper makers by giving their iron access to a wider market. McLean Brothers & Rigg of Melbourne expressed their indifference, as they always stocked both the Emu and Orb brands, implying that it was between these two that the main difference lay. T W Eddy & Son of Sydney recommended the Emu profile as the standard, 'as we find it fits the corrugations of most iron imported into this market.' J Colton & Co of Adelaide went further and said:

So far as we are concerned, when we buy a parcel in the market we always stipulate that it is to be of a similar corrugation to 'Emu', which is standard for country trade, and often have to pass outside brands which we should be glad to purchase if they suited us in this particular.¹⁷⁰

In subsequent correspondence an anonymous merchant said that he had tried to resolve the issue by requiring a guarantee, before buying from any maker, that their corrugations would correspond to Gospel Oak. But the requirement was not satisfactorily met and, moreover, some makers supplied narrower sheets which did not

¹⁶³ James Moore & Sons Pty. Ltd., *Price List 96 August 1913* (Melbourne 1913), p 1.

¹⁶⁴ Colton, Palmer & Preston, Ltd., *You are Secure with Us for Builders Hardware* (Adelaide 1917), p 97.

¹⁶⁵ Lysaght's Works Pty. Ltd., *Lysaghts Silver Jubilee* (Sydney 19546), p 178.

¹⁶⁶ *Australasian Ironmonger*, 1 November 1886, p 83.

¹⁶⁷ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 1.

¹⁶⁸ *Australasian Ironmonger*, 1 June 1886, p 58.

¹⁶⁹ Donald Watson, *The Queensland House* [typescript report] (Brisbane 1981), p 13-1.

¹⁷⁰ *Australasian Ironmonger*, 1 July 1886, p 83.

lap satisfactorily. Subsequently therefore he had confined his purchases to Redcliffe, and was very satisfied with this.¹⁷¹ Ten out of eleven local dealers supported the idea of a standard pitch, and E T Harris, of Macpherson & Co, Townsville, reminded his colleagues of how the British makers had been reluctant to produce iron of a lesser thickness than 24 gauge, but when Lysaghts broke ranks and made 26 gauge, the others quickly followed.¹⁷²

On 14 October 1886 a meeting of the Galvanised Iron Trade Association in Birmingham discussed the advisability of fixing a standard corrugation, but it was argued that the sheets of the major manufacturers would 'work into each other', and no action was taken. The *Australasian Ironmonger* collected contrary evidence by measuring a number of brands on the Australian market, recording the depth of the corrugations and the pitch at top and bottom (which is odd, because they must be the same in any regular sheet). A sample from the Gospel Oak works of at least four inch [102 mm] was discarded, as it was four or five years old and had been discontinued, leaving thirteen types, all 26 gauge except Butterfly, which was 28 gauge:

DIMENSIONS OF CORRUGATED IRON IN AUSTRALIA IN 1886¹⁷³

brand	depth		top pitch		bottom pitch	
	ins	mm	ins	mm	ins	mm
Arrow	11/16	17.5	3 ¹ / ₈	79.4	3 ¹ / ₈	79.4
Blackwall	5/16	7.9	3 ³ / ₃₂	78.6	3 ³ / ₈	85.7
Redcliffe	11/16	17.5	3 ¹ / ₈	79.4	3 ¹ / ₄	82.6
Owl	13/16	19.9	3 ³ / ₄	95.3	3 ¹ / ₁₆	77.8
Emu	13/16	19.9	3 ¹ / ₁₆	77.8	3 ¹ / ₁₆	77.8
The Butterfly	13/16	19.9	3	76.2	3 ¹ / ₄	82.6
Orb	5/8	15.9	3 ¹ / ₈	79.4	3 ¹ / ₈	79.4
Vine leaf	3/4	19.1	3 ¹ / ₂	88.9	3 ⁵ / ₈	92.1
Shamrock	11/16	17.5	3	76.2	3 ¹ / ₈	79.4
Sunflower	11/16	17.5	3 ⁵ / ₁₆	77.0	3 ⁵ / ₁₆	84.1
Stork	5/8	15.9	3	76.2	3 ¹ / ₈	79.4
Three cones	13/16	19.9	3 ¹ / ₈	79.4	3 ¹ / ₈	79.4
Star and Crescent	11/16	17.5	3 ⁵ / ₁₆	84.1	3 ⁵ / ₁₆	84.1

Standardisation gradually developed, despite the inaction of the trade. Ludlow Brothers, a new and small Birmingham manufacturer, wrote to the *Australasian Ironmonger* expressing their willingness to comply with customer requirements, and saying that their brands, 'Snowflake' and 'Ludlow' at present fitted exactly with 'Arrow' and Redcliffe' iron.¹⁷⁴ James Davies (the maker of Crown brand iron) wrote to London *Ironmonger*, and was in turn reported in Australia. He had had difficulties in getting his iron to match the standard brands. One reason was that the dies used to stamp it would get worn 'so that the tendency is for the gauge to widen'. This is a

¹⁷¹ *Australasian Ironmonger*, 1 September 1886, p 144.

¹⁷² *Australasian Ironmonger*, 1 October 1886, p 150.

¹⁷³ *Australasian Ironmonger*, 1 December 1886, p 198.

¹⁷⁴ *Australasian Ironmonger*, 1 March 1887, p 46.

puzzling account because the pitch, which is what is meant, could not change with wear, though the depth might. The second reason was that however deep the dies were the iron tended to spring back out rather than assume the complete shape. The first (supposed) difficulty he dealt with by keeping a steel template of the corrugations, and planing the dies to match it when necessary, and by replacing them when required. The second problem he dealt with by close annealing in large wrought iron boxes, which was expensive, but feasible where the output was over 100 tonnes a week.¹⁷⁵

In his book of 1899 Davies advised manufacturers in their own interests to ensure that their corrugations matched those of the three main brands, which were uniform. These brands were John Lysaght's 'Orb', George Adams & Sons' 'Mars', and the Gospel Oak Co's 'GO'.¹⁷⁶ The Australian and New Zealand markets were said in 1899 to buy lengths of five to ten feet [1.5 to 3 m] in 27 gauge [nominally 26 gauge] thickness, with eight three inch [76 mm] corrugations to the width. Small amounts of 24 gauge iron were ordered for curving for rainwater tanks and roofs.¹⁷⁷ In the United States Mesker & Bro advertised corrugated sheets of 2¹/₂ inch [64 mm] pitch in lengths of 6, 7, 8, 9 and 10 feet.¹⁷⁸

'Bishop's Lodge' at Hay, New South Wales, of 1888, is Australia's grandest corrugated iron house, and a surprising one given that it one would expect a bishop's palace to be Gothic, and built of masonry. It is rather reminiscent of a corrugated house manufactured by Samuel Hemming in the 1850s to the order of the Bishop of Sydney,¹⁷⁹ but this makes it no less surprising, for the image of corrugated iron had declined in the intervening years from that of a wonder material to that of a gimcrack makeshift. We will refer to Bishop's Lodge again in connection with its extensive verandah and with the views on the subject expressed by its putative architect, John Sulman.

For the present it is more relevant to consider the reasons for which Bishop Sydney Linton chose corrugated iron, and the success with which this decision was attended. As to the first, Linton wrote:

the contraction of the soil in the heat, and the expansion, when there is wet, are so great that enormous cracks appear in the walls of almost all brick buildings. At night in the hot weather brick walls in a greater degree, and wood in a lesser degree, retain the heat, whereas iron cools immediately as the temperature cools. The expense of the iron house is somewhat less than one of wood ... and considerably less than one of brick ... the open space between the [lining] and the outside walls is to be filled with sawdust as a non-conductor of heat and cold.¹⁸⁰

As to the second:

¹⁷⁵ *Australasian Ironmonger*, 1 February 1887, p 22.

¹⁷⁶ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 54.

¹⁷⁷ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 35.

¹⁷⁸ *Mesker and Bro. House Fronts*, p 44.

¹⁷⁹ Broadsheets held by the Baillieu Library, University of Melbourne; also Rex Nan Kivell Collection, National Library of Australia, NK 480.

¹⁸⁰ Peter Freeman, *The Homestead: a Riverina Anthology* (Melbourne 1982), p 216, quoting *Riverine Papers*, 5 (1888).

The house surpasses all our utmost expectations, for comfort, convenience, and for beauty. The painting of the interior walls is lovely, and is done in admirable taste, the exterior is quite plain, but not ugly ... We can now speak of the house as being admirable for a summer residence, and cool beyond any other in town ... The thermometer has never exceeded ninety degrees within the house ...¹⁸¹

The exterior walls of Bishop's Lodge are of corrugated iron running vertically. Most of the interior is lined in flat galvanized iron sheets (with the G O - Gospel Oak - brand visible in the rear), with a grid of timber mouldings giving the appearance of panelling.

Corrugated iron remained important for a longer time in remote areas, and indeed began to acquire genuine vernacular characteristics. Michael Davitt, commenting on Charters Towers in 1897, takes the old line that the houses 'are all roofed with corrugated iron - as most Queensland dwellings are - and this imparts anything but a pleasing appearance to the place when seen from an elevation.'¹⁸² In truth, however, he should have recognised the charm of the galvanised iron window hoods, the ventilators on the roof ridges - masterpieces of the tinsmith's art, and the broad encircling verandah from which cantilevers a further secondary awning.¹⁸³ The mining town of Broken Hill developed from the 1880s, but the building stock is mostly much more recent. Even in 1888 a South Australian journalist expressed surprise that 'sardine tin houses' could exist in a town 'in the presence of wealth'.¹⁸⁴ Geoff Ashley has written of typical houses of the 1890s, in which the front face is of ripple iron, the sides are of normal corrugated iron, and the verandah ends finished in pressed metal sheets of patterns designed for interior use.¹⁸⁵

In 1907 there was built in Victoria a house which, like Bishop's Lodge at Hay, deliberately tried to capitalise on the qualities of corrugated iron. The house at 3 Oak Dene, Kyabram, was designed by Gerard Wight, an architect who had taken the engineering course at Melbourne University, for his brother John Wight, the local doctor. It was a substantial dwelling with twelve rooms with twelve fireplaces. Like Bishop's Lodge it was clad in corrugated iron and substantially surrounded by a verandah. Even the internal wall surfaces were of corrugated iron covered in wallpaper, and both the internal and the external walls were packed with sawdust to insulate them. The verandah columns, of terra cotta pipe and concrete, have been referred to above.¹⁸⁶

k. variant types

¹⁸¹ Freeman, *The Homestead*, p 216, quoting *Riverine Papers*, 6 (October 1888).

¹⁸² Michael Davitt, *Life and Progress in Australasia* (London 1898), p 288.

¹⁸³ See for example Ray Sumner, 'The Tropical Bungalow - the Search for an Indigenous Australian Architecture', *Australian Journal of Art*, I [1978], pp 27-39.

¹⁸⁴ Geoff Ashley, 'Two Centuries of the Western NSW Dwelling' (paper at 'The Australian Dwelling' conference, Hay, NSW, 1990), p 11, citing *The Barrier Silver and Tin Fields in 1888* (Libraries Board of South Australia facsimile, Adelaide 1970).

¹⁸⁵ Geoff Ashley, 'Two Centuries of the Western NSW Dwelling' (paper at 'The Australian Dwelling' conference, Hay, NSW, 1990), p 12.

¹⁸⁶ National Trust of Australia (Victoria), file no 2681.

Ripple iron - with corrugations of a small pitch (typically one inch, or 25 mm) - is first found in Australia in a surprising but apparently unchallengeable example of 1867 in Armidale, New South Wales.¹⁸⁷ Mayes's price book of 1886 still mentions only 3½ inch corrugated iron.¹⁸⁸ An even more finely fluted profile, like corrugated cardboard in appearance, was manufactured around 1900 by Wunderlichs and other pressed metal ceiling manufacturers, and in that context will be mentioned. Ripple iron was exported from Britain in the 1890s to Chile, where it was used for building facades,¹⁸⁹ but still not to Australia in any significant amounts. Nevertheless it began to appear locally, for example, in balustrades added to a building at 275 Waymouth Street, Adelaide,¹⁹⁰ and in 1903 in the skylight of the Explosives Magazine, Port Adelaide.¹⁹¹ In Victoria it was used as the partitioning for two bathrooms at 'Boisdale', of 1892. In 1895 it was used as the inner lining of the walls of the Department of Lands office at Hay, New South Wales,¹⁹² and it was used to line the ceilings and soffits of G H M Addison's Exhibition Building in Brisbane, when it was converted for museum purposes in 1898-9.¹⁹³

In fact ripple iron seems to have found a special home in Queensland. It was used for a barrel-vaulted ceiling at the Boggo Road Gaol in Brisbane in 1901, and is believed to have been used in the same year in the Naval Offices.¹⁹⁴ It was also used in 1910 in extensions to the Government Printing Office, Brisbane, though here the iron itself bears a much earlier date, 17 June 1891.¹⁹⁵ In 1920 it was used to clad the building containing temporary vestries for the Anglican Cathedral at Brisbane, after the architect Robin Dods had considered prices for other sorts of walling.¹⁹⁶ The building still stands. Only three brands have been reported for ripple iron. One is the 'Blackwall First Quality' of the ceiling in rooms added to a miner's cottage at Burra, South Australia.¹⁹⁷ The second is 'Lysaght Orb', on a fence in Arkaba Street, Hawker, South Australia,¹⁹⁸ and in a valance on the dairy and the service wing at 'Powerscourt', Victoria. The third is a Japanese 'River' brand, probably of the 1950s.

From this time it became increasingly popular as lining material almost until World War II, especially in more remote and arid areas. Jeffries's *Building Estimator* of 1907 lists 'small corrugation' iron in 1907,¹⁹⁹ but only in 1908 is there an unequivocal reference in Mayes's price book to one inch corrugation 'ceiling iron', available and lengths from five to ten feet (1.5 to 3 m),²⁰⁰ while the thickness, 26 gauge (0.5 mm), is

¹⁸⁷ Dr Bruce Mitchell of the History Department, University of New England, has advised me, 25 February 1986, that he has found iron of one inch pitch and half inch depth of corrugation, one section of which has been covered with 1867 newspaper.

¹⁸⁸ Charles Mayes, *The Australian Builders' Price-Book* (5th ed, Melbourne 1886), p 139.

¹⁸⁹ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), pp 36, 50.

¹⁹⁰ Information from Paul Stark, 1991.

¹⁹¹ Information from Peter Donovan, 1991.

¹⁹² Peter Freeman, *The Homestead: a Riverina Anthology* (Melbourne 1982), p 217.

¹⁹³ Information from Richard Allom & Peter Marquis-Kyle, 1991.

¹⁹⁴ Information and extracts from specifications from Paul Burmester, 1991.

¹⁹⁵ Information from Michael Kennedy, 1991. The date of 1910 advised by Paul Burmester.

¹⁹⁶ Information from Britt Andresen, 1991.

¹⁹⁷ Peter Bell, 'An Early Timber Cottage at Burra' [typescript], p 10.

¹⁹⁸ Photo supplied by Linda Barraclough, 1998.

¹⁹⁹ Walter Jeffries, *The Australian Building Estimator* (Sydney 1907), p 221.

²⁰⁰ Mayes, *Australian Builders Price Book* (1908), p 163.

stated explicitly only in 1914.²⁰¹ In 1917 Colton, Palmer & Preston of Adelaide offered 'Orb' ceiling iron in one inch corrugations.²⁰² Ripple iron was still available from Lysaghts in 1969,²⁰³ and even after that on a limited scale. An original machine at Port Kembla, restored and in operation by 1969, was capable of rolling five sheets at a time, though it was expensive and labour intensive.²⁰⁴

A house at Coree, near Jerilderie, New South Wales, is clad in ripple iron mostly bearing (on the inside face) printed labels for Tucker Box Dog and Cat Food. It would seem that sheets intended to be made into pet food cans were for some reason scrapped, and then recycled into ripple iron.²⁰⁵ Two inch [about 50 mm] iron is not much heard of in Australia after the Tupper's tiles of the 1860s, referred to above. However 3 ft 6 in [1.05 m] sheets of it with the Gospel Oak brand survive on stables at 'Baroona', near Singleton, New South Wales, a building of 1886 designed by Horbury Hunt.²⁰⁶ Corrugated iron is not nearly so prominent in the United States as in Australia, and it is unlikely that much of the American product reached this country, as the Americans, typically enough, chose to manufacture in sizes which for the most part conformed neither to British practice nor to simple unit dimensions, principally 2½ inch [64 mm] and 1¼ inch [32 mm], but also 5 inch [127 mm]; 3 inch [76 mm]; ¾ inch [19 mm]; ⅝ inch [16 mm]; and ⅜ inch [4.8 mm].²⁰⁷

In 1887 Lysaghts introduced a perforated corrugated iron for use in fences, with vertical rows of square, diamond and other shaped holes, somewhat unconvincing in effect. The sheet was perforated first, corrugated next, and finally galvanised.²⁰⁸ An example with diamonds and circles survives at 'Orama', 21 Jersey Road, Paddington, Sydney.²⁰⁹ An advertisement by Lysaghts shows perforations in the form of an elongated cross.²¹⁰ Amongst the other products of the British manufacturers in the 1890s was a 'stepped' corrugated, or indented sheet, for purposes such as filling the sides of bridges, which has yet to be reported in Australia. There was also an 'Italian' corrugation, which was a plain sheet or strip with a roll at either edge, and Brabys made a corrugated sheet with the outermost corrugations slightly larger than the

²⁰¹ C E Mayes, *The Australian Builders' and Contractors' Price Book* (8th ed, Sydney 1914), advertisements p 243.

²⁰² Colton, Palmer & Preston, *You are Secure with Us*, p 97.

²⁰³ *Lysaght Referee* (23rd ed, Sydney 1969), p 38.

²⁰⁴ Information from Bill Nairn, Adelaide, 1995.

²⁰⁵ Illustrations from Deborah Kemp, 2003.

²⁰⁶ Information from Barney Collins of EJE Architecture, Newcastle, 1997. See also the illustration of the building in J M Freeland, *Architect Extraordinary* (North Melbourne 1974), plate 40.

²⁰⁷ Garry Iron Roofing Co., *Garry's Patent Iron and Steel Roofing* (Cleveland [Ohio] no date [c 1887]), p 12, and *ibid*, [1891], pp 7-8: the former lists the five larger sizes, 5, 3, 2½, 1½ and ¾ inch, while the latter omits the 3 inch. *Porter Iron Roofing and Corrugating Co* [leaflet] (Cincinnati [Ohio] no date [c 1885-90]), lists the four smaller sizes, 1¼, ¾, ⅝ and ⅜ inch. In 1910 Sears, Roebuck offered only the 2½ and 1½ inch sizes: Sears, Roebuck and Co, *Sears, Roebuck Home Builder's Catalog* (New York 1990 [Chicago 1910]), p 145.

²⁰⁸ *Australasian Ironmonger*, 1 September 1887, p 284.

²⁰⁹ Kindly brought to my attention by Michael McCowage, 1991.

²¹⁰ *Sands & McDougall's Melbourne and Suburban Directory* for 1888 (Melbourne 1888), p xliv.

others, which was supposed to improve the weathertightness of the overlapping joints.²¹¹

Corrugated iron was overwhelmingly but not exclusively of British manufacture. The impact of Swedish galvanized iron on the British market in the 1880s has been mentioned, but whether this included corrugated sheets is not known. German corrugated iron was imported to South Australia, and used in Joseph Seppelt's winery building at Seppeltsfield, presumably because Seppelt himself was of German origin.²¹² Later Traegerwellblech structural iron reached Australia, and this will be discussed below.

Surprisingly, New Zealand preceded Australia in the manufacture of corrugated sheets. It has been speculated, on the basis of no apparent evidence, that this was done by R and T Haworth of Dunedin from 1864. A more circumstantial account is given of the works of Samuel Palmer at Victoria Street, Auckland, who is reported to have imported English 'black iron' from 1886, galvanised and corrugated it, and also manufactured such products as ridging, spouting, downpipe, tanks and brackets. His Southern Cross Iron Manufacturing Co Ltd later built a substantial factory in Mechanics Bay, clad in their own product, and it survived in part in 1983.²¹³

1. Lysaghts' Australian operation

It is not surprising that local manufacture should have seemed desirable as soon as local iron production had reached commercial levels, and the Australian company, as we have seen, began production in 1921. In 1921 the Lysaght Referee indicated that the simple orb brand was that made in England, whereas the Australian equivalent was:²¹⁴

LYSAGHT
[orb containing on the horizontal band:
ORB
]
AUSTRALIA

This distinction remained in the 1923 edition,²¹⁵ and then in 1927, when there are three Lysaght brands, it is stated that the word 'AUSTRALIA' is stencilled in blue under the brand if it is locally manufactured. The three brands are 'Orb', as before; 'Orb Blue (which appears to have been made only in England), 'the highest grade of tankmaking sheets', for use in extreme climatic conditions, or when the water contains deleterious minerals, and 'Guinea', a second quality cheaper sheet.²¹⁶ It is not clear whether Guinea brand was already regarded as being of second quality when it was imported to Australia in the 1880s, for it seemed to sell at prices similar to those for other Lysaght

²¹¹ James Davies, *Galvanized Iron. Its Manufacture and Uses* (London 1899), p 50.

²¹² Katrina McDougall, *Winery Buildings of South Australia 1836 to 1936 - the Burra Region* [extract only sighted: publication details unknown], p 23.

²¹³ Geoff Chapple et al, *Corrugated Iron in New Zealand* (Wellington 1983), p 27.

²¹⁴ John Lysaght (Aust.) Ltd, *The Referee* (12th ed, Sydney 1921), p 76.

²¹⁵ John Lysaght (Aust.) Ltd, *The Referee* (13th ed, Sydney 1923), p 9.

²¹⁶ John Lysaght (Aust.) Ltd, *The Referee* (15th ed, Sydney 1927), p 6.

iron. Not much is heard of it in the years up to the 1927 *Referee*, but by 1938 it was now locally made and labelled 'Australia'.

There was also at this time a special variety for tank making, and a stronger but less ductile grade which was unsuitable for curving, introduced in 1932. Within the arms of the orb Lysaghts were now incorporating numerals indicating the year of manufacture; all iron made at the Port Kembla works had the letter 'K' incorporated into the brand; and roofing iron sheets had a six-pointed star on the reverse side.²¹⁷

These brands can be understood from the *Referee*, which reappeared in 1950 after an eleven year hiatus. The figure '26' to the left of the orb, is that day of the month, and the number of the month should appear to the right, though in this case cut off. At the time of this edition the figures for the year were still appearing in the maltese cross of the orb brand, one in each of the side arms,²¹⁸ but subsequently they were placed between the orb and the word 'Australia', as with the '60' of the illustrated example.²¹⁹ The lettering above the 'UB' should be two figures such as '50' to indicate the year of manufacture. Such figures now (by 1950) appeared also within the star on the reverse side of normal roofing sheets.²²⁰ Though three inch [76 mm] pitch iron had long been the standard, Lysaghts were still advertising the one inch [25 mm] and five inch [127 mm] as late as 1958.²²¹

m. other twentieth century types

An exceptional brand of corrugated iron, 'Mun-Aon' three stars, is found in the Chinese temple at Atherton, Queensland, and Seumas Andrewartha believes that it may have come from a supplier in South China in about 1900. It consists of a 25 mm circle of mostly illegible lettering, containing other characters, as follows:²²²

[
annulus of lettering comprising
at the top: about six characters, space, 'MUN-AON'
at the bottom: about five characters
within:
[star star star]
8
T
J
]

The 'Merino', 'Target' and 'Raven' brands, are all identified in the same manner as 'British Make', and seem most likely to be of the early twentieth century. Other brands of iron imported into the twentieth century may have included still the hexagram 'AB'

²¹⁷ *Lysaght's Referee* (1938), p 12.

²¹⁸ John Lysaght (Australia) Pty. Ltd., *Lysaght's Referee* (18th ed, Sydney 1950), p 7.

²¹⁹ John Lysaght (Australia) Pty. Ltd., *Lysaght's Referee* (21st ed, Sydney 1961), p 8.

²²⁰ *Lysaght's Referee* (18th ed, Sydney 1950), p 7.

²²¹ *Australian Home Beautiful*, May 1958, p 5.

²²² Information from Seumas Andrewartha, Sydney, 1991.

type referred to above; a small six-pointed star (without lettering);²²³ the paddle steamer and the 'Marksman' brands.²²⁴ Dorman Long & Co, of Middlesborough, England, had three brands, Lyrebird, Diamond and RPD. However, only the lyrebird was normally used in Australia, the RPD in India and South America, and the diamond in South Africa.²²⁵ In 1910 Noyes Bros of Sydney were importing Emu brand iron 'manufactured by one of the largest makers in the world',²²⁶ which was probably the same as the earlier Wolverhampton Emu iron, though not specifically designated as such. Two brands found in Victoria, 'Vincent' and 'Phoenix', date from at least the 1920s, and possibly later. The Phoenix brand has been found on both corrugated and flat iron, and an advertisement of Colton, Palmer & Preston Ltd of Adelaide in 1926 confirms that Baldwins made both. The brand was said to be used by the South Australian Government.²²⁷ Elsewhere - in Sydney, Melbourne, Brisbane and Wellington - it was sold by R Johnson, Clapham & Morris Ltd.²²⁸ It was also advertised in Sydney in 1927 by George Hudson Ltd, in lengths from five to ten feet [1.5 to 3 m].²²⁹ The Bathurst department store E Webb & Co applied its own brand, 'WEBB' within a shield, to iron it sold between the world wars, and the name of the manufacturer is unknown.²³⁰

By 1919 'Armco Rust Resisting Iron', apparently made by the American Rolling Mill Co of Middletown, Ohio, was advertised by the Armco Australian Agency Co of Sydney.²³¹ There are two other undated American brands, 'Apollo' and D B S, the latter interestingly branded:

D B S
MELBOURNE
MADE IN USA

A Japanese iron, 'River Brand. Kawaski', has been reported by Graeme Butler in a structure of the 1920s, but as it is labelled as conforming to United States Government standards, it seems more likely to date from after World War II. Bill Nairn also reports versions of the same, in addition two versions of a Japanese 'Moon Star' brand used by the South Australian Housing Trust in the 1950s.²³²

A number of other twentieth century brands are listed in the Gazetteer which follows, amongst them a mysterious type found on the cladding of the Windorah Store in far western Queensland, which may well be a prefabricated building and has a steel frame

²²³ Zumsteins in the Grampians, Victoria (see below).

²²⁴ 'Redgum Cottage', Zumsteins, Grampians, Victoria; 95 Hall St, Semaphore, South Australia, c 1910 (reported by Bill Nairn, 1995): also illustrated in Baglin & Austin, *Galvo Country*, p 80.

²²⁵ Dorman Long & Co, *Pocket Companion in Steel* (Middlesborough 1910), p 159; Dorman Long & Co., Ltd., *Handbook for Constructional Engineers* (Middlesborough 1924), p 213.

²²⁶ *Building*, 12 December 1910, p 7.

²²⁷ *The South Australian Building and Allied Trades Directory* (Adelaide 1926), p 2.

²²⁸ *Book of Australian Bungalows* (Sydney, no date [c 1920]), p 104.

²²⁹ *Sydney Morning Herald*, 10 December 1927, p 14.

²³⁰ Found at 'Wardell', Penrith, New South Wales, inspected 2002: information from the owner, Mr Hamer.

²³¹ *Building*, 12 September 1919, p 20.

²³² Information from Bill Nairn, 1995: the profile differs from the standard form in having a slightly more complicated flute.

branded 'Dalzell'. The corrugated iron is branded with three crowns and the word 'Amor'.²³³

[circle containing
[crown]
[crown] [crown]
AMOR
]

Finally, the letters 'AWB' which appear on some iron are not a brand at all, but an indication of the ownership of the Australian Wheat Board, intended to discourage theft.

n. protected metal

A 'silicate cotton lined' corrugated iron had been shown at the Melbourne Centennial Exhibition of 1888-9,²³⁴ but is not known to have met with any acceptance in Australia. Later there was an American product called 'Ferroinclave', which consisted of a special crimped or corrugated iron or steel, coated on both sides with a mixture of Portland cement and sand.²³⁵ The equivalent English materials were 'Ferro-Rok', one of the Rok brand products of D Anderson & Son Ltd,²³⁶ and 'Cellactite',²³⁷ but neither has yet been reported in Australia (though Noyes Brothers sold 'Rok' roofing felt²³⁸).

In 1927 the American form of 'fire-protected' corrugated iron was advertised in Australia, seemingly very soon after its first introduction in the United States. This was 'Robertson Protected Metal', which had been fire tested in America in 1926, and approved for use in industrial buildings without sprinklers, so long as no combustible material was used in the construction. It consisted of corrugated sheet steel first dipped in asphalt, then wrapped in asbestos felt, which was in turn impregnated with asphalt, and finished with a layer of bitumen. If desired this could be coloured red with mineral pigments.²³⁹ Although the material was available in America also flat or V-shaped, the Australian agents, Noyes Bros (Sydney) Ltd, appear to have offered only the corrugated type. The sheets could be curved lengthwise, and were available in gauges from 26 to 20, and in black, maroon or aluminium finish.²⁴⁰ In 1929 this material was used to roof a power station at Botany, Sydney, designed by the architect H E White,²⁴¹ and it survived there in a hostile environment for at least a quarter of a

²³³ Mrs Dot Gordon of Windorah, letter of 14 March 1994.

²³⁴ Centennial International Exhibition, *Official Record*, p 459.

²³⁵ M S Ketchum, *The Design of Steel Mill Buildings* (2nd ed, New York 1909 [1903]), pp 260-1.

²³⁶ D Anderson & Son, Limited, *"Rok" Roofing* (Manchester, no date [c 1930]), pp 14-15, 17.

²³⁷ 'Permanent steel-cored corrugated sheets' made by Cellactite and British Uralite Ltd: J E Sears & J E Sears [eds], *The Architects' Compendium and Annual Catalogue* (London 1936), p 90.

²³⁸ Mayes, *Australian Builders Price Book* (1927), advertisements p 13.

²³⁹ F E Kidder & Harry Parker, *Kidder-Parker Architects' and Builders' Handbook* (18th ed, New York 1931), p 924.

²⁴⁰ C E Mayes, *The Australian Builders & Contractors' Price Book* (9th ed, Sydney 1927), p 40 & advertisements p 13.

²⁴¹ [?Bunerang] power station, Botany, as advised verbally by Margaret Doring, August 1992.

century.²⁴² At the Kirstall-RepcO headquarters in Clayton, Victoria, of about 1953, the main factory was clad in protected metal because the vibrations would have frayed asbestos cement, and the fumes would have corroded ordinary galvanized iron. The material was supplied by Robertsons, of England,²⁴³ but at about this time it was being distributed in Australia by a sole agent, Engelbach & Co of Sydney.²⁴⁴ Protected metal continued to be produced in the United States until at least the 1980s.²⁴⁵

²⁴² F W Ware & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (Melbourne 1954, §13/3.

²⁴³ *Cross-Section*, no 17 (March 1954), p 1.

²⁴⁴ *Ramsay's Catalogue* [1954], §13/3.

²⁴⁵ Colin Allen reports that several times during the decade he visited the plant in Ambridge, Pennsylvania, which had a continuous strip galvanising line, and was still using asphalt. It was subsequently taken over by another company.