The Glen Osmond silver-lead mines, South Australia: Australia's first metalliferous mines

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The Glen Osmond mines, located in south-eastern suburban Adelaide, in the foothills of the Mount Lofty Ranges, consist of several individual mines, the most important being Wheal Gawler, Wheal Watkins and the Glen Osmond Mine (Fig. 1). These mines, described by Blainey as 'the cradle of [Australian] metal mining',[1] proved to be small in terms of production,[2] but are of national historical significance, being recognised as the first metalliferous mines in Australia and having produced the first metalliferous export. Payton has commented that 'the development of the Glen Osmond silver-lead mines … seemed to herald the dawning of a new mineral age and increased the clamours for renewed immigration'.[3] As few company records exist, the history of the Glen Osmond mines, mainly documented in newspaper sources, reveal how the discovery and development generated a new mood of optimism in the colony. These sources also highlight the role played by immigrant miners from Cornwall and, to a lesser extent from Germany, in the development of the mines.

The Glen Osmond ore bodies were discovered at a time of economic difficulty in the Colony of South Australia[4] and were the first indication of the important role that mining would play in the development and prosperity of the colony.

The Discovery

The land at Glen Osmond was first surveyed into 80-acre sections and sold in the late 1830s and, according to the laws at that time, the mineral rights belonged to the purchasers. The boundaries of the properties would become the boundaries of the separate mines.

According to Hodder, the 'first undoubted indication of the existence of silver-lead ore was made in 1838, on a section [295] belonging to Mr. Osmond Gilles',[5] but several different accounts have been given of the discovery. The first mention of ore having been found in the Mount Lofty Ranges was contained in a letter from Marmaduke Laurimer, a Cornish settler in South Australia, to his mother in Cornwall:

> I saw a piece of silver ore about 28 lbs weight,[6] that was picked up by a young man of the name of James Nichols, who was a shipmate with me; on the mountains he traced the load [sic] for a mile, and picked up about thirty pieces as big as a hens egg, all of which he showed me.[7]

Laurimer's letter appeared as a poster in and around Falmouth in June 1839 by the emigration agent A.B. Duckham, no doubt to attract the attention of Cornish miners. Laurimer and Nichols emigrated on the *Henry Porcher* which berthed in Port Adelaide on 1 July 1838, and Laurimer's letter was written only one month later. The letter gave no further information as to the location of the find and there was no report in the Adelaide newspapers of a discovery of silver-lead ore. The *South Australian Gazette and Colonial Register* did, however, report in August 1838 that: 'We are informed that copper has been discovered on the preliminary section [295] recently selected by the Colonial Treasurer, Osmond Gilles, Esq.'.[8] As there was no subsequent reference to copper on this section, it may be assumed that the report referred erroneously to the silver-lead discovery.

But did Nichols actually make the discovery? According to Wilkinson the discovery was fortuitous and took place while a dray was descending the road from Mount Barker:

> as the hill was steep, large drags were placed behind the drays to enable the bullocks to hold back and steadily descend the hill. One of these drags, striking against a stone in the road, broke off some shining substance, which was found to be good lead ore; and when this was seen, every person was in a state of excitement, until the place was opened, and the lode of ore discovered.[9]

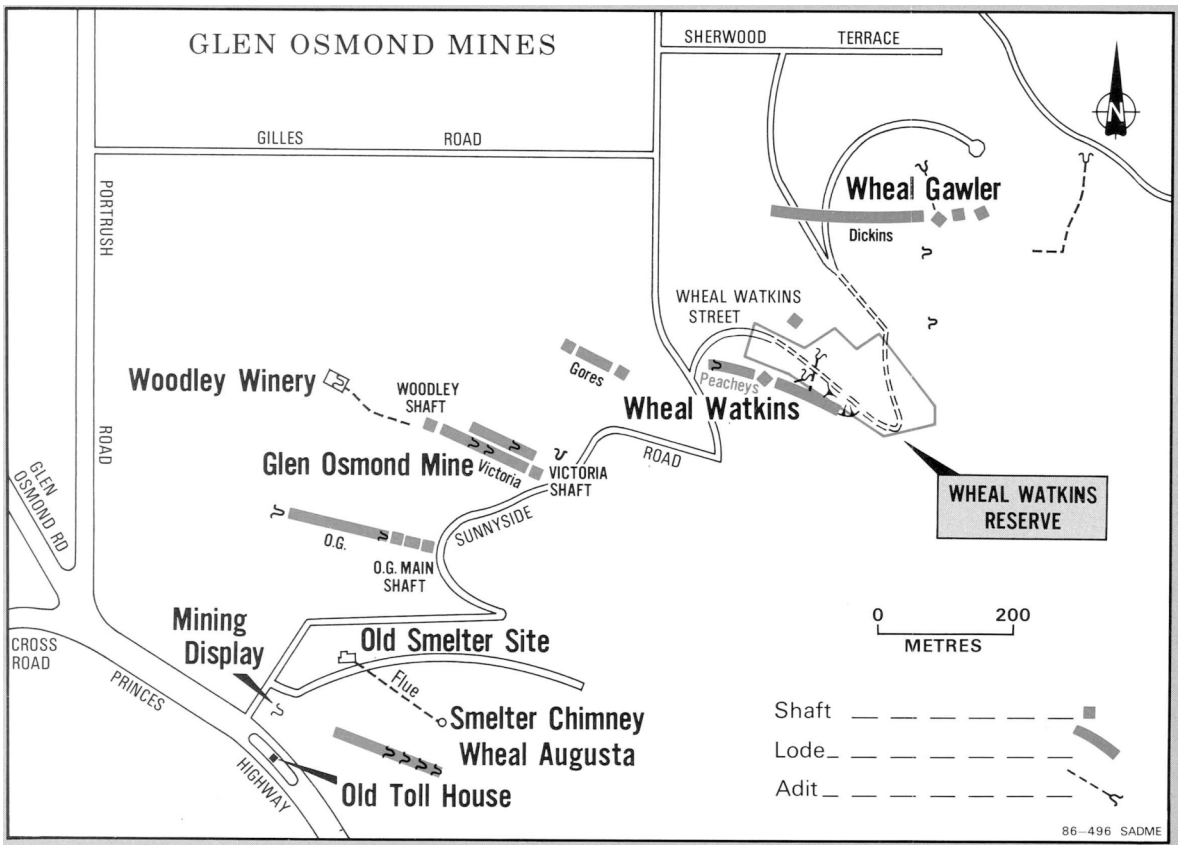
A different version is that by John W. Bull who claimed many years later that the discovery was made during a picnic, in which he took part, at a spot known as the 'Dimples':

> On the spurs some whitish quartzy-looking stones were picked up, which showed small bright specks of lead, not thought much at the time. In the following year, 1839, large projecting blocks of what appeared to be limestone, on being broken on the hillside, were found to be internally pure galena; and now great excitement was caused. A few men were put on by the proprietor [Osmond Gilles] at first, under his chief clerk, Mr. Finke.[10]

Bull also added that some Adelaide speculators offered to purchase the section from Gilles, but 'he met them by saying that he would not part with the property even if

£30,000 was offered for it'.[11] However, as noted below, Gilles made no serious attempt to develop a mine until 1842.

Figure 1: *Location of Glen Osmond Mines. Wheal Gawler deep cross-cut is located east of Dickins Lode.*



Source: Primary Industries and Resource South Australia, plan 1986-0496.

Wheal Gawler – the first mine

The discovery of a silver-lead vein on Section 909 was first reported by the *The Southern Australian* on 29 December 1840:

> MINERALS IN SOUTH AUSTRALIA - On Saturday last a splendid specimen of lead ore, picked up in the Mount Lofty range, was brought to our office for inspection, the yield of pure metal from which, is, we understand, at the rate of eighty per cent. The portion of silver this ore contains we have not yet heard. The parties who made this discovery are practical miners and inform us, that the vein from which this was taken is very rich, and exceeds a mile in length.[12]

The Adelaide Chronicle made no mention of the discovery until 3 March 1841, when it stated that the find had been made in the previous week 'a short distance above Mr Gleeson's' and that the ore 'is said to yield 10 per cent. of silver and 75 per cent. of lead'. Governor Gawler was said to have visited the site and it was also reported that a company was about to be formed to commence working the mine.[13] Messrs Hutchins and Thomas were credited by *The Southern Australian* with discovering and securing the site on which work was then being undertaken,[14] although the report of them having 'secured' the land is incorrect, as Section 909 was granted to Edward Stephens on 8 May 1841.[15]

These initial reports were followed by expressions of unrestrained optimism, with reports claiming an abundance of minerals such as gold, silver, lead and iron that surpassed any other colony of the British Empire,[16] and predicting that the recent silver and lead finds would prove of 'immense commercial importance … to South Australia'.[17] The mine was named Wheal Gawler in honour of the Governor, and the formation of the South Australian Mining Association, with a nominal capital of £6,000, was announced on 17 March 1841.[18] The prospectus included reference to 'the original discoverers', describing them as:

> persons in the humbler walks of life, though practical and experimental miners, and so satisfied are they with the ultimate value of the discovery, that they will take shares in the adventure for the premium they expect for the set. [19]

Blainey observed that the Christian names of Thomas and Hutchins had long been forgotten.[20] However, from shipping records, it is possible that one of the men was William Hutchins, age 43, from Truro, Cornwall, who arrived on the *Waterloo* on 9 November 1840, accompanied by his wife and three children.[21] Hutchins' occupation was recorded as 'schoolmaster'. The name 'Thomas' was more common but it is interesting to note that also arriving on the *Waterloo* were two miners from Redruth, viz. John Thomas (age 34) and William Thomas (age 20),[22] one of whom may have been the co-discoverer of Wheal Gawler.

Six miners were employed to begin operations at Wheal Gawler and samples of the ore were submitted for assay to Messrs Davey and Weston, who reported that it consisted of galena and that from 'the external aspect of the ore, it may be safely computed that it actually contains upwards of 75 per cent. of *lead*'. Assays of several specimens gave an average silver content of 12.526 oz/t.[23] A trial shipment of ore was sent to London on the

barque *Cygnet* in May 1841,[24] this being the first export of metalliferous ore from Australia.[25] According to The *Cyclopedia of South Australia* for 1909, the value of that shipment of ore was £300,[26] but this is highly unlikely since various reports indicate that the shipment was no more than a few tons.[27] This appears to be confirmed by a report in 1845 that described Wheal Gawler as having been 'discovered and partially worked in 1841, when three tons of ore were raised and sent to England, where it sold at twelve guineas per ton'.[28]

In spite of the early optimism, there was little attempt to carry out further mining, for despite reports of renewed interest in August and September 1842[29] there is no evidence of further active mining. The successful opening of the adjoining mines, Wheal Watkins and Glen Osmond, as well as discoveries of copper elsewhere in South Australia, drew attention away from Wheal Gawler until June 1845, when a syndicate comprising John Dickins, Thomas Reynolds, Charles Flaxman and Herman Stakemann obtained a lease of the mine for seven years, with royalties of one-twelfth of production to be paid to the land owners.[30] In August 1846 the syndicate purchased Section 909 for £2,000.[31] As only about 12 tons of ore had been raised to the end of 1846, Wheal Gawler was described in one report as 'more of a prospective than a productive mine'.[32]

Edward Henkel was appointed mine captain and up to 20 miners from Germany were employed between 1846 and 1848.[33] Henkel was described as 'an experienced gentleman, who, up to the period of his emigration to South Australia, held a responsible situation at the Hanoverian Government Mines in the Harz Mountains'.[34] In May 1847 it was reported that the mine was under the management of H.C. Stakemann, Consul for Bremen, and that large quantities of silver-lead ore were being raised.[35] Eleven lodes were subsequently discovered but only Dickins' Lode (Figs 1 & 2) was productive, and was worked by means of a vertical shaft and two adits. The lode averaged four-feet in width and lumps of pure galena weighing up to 84 pounds were recovered.[36] An exploratory tunnel (the 'deep cross-cut', Fig. 1) to test for an extension of Dickins' Lode was commenced in 1847 on the northern side of the hill.[37]

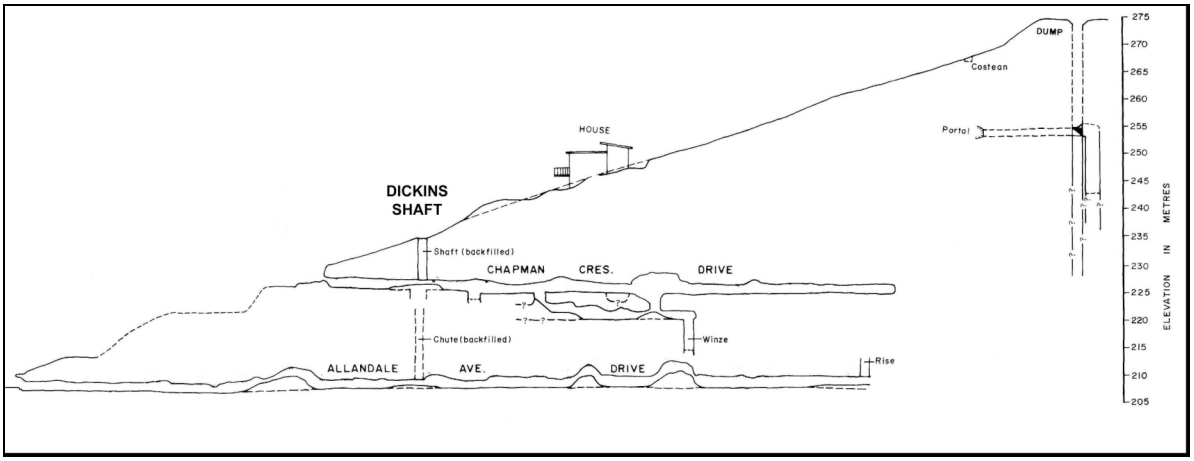
In July 1848 the Wheal Gawler Mines Association was formed 'with a view to a more vigorous prosecution of the operations' and issued 1,280 shares of £10 each to raise funds for further development of the mine.[38] H.C. Stakemann, C. Flaxman, W.C. Crane,

William Randall and Henry Stanford were elected as directors.[39] A report by J.C. Dixon accompanying the prospectus made some confident assertions and optimistic predictions:

> It would be impossible for a man conversant with geological analogy to examine the Wheal Gawler Mines, without being convinced that the estate contains a great many metallic deposits of the richest and most profitable kind … their well-defined walls, and dip or inclination downwards; their ascertained longitudinal extension; the *extremely rich character* of the silver-lead ores which some of them bear, and the very promising appearance of the rest, - would all tend to the conviction that at a greater depth, many of the lodes would be filled with massive ore, and would improve in size and value as they go deeper underground until they touch the granite.[40]

Dixon's 'geological analogy' most likely came from experience with Cornish mines, where mineral veins are located in the vicinity of granite bodies, and this may account for the optimistic reports throughout the 1840s. The geological setting of the Glen Osmond veins differs from Cornwall, however, as there is no association with granites.

Figure 2: *W-E section of Dickins Lode workings, Wheal Gawler.*



Source: Adapted from Primary Industries and Resource South Australia plan 1982-0341.

The Adelaide Observer compared Wheal Gawler to the Almagrera Lead Mines in Spain and made the somewhat fanciful observation about the global distribution of lead ores that 'all the principal argentiferous lead mines *are in similar latitudes North or South of the equator*, say 35 to 40 degrees'.[41]

In September 1848 the company held a ceremony for the naming of 11 'well-defined *metallic* lodes', labelled by the Directors and friends as: Governor Young, Latham,

Flaxman, Stanford, Dickins, Bergeest (previously known as Fahlerz), Crane, Randall, Dixon, D'Almeida and Stakemann lodes.[42] *The Adelaide Observer* expressed great confidence in the future of the mine, believing that:

> From what we saw on Wednesday, we will boldly prophecy [sic], without any of the miserable *double-entendre* of the ancient oracle, that the produce of the Wheal Gawler mines will by-and-by altogether *astonish* the colony and that they will in good time take their rank among the most valuable of the mines of South Australia.[43]

A horse whim was erected[44] and by 1850 the main shaft had been extended to a depth of 240 feet.[45] High quality ore was mined from Dickins' Lode and several other lodes were opened up on the northern side of the hill.[46] The optimistic reports had the presumably desired effect on the share price, for in October 1848 several purchases were made 'some as high as £20 on terms'.[47] But by January 1849 there was evidence of shareholder discontent, as 'An Unfortunate Speculator' noted when commenting that:

> Mr Richardson, share-broker of King William-street asserts weekly that the Wheal Gawler Mine is worked by a paid-up capital of £12,800. Mr Richardson aids a delusion by such a statement. £12,800 has not been paid up; not even a fourth part of that sum has been paid in *cash*; and I am sorry that the Consul for Bremen, Mr Stakemann, Mr Charles Flaxman, Mr Bergheest, and other respectable gentlemen connected with the Wheal Gawler, have not come forward before this time to disabuse the public of Mr Richardson's misstatements.[48]

The concerns of the letter writer were confirmed two days later when the reported paid up capital was said to have been 'merely the value put upon the mine by the adventurers themselves'.[49] Nevertheless, shares were still traded at up to £30 during 1849, although operations appear to have been intermittent with little evidence of ore production.[50] This did nothing to inhibit the directors' confidence, as at the First Annual Meeting of shareholders of the Wheal Gawler Mines Association, held on 28 September 1849, it was reported that 'the state and prospects of the Mines are of a very encouraging character'.[51] The report further outlined the mining operations undertaken, emphasising that 'from the Dickins Lode, silver-lead ore of a very superior quality is being raised'. Claims were also made of promising indications of good ore in the D'Almeida and Stakemann lodes. It must have been comforting to the directors when a resolution was passed unanimously at the

meeting praising 'the superior manner in which … the operations have been conducted' and 'the zeal and ability with which [the directors] have gratuitously devoted themselves to the interests of the Association'.[52]

Some five months later at a Special General Meeting of shareholders held on 28 February 1850, it was resolved to increase the capital of the company by the issue of 320 additional shares at the original price of £10, 'to allow of the present operations being effectively followed out to the full realisation of the expectations entertained as to the great value of this mineral property'.[53] By August, however, share prices had dropped to £6.[54]

The Second Annual Meeting of shareholders on 7 October 1850 received yet another confident appraisal of the situation:

> The improvements which have lately taken place in the results of the workings are of so decisive and unequivocal a character that they believe themselves to be fully warranted in asserting that, at length, after having experienced a fair amount of the usual preliminary disappointments and difficulties, the final and complete success of the undertaking may now be considered as beyond all reasonable doubt.[55]

Less palatable was the report on operations on the northern side of the hill. This had proved unproductive and efforts were concentrated on sinking a shaft on the southern side of the hill and cross-cutting to the lodes because the deep cross-cut on the northern side of the hill had been abandoned after failing to find the anticipated extension to Dickins' Lode.[56] A report on the mine by Mr John Alsop was also presented at the meeting. This had been commissioned by the directors because of 'sundry erroneous reports, of a specific nature respecting both the immediate and future prospects of the mines', but while expressed in less extravagant terms than the report by the directors, it was still optimistic:

> … after a careful inspection, I considered the plans now being adopted the most judicious for a full and effectual development of its true value … The facility thus afforded for working several lodes in three levels at the same time, and the present improvement in the Flaxman Lode at the 26 fathom level, lead me to think that within three months a very productive mine will be opened, and the skill shown in arrangement will enable it to be worked very economically.[57]

By November 1850 all of the additional shares approved at the February meeting had been purchased[58] but despite the optimism, the mine proved to be unproductive, leading to a Special General Meeting of shareholders being called on 3 November 1851 'to consider the best means of disposing of the property, and of liquidating the debts'.[59] A

further Special General Meeting on 24 March 1852 was held 'for the purpose of determining on a dissolution of the Association'.[60] About 100 tons of high grade ore per year had been produced between 1846 and 1849.[61]

The only subsequent activity occurred over 100 years later in 1957 when three amateur prospectors took out mining rights on the Wheal Gawler property and were reported to have chipped for assay purposes 'a hundredweight of ore from a 10 ft seam in an old shaft'.[62]

Glen Osmond Mine

Although silver-lead ore had been discovered on Osmond Gilles' property (Section 295) as early as 1838, no serious mining operations were undertaken until September 1842, when four miners were employed and about 10 tons of ore were shipped to England 'for experimental purposes'.[63] In early 1844 additional men were engaged to sink a shaft and Gilles' brother Lewis came from Tasmania to direct operations.[64] By December 1844 more than 200 tons of ore had been raised and up to 25 men were employed.[65] The scene at Glen Osmond around this time was depicted in a painting by S.T. Gill (Fig. 3).

Figure 3: *S.T. Gill Glen Osmond Mine 1845 showing Victoria shaft.*

Source: Courtesy of Art Gallery of South Australia, Adelaide. Gift of the South Australian Company, 1931.

Lewis Gilles paid his brother £500 for a lease of the mine[66] and sailed for England on the *Bleng* in January 1845 to 'superintend the assays' of the ore and form a company to work the mine.[67] Subsequently, the Glen Osmond Union Mining Company was formed in London in May 1846, with a paid up capital of £30,000, consisting of 3,000 shares of £10 each.[68] Six-months later Adelaide readers were informed that Lewis W. Gilles, General Superintendent of the Company, had arrived in Adelaide the previous Saturday to commence operations. In addition, 'A strong party of miners under a skilful and efficient Captain (Mr Pascoe)', had arrived by the *Lady Bruce* to commence their labours.[69]

The Deed of Settlement signed in London on 1 May 1846 stipulated that the Company would hold a lease of the mine for a term of 35 years, with a royalty of seven-sixteenths of all ore raised to be paid monthly to Osmond Gilles.[70] Before leaving London, Lewis Gilles received instructions from the directors to 'procure if possible further reduction of the Royalty from your Brother'.[71] On his return, Lewis Gilles wasted no time in carrying out his instructions; a new lease was signed on 5 December 1846 reducing the royalty to one-eighth of all ore raised and the term of the lease to 21 years.[72]

Work recommenced at the mine in December 1846, and in January 1847 it was reported a residence for Captain Pascoe and 'seven or eight cottages for the miners' in the village of Harrow were being constructed and that at 'the foot of the hill, a number of boys and girls were busy washing and cleaning the ore, which was heaped up in large quantities'.[73] This is the only documented use of *bal-maidens* (females employed in ore dressing) on a mine in Australia.

By October 1847, 40 men were employed, six of whom were raising ore, while the rest were employed in driving adits, sinking shafts and other development work. Roughly £4,000 had been expended and it was believed that in two months the outlay would have been repaid. Of the 13 lodes discovered, only the Victoria, O.G. and Gores, and Lewis - also known as the North Victoria (Fig. 1) were then being worked,[74] with a horse whim having been installed to raise material from these lodes.[75] *The South Australian* also referred to 100 tons of ore having been shipped during the year, excluding 20 tons of 'royalty ore lying ready for delivery to "O.G.", the lord of the soil',[76] this being a reference the royalties due to Osmond Gilles. A few months later, in April 1848, 30 miners and 20

'grass-men' were employed at the mine and ore production was averaging 12 to 15 tons per week.[77]

An account by a Sydney journalist, who visited the mines of South Australia in 1848, described the operating costs and mining practices of the Glen Osmond Mine:

> The miners work this [Victoria] lode for £2 a fathom (6 feet in height and depth, and 3 in width). And as this … gives about 7 tons of ore to the fathom, … the profit here is enormous. The price per fathom varies according to the nature of the ground. In another vein … where the mineral is from 2 to 4 inches wide in a vein of 6 or 8 inches, the price is £3 a fathom, and the produce about 1½ tons per fathom. In both cases the miners find … powder and quills, sharpen their own tools, pay for their candles and their food, and bring all the rubbish and ore to the surface. [In good order] [t]he ore is worth … £11 a ton in England. … The sinking of … additional shafts, and connecting the workings of the various lodes and levels by cross-cuts or galleries, where no ore is met with, is paid for generally in this mine at the rate of from £3 to £5 per fathom, finding everything. The Captain reckons that … the ore may be got to the surface at an average of £2 per ton. The ore here has to be broken small, and freed from … impurities that are mixed with it, washed where dirty, packed in bags weighing when full about 2cwt. each, and sent to the port for 7s per ton. It is then conveyed to England [direct] … from £3 to £4 per ton, sometimes by way of Sydney, for £2 10s to £3 per ton, leaving a profit of £6 per ton.[78]

This describes the traditional Cornish mining practice of *tribute* (ore extraction) and *tutwork* (development), which was used in South Australian mines throughout the 19th century.

Operations at the Glen Osmond Mine were suspended in January 1849 as a result of a dispute between the mining company and Osmond Gilles.[79] Action was taken in the Supreme Court by Gilles 'being determined to resume possession of his valuable property in consequence of receiving no rent and the non-fulfilment of the obligations of the Company towards him'.[80] However, evidence in the court case given by Captain Pascoe and others, showed that on several occasions ore had been set aside as royalty payment but Gilles had permitted the ore to be shipped on account of the Company because he 'wished to see the mine worked, and to have his dues all at once'. The jury found in favour of the company.[81] Nevertheless, as they were not satisfied with the operation of the mine, the Directors terminated their agreement with Lewis Gilles and gave instructions that 'all ores hereafter to be raised shall in the first instance be applied to the arrears of royalty due to the lessor'.[82] Subsequently, in November 1849, Osmond Gilles received 20 tons of ore as a

portion of his arrears of dues from the Company that was transferred to the recently completed smelting works at Glen Osmond.[83]

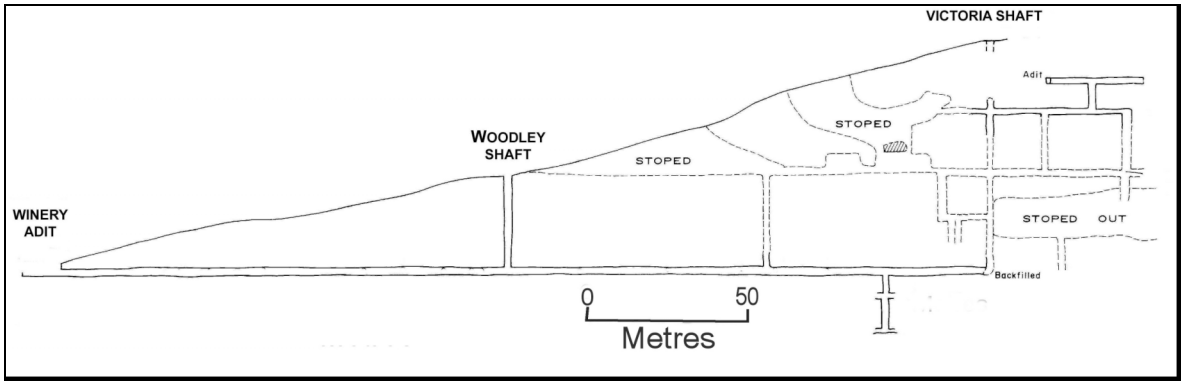
In August 1850 it was announced a special meeting of the shareholders was to take place in London 'for the purpose of authorising the Directors to sell additional shares, so that an increased working fund might be obtained'. There was also optimism, it being reported that 'Even with its present couple of pick and gadmen', the mine was turning out finer ore than ever, and in such abundance as to considerably reduce the heavy expenses of royalties due to the proprietor, Osmond Gillies.[84] A month later, reports indicated that the Glen Osmond Mine could resume full operations 'if the proprietor … has good nature enough to … submit to another trial, under less questionable management'.[85]

John Alsop who prepared a report for Osmond Gilles in September 1850 was particularly impressed by the potential of the Victoria and O.G. lodes, emphasising that 'very few mineral properties possess the facilities for remunerative mining … as this does'.[86] With such glowing testimonials it appeared as if production was about to proceed under the direction of Captain Pascoe 'with the full force of men stipulated for'.[87] Credence to the claim was exhibited by the news that 35 tons of ore was to be handed over to Osmond Gilles as the final arrears of royalty due to him.[88] However, this was not to be, for the discovery of gold in Victoria, resulted in the Company being unable to obtain sufficient labour to expand its operations. It was thus decided to forgo the agreement.[89] The mine closed in 1851 and the property reverted to Osmond Gilles.[90] Ore production from the Glen Osmond Mine up to 1851 has been estimated at approximately 1,000 tons.[91] Further attempts were made during Gilles' lifetime to obtain a lease of the mine but each application was refused.[92]

Three years after the death of Gilles in 1866, a prospectus was issued by the Glen Osmond Silver and Lead Mining Company,[93] but according to *The Adelaide Observer* the attempted float was unsuccessful, 'chiefly because the public had no faith in silver-mining at that period, and also because the board of Directors was composed principally of Melbourne men'.[94] Almost 20-years later, high metal prices and the spectacular discoveries of silver-lead ore at Broken Hill in the 1880s led to renewed interest in the potential of the area.[95] In April 1888 the Gilles Glen Osmond Silver Lead Mining Company was formed to redevelop the Glen Osmond Mine,[96] resulting in the employment of Captain B. Worth and

nine men to develop access to the O.G. and Victoria lodes.[97] Worth soon joined the long list of optimists when reporting at the end of July 1888 that there were six ore-bearing lodes and that his experience as Inspector and mining reporter 'on the Barrier' led him to compare the mine favourably 'with the best of them at Broken Hill'.[98]

Figure 4: W-*E section of Victoria Lode workings, Glen Osmond Mine.*



Source: Adapted from Primary Industries and Resource South Australia plan 1982-0344.

By March 1889, the work force had been increased to 24 men in order to carry out development in the workings of O.G Lode, Gores Lode and, particularly, Victoria Lode, and the shaft at the latter was deepened from 200 feet to 260 feet, while the Winery Adit was extended to 1,100 feet on the 240 feet level (Fig. 4).[99] The results, however, did not justify Worth's previous predictions. Lack of ore resulted in closure of the mine in 1892, after having produced only about 100 tons of ore in this second episode of mining.[100] The ore was concentrated on site and the majority sold to the English and Australian smelting works at Port Adelaide, although some was shipped to Freiberg.[101] The Company was wound up in July 1898.[102]

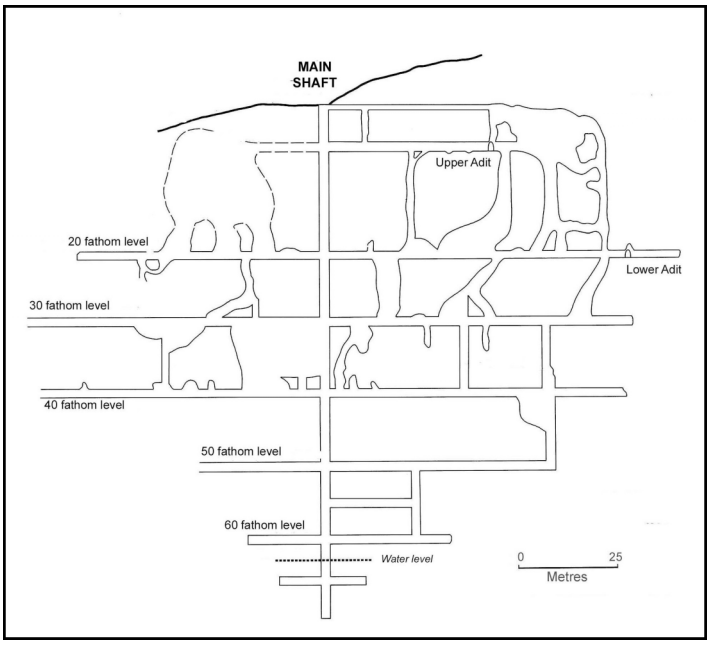
Wheal Watkins

Section 910, adjoining the southern boundary of the Wheal Gawler property was granted to Mr Robert Watkins of Sussex in February 1842.[103] Subsequently a lode was discovered by Mr Peter Peachey, the owner's agent. It is likely that the ore discovery on Section 909 prompted Watkins to purchase the adjoining section. Wheal Watkins was first worked in 1843,[104] and by December 1844 up to 18 miners were employed and 150 tons of ore had been raised, of which 100 tons (assaying 75 percent lead and 30 oz/ton silver) had been

shipped and sold in London for £13.13s per ton.[105] Section 910 was later transferred by Watkins to Peachey, although the date of this transfer is uncertain.[106]

Newspaper reports consistently referred to the high quality and abundance of the ore.[107] Access to the mine was by means of a shaft and two adits, referred to as the 6 fathom adit and the 20 fathom adit (Fig. 5). Up to 1848 about 100 tons of ore per year were raised.[108]

Figure 5: *W-E section of Peacheys Lode, Wheal Watkins, including deeper workings of the 1888-1889 period.*



Source: Adapted from Primary Industries and Resource South Australia plan 1986-0493.

The Adelaide Silver-Lead Company, formed in 1848 with five shareholders holding a total of 10 shares of £100 each, leased Wheal Watkins for 18 months from Peachey for a 'premium' of £500 and royalties of one-tenth of gross proceeds.[109] The Company commenced operations in October 1848, with J.B. Pascoe as Mine Captain and L.B. Gilles (son of Lewis W. Gilles) as Company Secretary.[110] Pascoe was for a time Mine Captain of both Wheal Watkins and the Glen Osmond Mine. The Company called for tenders for purchase of the ore[111] and some 350 tons of ore were produced in 1849.[112] However, by 1850 many small mines in South Australia, including Wheal Watkins, were facing financial difficulties, it being claimed that shortage of capital prevented the working of some 30

known deposits of copper and silver-lead ores.[113] The same source, the *South Australian Gazette and Mining Journal*, suggested that Wheal Gawler would prove more prosperous and productive if 'conjoined with Wheal Watkins and the Glen Osmond mines'.

In addition to lack of capital, the Adelaide Silver-Lead Company faced a legal complication in renewal of the lease following the death of Peachey in August 1849. The Management Committee received advice that it would need to apply 'to the Court of Chancery for an order for a lease from the infant son of late P. Peachey', and Captain Pascoe was ordered to make arrangements for working of the mine to cease on 16 April 1850.[114] By that time, the main shaft had reached a depth of 300 feet[115] and from 1844 to 1850 some 1,200 tons of ore averaging 73 percent lead and 18 oz/ton silver had been produced, at an average worth of £12.10s.[116]

After having reported a profit of £7,000 after deducting working expenses, Pascoe remained confident in his 1855 report, as surface indications on other known lodes suggested that expansion into these areas would prove as lucrative. [117]

Over 30 years passed before interest in the mines of the Glen Osmond area was again renewed when the Wheal Watkins Silver and Lead Mining Company reopened the Wheal Watkins in March 1888.[118] About ten men were employed under Captain Rowe, the shaft was cleared out, a new poppet head was erected, an engine, two boilers and winding gear were installed, and a blacksmith's shop constructed.[119] In September the Government Geologist inspected the mine, reporting that although Peachey's lode had been worked out above the 30 fathom level, it was likely to continue to deeper levels. He also recommended development of other known lodes 'such as Fink[e]'s, Gore's, &c.' and suggested these be accessed by a crosscut 'from the bottom of the present shaft when this has been reached'.[120]

In October, M. Paul Ruef, a visiting civil engineer from France, inspected the mine, providing the all too common enthusiastic observation that 'little doubt exists in my mind that the Wheal Watkins Mine will eventually take its place amongst the leading lead mines of the world'.[121]

After water was struck at a depth of 375 feet 6 inches,[122] operations were confined to Peachey's Lode between water level and the 30 fathom level, although Mr Rosewarne, Inspector of Mines, made a further recommendation for investigation by crosscutting at the

bottom of the shaft so as to prove Finke's and Gore's lodes, which he believed 'may yet prove to be the main-bearing lodes'.[123]

Although a pumping plant was installed in October 1889[124] and the shaft extended to 429 feet,[125] the lode was not payable due to a slump in metal prices.[126] A shipment in March 1889 of 15 tons of dressed ore to Stalberg, Germany, netted only about £6 per ton[127] and operations were suspended at the end of the year.[128] Approximately 130 tons of ore were sold to the English and Australian smelting works at Port Adelaide during this second period of operation of Wheal Watkins.[129]

In 1916 the Tarcoola Development Syndicate drove a tunnel along a 'nice seam of galena and carbonate of lead, from which about 2 tons of rich ore was obtained'.[130] In November of the same year the syndicate reported having forwarded to the Sulphide Corporation's Cockle Creek smelter, in New South Wales, '3 tons 8 cwt. of silver-lead ore, which assayed 45 per cent. lead and 10 oz. of silver, for a gross return of £51 18/5'.[131]

Glen Osmond Smelter

As the Glen Osmond mines developed, ore was shipped to smelters in Swansea, Wales. Since shipping costs of £3 to £4 per ton amounted to more than half of the total costs, there was an obvious need for a local smelter. Experimental smelting operations were carried out in 1845 at Mr Carleton's furnace in Rundle Street,[132] and in 1848 pig lead was produced at Dr Kent's mill in East Terrace and sold to plumbers and others at 20 guineas per ton.[133]

In 1849 the Glen Osmond Union Mining Company contracted Messrs Penny to construct a smelter incorporating the latest smelting principles. It was built on the floor of a valley close to the Glen Osmond Mine (Fig. 1) and connected to a chimney on the adjacent hillside by a long underground flue. By November the smelter was in full operation under the management of Mr Alsop, it being hoped that 'the supply of ore will be continued in quantities sufficient to keep the furnaces hot for the next century'.[134] This again proved over-optimistic and although the smelter received ores from various mines in the Glen Osmond area, only small amounts were treated before cessation of activity at the mines led to closure of the smelter in 1851. However, when in production the smelter had successfully separated silver 'from the baser metals' and had produced lead for both domestic and export purposes.[135]

The Heritage

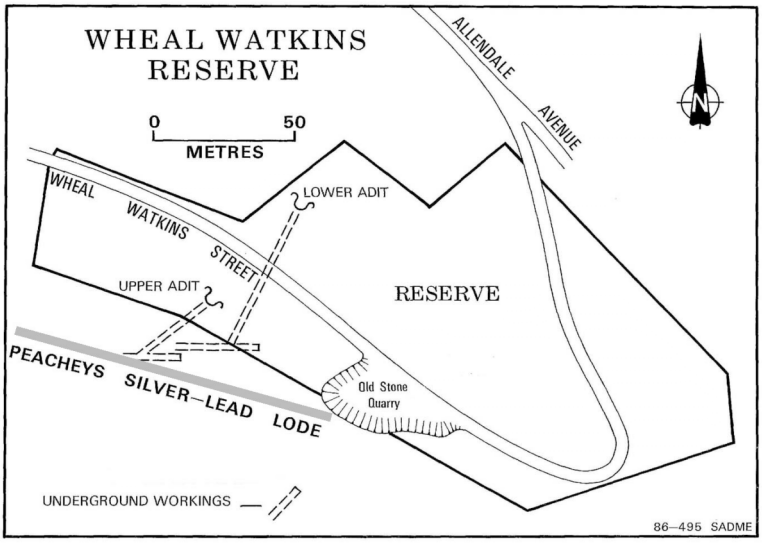
Increasing awareness of the historical significance of the Glen Osmond mines came too late to preserve public access to most of the workings. The 1970s saw a rapid increase in subdivision of land in the Adelaide foothills because of the spectacular views over the city of Adelaide, with the result that the various Glen Osmond mine workings are now located on or surrounded by residential properties. In 1980 Burnside Council requested staff to prepare a report on 'the feasibility of clearing and restoring the mines and of developing the sites as a possible tourist reserve'.[136] The report included an inspection and survey of the remaining accessible workings by H.F. Coates, Inspector of Mines. Coates concluded that most of the workings were unsuitable for access by the public and that the only sites in a suitable condition were the 20 fathom adit of Wheal Watkins and the adit of the Tarcoola Development Syndicate. In addition, it was suggested that the 6 fathom Wheal Watkins adit might be worthwhile preserving for its geological and mining educational value. Publication of the report was followed by strong objections on the part of property owners in the vicinity of the mines to any proposals for development on the scale of a tourist attraction,[137] so in 1981 Council established a working party 'to consider the preservation and restoration of these historic mining sites'. The working party, known as the Burnside Historic Mines Conservation Group, comprised Council staff, academics and representatives from the local area, the Department of Mines and Energy, the mining industry, the Department of Tourism, Recreation and Sport, and the State Heritage Branch.[138] A recommendation by the working party that efforts be concentrated on restoration of the Wheal Watkins adits so that guided public tours could take place, led to Council submitting an application to the South Australian Sesquicentenary Fund for a grant for this purpose.

In response to a public nomination in 1982 for heritage listing of the Glen Osmond mines, the South Australian Heritage Branch evaluated their significance. As a result, three sites were added to the Register of State Heritage Items in 1984, viz. Wheal Gawler Historic Site, Wheal Watkins Historic Site and Glen Osmond smelter chimney.

All Wheal Gawler adits and shafts, as well as being on private land and, hence, not available for public access, are totally unsuitable for entry. The Wheal Gawler Historic Site is an area of about 1.5 hectares around the main shaft. The heritage assessment argued that

although the site was compromised by the intrusion of nearby housing, the main shaft area 'is highly significant as a cultural landscape, being the remains of the birthplace of Australian mining'.[139] The site contains depressions of Main Shaft and other minor shafts, the line of which marks the east-west orientation of Dickins' Lode, as well as an adit driven from the north to a point 20m below the shaft collar (Fig. 2). Main Shaft has been backfilled with rubbish which is hung up above the adit. The shaft has more recently been capped with concrete by the land owner to reduce the risk of major subsidence of the backfill. The site is now seriously compromised by a sealed access road to a residence about 150m east of the main shaft.

Figure 6: *Wheal Watkins Reserve.*



Source: Primary Industries and Resource South Australia, plan 1986-0495.

Wheal Watkins Historic Site is located on a council reserve (Fig. 6) about 2 hectares in area, centred on the 6 fathom and 20 fathom adits. It was accepted as being of heritage significance because 'it contributes to an appreciation of the scale and extent of the mines at Glen Osmond' and for the two adits that are still accessible and provide examples of Cornish mining technology.[140] Main Shaft (Fig. 5), the deepest at Glen Osmond at 429 feet, is located under a concrete cap in the roadway about 50m west of the reserve and is marked by a plaque installed by the Burnside Historical Society. In 1986 a South Australian Sesquicentenary grant of $20,000 to Burnside Council enabled partial restoration of the adits.[141] Interpretive signs were prepared and erected by the South Australian Department

of Mines and Energy and public tours began in October 1986, with guides provided by the Burnside Historical Society. Although the tours were restricted to those parts of the adits considered safe for public access, visitors were able to see many features that demonstrated mining methods employed by the Cornish miners, e.g. hammer and tap holes, adits, a drive, winze and stopes, as well as some remnant galena in Peachey's Lode. Approximately 4,500 visitors participated in these tours up to April 2005, when tours had to be suspended following rock falls in both adits. Burnside Council is responsible for maintenance of the adits and external surroundings and a decision on the restoration required to recommence public tours is still under consideration in 2008.

The Glen Osmond Mine workings are located on private land, which includes the former Woodley winery. This was one of South Australia's oldest wineries, dating from 1858 when Osmond Gilles planted cuttings on his property near the abandoned mine.[142] In 1862 a cellar was built at the entrance to the 40 fathom level, which has since been referred to as the Winery Adit (Fig. 4). Following Osmond Gilles' death, Lewis Gilles renamed the estate 'Woodley'. In 1900 a new winery was developed on the site and the old cellars were rebuilt into the entrance of the Winery Adit. The first 15m of the adit, which continues into the hill to an old ventilation shaft, were adapted for wine storage. The winery was sold in 1926 and operated by Woodley Wines Pty Ltd until 1988 when the property was sold. For many years limited access to the Winery Adit was possible by negotiation with Woodley Wines.

The Woodley Winery complex was assessed for its heritage significance in 1985 and the Winery Adit and related ventilation shaft were added to the register because of their association with the Glen Osmond mines.[143] An application in 1988 to convert the former winery buildings into three residential dwellings was approved by Burnside Council.[144] The Burnside Historical Society appealed this decision to the South Australian Planning Commission[145] on the basis of heritage significance of the site, but the appeal was unsuccessful. The old cellar building and Winery Adit are now part of a private residence and the ventilation shaft and several other workings are located on private property. The Victoria shaft has been backfilled and a house built on a mullock dump surrounding the shaft. Access is still possible to the shaft via an adit from the north which shows that the backfill is hung up in the shaft.

Figure 8: *Glen Osmond smelter chimney.*

Source: Courtesy of Primary Industries and Resource South Australia, photo 035848.

The chimney and upper section of the underground flue are all that remain of the Glen Osmond smelter. These are significant because of the association with the nearby mines and being the only above ground relic of mining activity in the Glen Osmond area.[146] The circular chimney is set on a square base with a slight taper towards the brick-banded top. It is the oldest remaining mine chimney in South Australia, and possibly in Australia. In 1897, a correspondent to *The South Australian Register*, drew attention to the historical significance of the chimney with the following eloquent description:

> Perhaps the most conspicuous and interesting of those old landmarks – at least within sight of Adelaide - is situated at Glen Osmond, where –
>
> Upon a mild declivity of hill
> A lonely column rears,
> With grey and grief-worn aspect of old days -
> 'Tis the last remnant of the wrack of years.[147]

Conclusion

The Glen Osmond mines were not significant metal producers but are of national historical significance, being recognised as the first metalliferous mines in Australia and having produced the first metalliferous export. Their discovery and development came at a critical time in the history of South Australia, for the colony was in desperate financial circumstances, and a new mood of optimism can be seen in newspaper reports. The discoveries also illustrate the sometimes ill-founded optimism of early newspaper reporters and mine promoters, though this experience was not confined to South Australia.

Cornish miners attracted to South Australia to work the mines brought with them their mining traditions, such as underground mining methods, management and employment systems, and mining terminology. Although the Glen Osmond mines failed to justify their early promise, they did create the impetus for further mineral exploration and were the start of South Australia's first mining boom.[148] The 1840s saw a rapid expansion of the mining industry in South Australia, with the discovery and exploitation of a large number of mines, the most significant being the copper deposits at Kapunda (1842) and Burra (1845). The Glen Osmond smelter was one of five smelters erected in South Australia in the late 1840s to process ore from the newly discovered mines.[149] Cornish miners and Welsh smeltermen dominated the developing mining industry in South Australia and with the advent of the gold rush their influence extended to Victoria and subsequently throughout Australia.

Several sites related to mining in the Glen Osmond area have been recognised for their historic and cultural significance by inclusion in the Register of State Heritage Items. Some sites are seriously compromised by housing developments but the smelter chimney remains in good condition and the Wheal Watkins adits, until their closure as a result of rockfalls in 2005, provided an important opportunity for the public to learn of the history of the Glen Osmond mines and gain an appreciation of the methods employed by the Cornish miners. It is essential that further restoration of the adits be carried out so that public access will again be possible to one of Australia's most significant mining heritage sites.

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Endnotes

[1] Geoffrey Blainey, *The Rush That Never Ended, A History of Australian Mining*, Melbourne University Press, Parkville, 1964, p. 107.
[2] G.J. Drew, *Glen Osmond Mines*, Department of Mines and Energy South Australia, Report Book no. 83/81, 1983, p.7; *The South Australian Register*, 24 August 1854. The latter is a compilation by Captain Pascoe of 'approximate returns of copper and lead ores raised in South Australia since the first discovery of our metalliferous deposits'. Combined production from Wheal Gawler, Wheal Watkins and Glen Osmond Mine from 1841 to 1851 has been estimated at approximately 2,300 tons of ore averaging 70 percent lead and 20 oz/t silver.
[3] Philip J. Payton, *The Cornish Miner in Australia: Cousin Jack down under*, Dyllansow Truran, Trewolsta, Cornwall, 1984, p. 16.
[4] Francis Dutton, *South Australia and its Mines*, T. and W. Boone, London, 1846; Andrew Trounson, 'Resources boom to rescue rust belt', *The Australian*, 2 July 2007.
[5] Edwin Hodder, *The History of South Australia from its Foundation to the Year of its Jubilee*, Sampson Low, Marston and Co., London, 1893, v. 1, p. 187.
[6] Units used in this paper: 1 (long) ton = 1.01605 tonnes; 1 pound = 0.4536 kg; 1 troy ounce (the standard measure of gold) = 20 dwt = 31.10348 g; 1 inch = 25.4 mm; 1 foot = 0.305 m; 1 mile = 1.609 km.
[7] Private Records Group [PRG 174], George Fife Angas Papers, S.A. Colonisation Commissioners, 666. Microfilm of A.B. Duckham's poster, dated 24 June 1839, incorporating Laurimer's letter of 1 August 1838; South Australian Archives [SAA].
[8] *South Australian Gazette and Colonial Register*, 25 August 1838.
[9] George B. Wilkinson, *South Australia; its Advantages and its Resources. Being a Description of that Colony and a Manual of Information for Emigrants*, John Murray, London, 1848, p. 254; see also Dutton, *South Australia and its Mines*, p. 297, and *The Mining Journal and Atmospheric Railway Gazette*, 3 January 1846.
[10] John W. Bull, *Early Experiences of Life in South Australia and an Extended Colonial History*, E.S. Wigg & Son, Adelaide, 1884, pp. 137, 139.
[11] *Ibid*.
[12] *The Southern Australian*, 29 December 1840.
[13] *The Adelaide Chronicle*, 3 March 1841.
[14] *The Southern Australian*, 16 March 1841.
[15] General Registry Office, Adelaide, Application 23070.
[16] *The Southern Australian*, 23 March 1841.
[17] *The Adelaide Chronicle*, 31 March 1841.
[18] This company should not be confused with the company of the same name that was floated in April 1845 and that was instrumental in exploitation of the Burra Burra copper mines.
[19] Prospectus for the South Australian Mining Association, dated 17 March 1841, *The Southern Australian*, 19 March 1841.
[20] Blainey, *The Rush That Never Ended,* p. 106.
[21] State Library of South Australia, Passenger Lists 1836-1851, compiled by Diane Cummins; Index to register of emigrant labourers applying for free passage to South Australia 1836-1841, compiled by Douglas Pike.
[22] *Ibid*.
[23] *The Adelaide Chronicle*, 7 April 1841.
[24] Conflicting reports appeared in newspapers of both the size of the shipment of ore and the sailing date of the *Cygnet*. *The South Australian Register* reported on 27 March 1841 that 'no less than forty boxes of the ore were yesterday shipped per *Cygnet*, for London' but according to the same newspaper on 1 May the *Cygnet*

'sails for London this day' with '1 box lead ore, Newman; 31 boxes lead ore, Mining Company' included in the list of cargo. *The Southern Australian* on 7 May recorded the sailing date as 5 May and the list of cargo as including '1 box lead ore, Newman; 21 boxes lead ore, Mining Company'. The '1 box lead ore, Newman' may have been forwarded on behalf of J.C. Dixon who in a letter to *The Mining Journal Railway and Commercial Gazette* of London, 27 November 1841, stated that 'a small box of silver-lead ore from Wheal Gawler Mine' had been forwarded per *Cygnet* so that readers could be assured 'by a resident on the spot that there is a vast abundance of this galena within three or four miles of the city of Adelaide'.

[25] H.T. Burgess (ed.), *The Cyclopedia of South Australia*, The Cyclopedia Co., Alfred G. Selway, Adelaide, 1909, v. 2, p. 124.

[26] *Ibid.*

[27] *The South Australian Register*, 14 December 1844; Francis Dutton, *South Australia and its Mines*, p. 299; Hodder, *History of South Australia*, v. 1, p. 188.

[28] *The Mining Journal Railway and Commercial Gazette*, 9 April 1845.

[29] *The Southern Australian*, 23 August 1842, 13 September 1842.

[30] General Registry Office, Adelaide, Application 23070, Grant for mining on Section 909 dated 14 June 1845.

[31] General Registry Office, Adelaide, Application 23070, Conveyance of Section 909 dated 14 August 1846.

[32] *The Mining Journal Railway and Commercial Gazette*, 17 June 1848.

[33] *Royal South Australian Almanack for 1848*, quoted in H.Y.L. Brown, *Record of the Mines of South Australia*, 4th edition, 1908, p. 18. Henkel arrived in Adelaide on the *Pauline* from Bremen on 27 September 1846 and the passenger list for the *Heerjeebhoy Rustomjee Patel*, also from Bremen, which arrived on 28 October 1846, includes 26 miners. See, South Australian State Library, Diane Cummins, Passenger Lists 1836-1851.

[34] *Royal South Australian Almanack for 1848*, quoted in Brown, *Record of the Mines of South Australia*, p.18.

[35] *South Australian Gazette and Colonial Register*, 15 May 1847.

[36] *Royal South Australian Almanack for 1848*, quoted in Brown, *Record of the Mines of South Australia*, p.18.

[37] *The Adelaide Observer*, 10 June 1848.

[38] *Ibid.*; General Registry Office, Adelaide, Application 23070, Indenture dated 2 October 1848.

[39] *The Mining Journal Railway and Commercial Gazette*, 16 December 1848.

[40] *The Adelaide Observer*, 10 June 1848.

[41] *Ibid.,* 22 July 1848.

[42] *Ibid.*, 16 September 1848.

[43] *Ibid*.

[44] *South Australian Gazette and Mining Journal*, 29 September 1849.

[45] Primary Industries and Resources South Australia, Record of Mines – Summary Card, no. 16.

[46] *South Australian Gazette and Mining Journal*, 29 September 1849.

[47] *The Adelaide Observer*, 14 October 1848.

[48] *South Australian Gazette and Mining Journal*, 25 January 1849.

[49] *Ibid.*, 27 January 1849.

[50] *The South Australian Register*, 19 May 1849, 22 August 1849.

[51] *South Australian Gazette and Mining Journal*, 29 September 1849.

[52] *Ibid.*

[53] *Ibid.,* 7 March 1850.

[54] *The Mining Journal Railway and Commercial Gazette*, 7 December 1850, report of share price in Adelaide on 28 August 1850.

[55] *South Australian Gazette and Mining Journal*, 10 October 1850.

[56] *Ibid.*; H.F. Coates, *Historic Mines, Burnside Council Area*, Department of Mines and Energy South Australia, Report Book no. 83/35, which records that a survey conducted in 1982 found the deep cross-cut to be 140m long, where it intersected a fissure and was followed for a further 46m. The survey showed that the cross-cut had been driven beyond the projected position of Dickins' Lode.

[57] *Ibid.*

[58] *Ibid.,* 2 November 1850.

[59] *Ibid.*, 25 October 1851, Notice of Special General Meeting of Shareholders.

[60] *Ibid.,* 27 December 1851.

[61] *Ibid.*, 13 May 1848.

[62] *The Advertiser*, 13 July 1957.
[63] *The South Australian Gazette and Mining Journal*, 13 May 1848.
[64] *The South Australian Register*, 28 February 1844.
[65] *Ibid.,* 14 December 1844.
[66] Business Records Group [BRG] 3/15, Knox and Hargrave Papers, Lease of mines on Section 295, Osmond Gilles to Lewis Gilles, 6 January 1845, SAA.
[67] *The South Australian*, 14 January 1845.
[68] BRG 3/15, Knox and Hargrave Papers, Deed of Settlement of the Glen Osmond Union Mining Company of South Australia, 1 May 1846, SAA; *The South Australian*, 5 May 1846.
[69] *South Australian Gazette and Colonial Register*, 21 November 1846; *The South Australian Register*, 14 November 1846 reported that 22 miners had landed to work at the mine.
[70] BRG 3/15, Knox and Hargrave Papers, Deed of Settlement of the Glen Osmond Union Mining Company of South Australia, 1 May 1846, SAA.
[71] *Ibid*., J. Gore to L.W. Gilles, 18 July 1846.
[72] City of Burnside Library, Local History Collection, Osmond Gilles Esq. to The Glen Osmond Union Mining Company of South Australia, copy of Lease of Mines Ores and Minerals in upon and under preliminary Section No. 295 District B in South Australia, 5 December 1846.
[73] *The South Australian*, 23 January 1847.
[74] *Ibid.*, 12 October 1847.
[75] *South Australian Gazette and Mining Journal*, 18 September 1847.
[76] *The South Australian*, 12 October 1847.
[77] *Ibid.*, 18 April 1848.
[78] *The Adelaide Observer*, 29 April 1848, *'A month amongst the mines'* by J.R. Hardy, reprinted from the *Sydney Atlas*, 1 April 1848.
[79] *South Australian Gazette and Mining Journal*, 8 March 1849, 9 June 1849.
[80] *Ibid.*, 7 April 1849.
[81] *The Adelaide Observer*, 9 June 1849.
[82] Third Annual report of the Directors of the Glen Osmond Union Mining Company of South Australia, dated 24 July 1849, *South Australian Gazette and Mining Journal*, 23 May 1850.
[83] *South Australian Gazette and Mining Journal*, 24 November 1849.
[84] *Ibid.*, 22 August 1850.
[85] *Ibid.*, 21 September 1850.
[86] 'Workings and Prospects of the Glen Osmond Union Mining Company's Mines', *South Australian Gazette and Mining Journal*, 21 September 1850.
[87] *South Australian Gazette and Mining Journal*, 3 October 1850.
[88] *Ibid.*, 30 November 1850.
[89] Prospectus of the Glen Osmond Silver and Lead Mining Company, *The Age*, 1 April 1869.
[90] *Ibid*.
[91] Drew, *Glen Osmond Mines*, 1983, p. 7; *The South Australian Register*, 24 August 1854.
[92] Prospectus of the Glen Osmond Silver and Lead Mining Company, *The Age*, 1 April 1869.
[93] *Ibid*.
[94] *The Adelaide Observer*, 28 January 1888.
[95] *Ibid.*, 19 May 1888.
[96] *The South Australian Register*, 28 February 1888; *The Adelaide Observer*, 14 April 1888.
[97] *Ibid.*, 26 May 1888.
[98] *Ibid.*, 4 August 1888.
[99] *Ibid.*, 30 March 1889.
[100] *Ibid.,* 1 June 1889, 13 July 1889, 7 September 1889, 2 November 1889, 25 January 1890, 1 March 1890.
[101] *Ibid.*, 1 March 1890.
[102] *The South Australian Register*, 30 July 1898.
[103] General Registry Office, Adelaide, Application 21379.
[104] *The South Australian Register*, 14 December 1844.
[105] *Ibid.*; *The Mining Journal Railway and Commercial Gazette*, 19 April 1845.
[106] General Registry Office, Adelaide, Application 21379, Undated affidavit by Peter Peachey's widow Elizabeth.

[107] See for example, *South Australian Gazette and Colonial Register*, 11 July 1846, 20 March 1847, 25 September 1847.
[108] *South Australian Gazette and Mining Journal*, 13 May 1848.
[109] BRG 3/3/1, Knox and Hargrave Papers, Adelaide Silver-Lead Mines, Constitution and extract from minute book, SAA.
[110] *Ibid.,* where stated that Lewis Gilles was to act for L.B. Gilles in his absence.
[111] *South Australian Gazette and Mining Journal*, 29 November 1849.
[112] *Ibid.*, 3 November 1849.
[113] *Ibid.*, 18 July 1850.
[114] BRG 3/3/2, Knox and Hargrave Papers, minute book of Adelaide Silver-Lead Company, SAA.
[115] *The Adelaide Observer*, 19 May 1888.
[116] BRG 3/3/1, Knox and Hargrave Papers, Captain Pascoe's Report on Wheal Watkins, 25 February 1855, SAA. Pascoe's estimate of 1,200 tons conflicts with his 1854 estimate of 1,000 tons, see, *The South Australian Register*, 24 August 1854.
[117] BRG 3/3/1, Knox and Hargrave Papers, Captain Pascoe's Report on Wheal Watkins, 25 February 1855, SAA.
[118] *The South Australian Register*, 16 February 1888; *The Adelaide Observer*, 10 March 1888.
[119] *Ibid.*, 24 March 1888, 19 May 1888.
[120] *Ibid.*, 29 September 1888.
[121] *Ibid.*, 13 October 1888.
[122] *Ibid.*, 8 December 1888.
[123] *Ibid.*, 16 March 1889.
[124] *Ibid.*, 12 October 1889.
[125] *Ibid.*, 2 November 1889.
[126] See for example Geoffrey Blainey, *The Rise of Broken Hill*, Macmillan of Australia, 1968, pp. 49-50.
[127] *The South Australian Register*, 27 March 1889.
[128] *The Adelaide Observer*, 28 December 1889.
[129] *Ibid.*, 29 December 1888, 19 January 1889.
[130] *The Register*, 11 July 1916.
[131] *Ibid.*, 9 November 1916.
[132] *South Australian Gazette and Colonial Register*, 13 September 1845. According to *The South Australian*, 16 December 1845, Carleton's smelting works 'are situated in Hindmarsh'.
[133] *South Australian Gazette and Mining Journal*, 18 August 1849.
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[136] W. Bromell and F.P. Hanning, *Mines in Burnside: Their Historical Significance*, 1981, Corporation of the City of Burnside.
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[140] Wheal Watkins Historic Site State Heritage Assessment, File 11607, Heritage Branch, HB.DEH.
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[149] D.A. Cumming and G.J. Drew, *'Copper smelting in South Australia, the first fifty years'* in, J. Selby (ed.), *South Australia's Mining Heritage*, Australasian Institute of Mining and Metallurgy, Melbourne, 1987, pp. 115-137.