

The Coke Works on Flagstaff Point, Wollongong, 1875–1890

BRIAN ROGERS

The way in which evidence obtained by excavation can expand and clarify the documentary evidence available for the interpretation of a site, is illustrated by an account of a coke works site at Wollongong. Accidental discovery of remains of coke ovens provided an opportunity to obtain answers to questions raised by the author's earlier unpublished historical study of two separate coking businesses on the site. The first part of the paper outlines the historical record, and the significant conflicts and uncertainties arising from it. This is followed by an account of the archaeological investigation carried out by Edward Higginbotham and of the evidence obtained. This latter section also demonstrates how the archaeological evidence contributed to the understanding and interpretation of the site. The author, a lecturer in the University of Wollongong, has had a long-standing interest in the site, and he assisted in the excavation.

INTRODUCTION

In June 1984, workers engaged in the redevelopment of the environs of Wollongong Harbour unearthed brickwork, which was readily identified as being part of the dome of a coke oven (Figs 1 & 2). Recognising the potential historical significance of the discovery, the engineer in charge of the project had work in the vicinity of the structure suspended, and brought the matter to the attention of the Illawarra Heritage Committee. As it was known that the earliest coke works in the Southern Coalfield had been established on the site in 1875, the Heritage Committee was anxious to establish the heritage significance of the find, and particularly to determine whether the structure was part of this pioneer undertaking.

Research undertaken in connection with another project had shown that two separate coke works had existed on the site between 1875 and 1890.¹ Unfortunately the contemporary record, consisting almost entirely of newspaper reports, does not make it apparent which undertaking the remains represented, and there are serious contradictions in the few scant references in secondary sources. To clarify the importance of the remains the Heritage Committee arranged

for an archaeological survey, in the hope that this would bridge the gaps in the historical record, and resolve the conflicts between various secondary sources. In the event, this hope proved to be well-founded.

Historical context

The first coke ovens in New South Wales were built in 1861 at Minmi, near Newcastle, and in 1875 or 1876 another set of ovens commenced operation at Plattsburg (near Wallsend).² In July 1875 it was reported that construction of coke ovens had commenced on a site near Wollongong Harbour.³ Whether this was the second or third set of ovens in New South Wales cannot be determined, because of the uncertain date of those at Plattsburg, but there is no doubt that it was the first coke works in Illawarra, and a harbinger of a major future industry in the district.

Coke had been made in England since about 1650, the earliest processes being merely adaptations of that used by charcoal burners, who fired wood in sod-covered piles which admitted only sufficient air to burn the volatile materials in the fuel, and leave the carbon.

Only when there was a need for a smokeless fuel for locomotives, and for the use of coke for smelting iron, were techniques for producing a more uniform and better quality coke sought. The first such process to be widely adopted in England and elsewhere utilised a dome-shaped structure, with a hole in the top for charging and a large doorway in the front for drawing the coke, as in Figure 3. These ovens were called 'beehive ovens', because their interior shape resembled the traditional domed straw beehives which were in general use in England until this century.⁴

While varied in detail, the general form and operation of beehive ovens were fairly standardised. The domes were usually 3–4 m in diameter and built in sets, being enclosed in a stone or brick casing packed with rubble, stone or sand to conserve heat. The external appearance of the ovens at Rix's Creek, near Singleton in New South Wales (Fig. 4), would seem to be fairly typical, particularly of those built in Australia.

The coking process

In preparation for firing a beehive oven the front door was partially bricked up and a charge of small coal was then fed through the hole in the top. This charge (perhaps 7 or 8

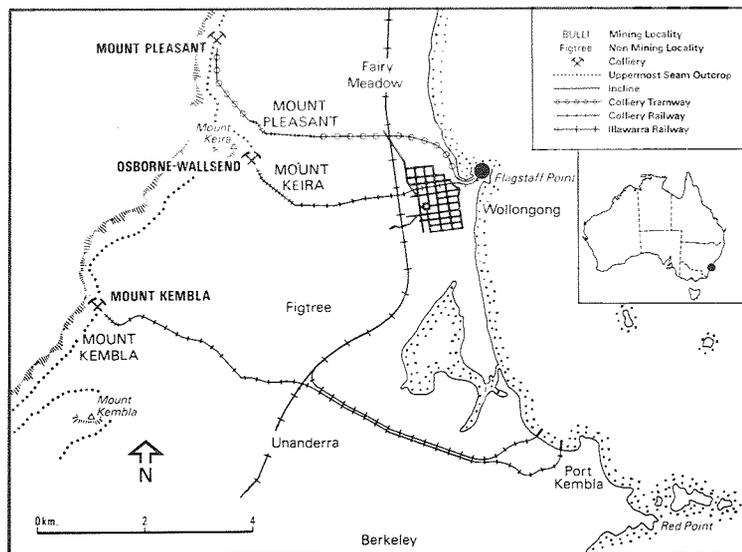


Fig. 1: Location of the Wollongong Harbour coke works site. The map also shows the location of the Mount Keira and Mount Pleasant collieries and the tramways which linked them to Wollongong Harbour (c. 1885).

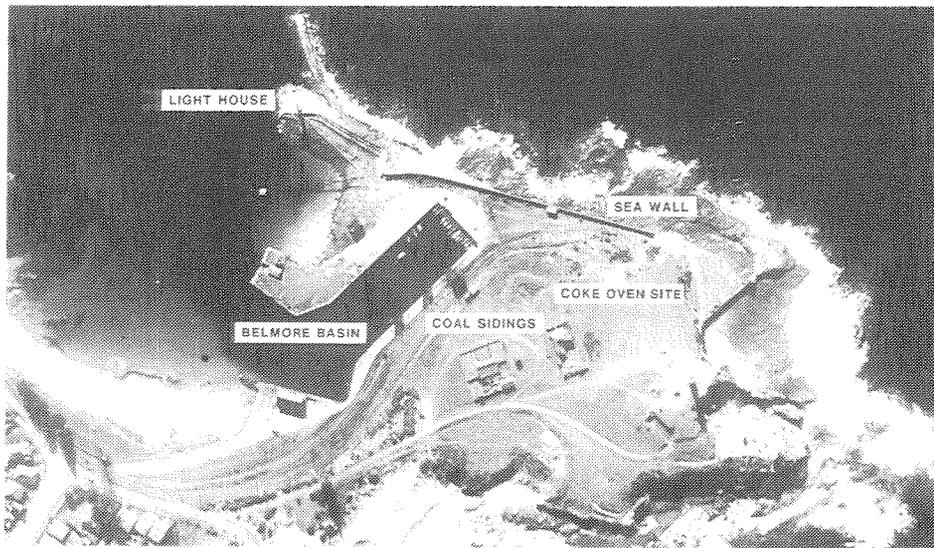


Fig. 2: Aerial photograph of Wollongong Harbour and Flagstaff Point, showing the site of the coke ovens excavated in 1984 and the relationship of the site to the colliery railway sidings and sea wall. The features shown can be readily compared with those in the section of the 1885 chart shown in Figure 5. The areal limitation of the site is very apparent. North is to the top. (Photograph: NATMAP Svy1630 — Port Kembla, 756–9; No. 20762. 21 June 1938.)

tonnes) was levelled to form a bed about 500 mm deep (Fig. 3) and the bricking of the door was then completed, leaving small gaps between the bricks to admit air. When the ovens were in full operation, the heat retained from the previous firing was sufficient to start the charge burning. As the burning increased, the volatile matter was driven from the coal and burned in the dome above the charge. To drive out all the volatile constituents normally required from two to four days firing, during which time the coke burner had to adjust carefully the amount of air allowed into the oven, so that the coke itself was not consumed. On average about one third of the coal was volatile matter which was burned during the coking process, together with some of the carbon. About 40 to 50 per cent of the initial charge was lost in these ways, leaving between 50 and 60 per cent of the original coal as coke. During the firing the carbon fused into a porous mass, swelling considerably in the process. Once the burning was completed, the oven was opened and the coke partly quenched with water to prevent it burning away. It was then withdrawn onto the coke wharf, where quenching was completed.⁵

With many variations in the details of their interior construction, beehive ovens were employed widely throughout the world as the principal means of coking, well into the twentieth century. Eventually they were abandoned in favour of ovens from which the coke could be more easily discharged, or from which the volatile products could be collected for use in chemical processes rather than burned, but in the 1870s banks of beehive ovens represented the standard English coking technology and it was this process which was introduced to Wollongong in 1875.

THE FIRST ENTERPRISE 1875–1879

The beginning

In July 1875, it was announced that William Ahern, a farrier, in partnership with James Osborne, an Illawarra gentleman, had commenced 'a new and ambitious project for making coke and other products' adjacent to Wollongong Harbour. Subsequent developments indicate that Ahern was the active partner, and that Osborne was probably only a financier, this role being in keeping with his social status. The site of their undertaking was a small rock platform on the north of Flagstaff Point (Fig. 2), which was so exposed that on occasion heavy seas washed about the ovens and carried away

stockpiled coke. Although small in scale, the project was designed in the grandest manner, being 'a conjoint establishment for the manufacture of coke, firebricks and salt'. According to the report, it was intended that the undertaking would have three coke ovens (or perhaps three *sets* of ovens?), three large pans for making salt from seawater, and a kiln for making firebricks. The intention was to use waste heat, resulting from the process of burning coke and bricks, to produce salt by evaporating seawater.⁶ Waste heat from coking processes had already been used in England for industrial purposes, such as raising steam and producing salt from seawater, and this technology could well have been known to Ahern and Osborne.

Cost savings, which the partners hoped to derive from the integration of several processes, were to be complemented by their ability to obtain raw materials cheaply. The fine coal which passed through the colliery

screens (*slack* or *duff* coal) was difficult to sell, and it accumulated in large dumps near the various coal mines. Burned in a coke oven this coal produced coke of good quality, and it could also be used to fire a suitable boiler to drive machinery about the works. Before the advent of large-scale coke manufacture in the district, slack coal could be purchased from the mines at trifling cost. Arrangements had been made by Ahern and Osborne for supplies to be obtained from the nearby Osborne-Wallsend (Mount Keira) mine, which belonged to James Osborne and his brothers.⁷ The same colliery was also to be the source of fireclay: a band of this material underlies the Illawarra coal seams and frequently it had to be dug out of the floors of main tunnels and dumped outside the mine.⁸ The third major material was seawater, which of course could be drawn into the plant from the nearby ocean in any amount for the cost of pumping.

By modern standards the coke works and its ancillary activities were on a very modest scale but they were nevertheless significant for the local economy. In 1875 Wollongong, with a population of no more than 1600 people, was really little more than a village clustered around the tiny harbour through which almost all the region's supplies were delivered and the produce of the district, including the output of two adjacent coal mines on Mount Keira and Mount Pleasant, was exported. In this context, the establishment of an enterprise with the potential for giving employment to four or five men would naturally be considered noteworthy.⁹

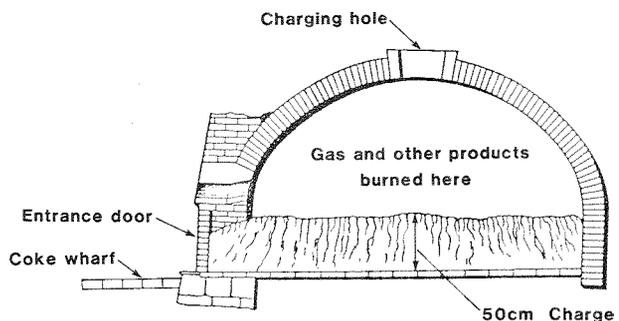


Fig. 3: Generalised cross-section of an older-style beehive coke oven, with the charge of coal raked level.

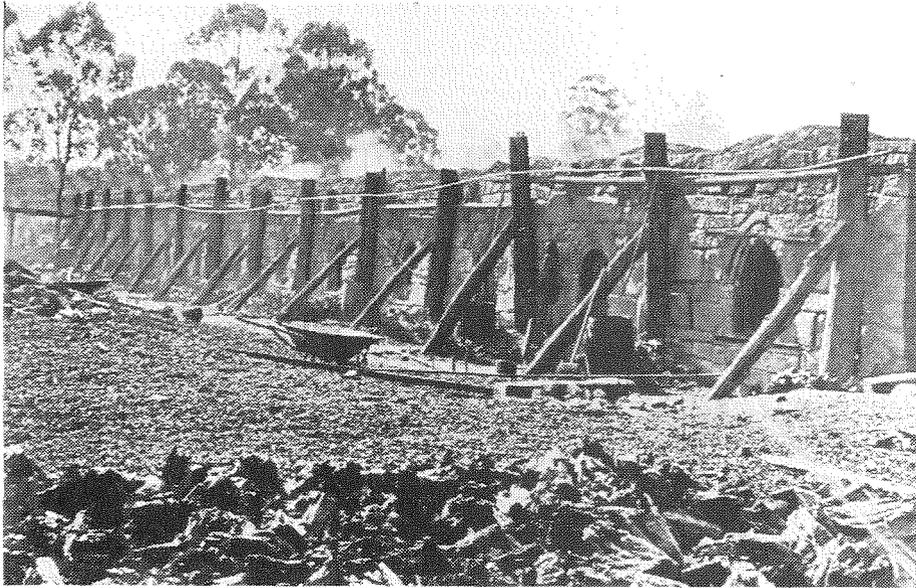


Fig. 4: This bench of twenty-six beehive coke ovens, built about 1900 at Rix's Creek (near Singleton) N.S.W., is typical of the kind. The ovens in this set were each 12 feet (3.7 m) in diameter and 6 feet (1.8 m) high, and built in two rows back to back to conserve heat. Except for the timber bracing on the front wall, the ovens at Wollongong would have had a similar appearance. (Source: Harper 1916.)

Development

In July of 1875 the preliminary work of getting construction materials onto the site was well under way. The partners had purchased and demolished the old Para Meadow (now Fairy Meadow) mill house (which was also known as Palmer's Mill) to provide timber, stone and part of the machinery for their coke works.¹⁰ Early in 1876 four ovens had been completed and, although not fully seasoned, were producing coke under the superintendence of Jonathan Payne. He was reported to have had considerable experience as a coke-burner in England and at Newcastle (N.S.W.). At the end of February, enthusiastic reports of trials at several metallurgical establishments in Sydney indicated that the coke was of excellent quality, being 'a fine clear strong product well-suited to metallurgical work'. Encouraged by these results, Ahern and Osborne stated their intention of immediately increasing the number of ovens, so as to permit production 'on the largest scale possible'. In May, 120 tons of the coke was shipped for Tasmania, where, according to the press, 'its great smelting powers' were already known.¹¹ This shipment was destined for the blast furnace of the British and Tasmanian Charcoal Iron Co. at Port Lempriere on the West Arm of the Tamar River. The success of this trial created the prospect of a large and steady market for Wollongong coke, which understandably led Ahern and Osborne to believe that the coke-making branch of their business was securely established and able to provide sound basis for operating the integrated activities. However, any such optimism must have been quickly shattered, because the iron company immediately set about erecting 40 coke ovens of its own, to process coal shipped from the Bulli pit. These ovens began production in September 1876, only four months after the trial of Wollongong coke, and they continued to supply the blast furnace until it ceased production about a year later.¹²

At about the same time as the Tasmanian ovens were brought into production, Ahern gave up his blacksmithing business. It was publicly announced that this action was to permit Ahern to take up full-time management of the coke works but it is more likely that the real reason was financial pressure. The Department of Mines noted that in the latter part of 1876 the coke ovens were idle because of limited demand for their product, which of course meant cash flow was minimal. The fact that Ahern had induced Payne, his coke-burner, both to accept deferment of wages and to loan money to the

business, highlights the liquidity problems already encountered by the small firm. It would seem that, in the circumstances, Ahern had little option but to inject any funds realised from his blacksmithing operation into the coke works and to save on the expense of wages by replacing hired labour with his own.¹³

The end

Apart from a report of the death of James Osborne in April 1877, no further information relating to the Wollongong Coke Works or its proprietors appeared until June 1879, when the entire plant and stock of the firm was put up for auction. While this sale was forced by the mortgagee, the necessity for clearing the way for impending improvements to Wollongong Harbour was an additional imperative. The latter circumstance could hardly have helped to attract potential purchasers, as there was no hope of their taking over the works as a going concern, and this disability was reflected in very low prices paid for major items of plant. Sold for the materials they contained, or as separate pieces of equipment, the sale

lots brought only a small fraction of their original cost. In particular, the auction report noted that: 'One of the two half-dozen sets of ovens fetched £24 and the other £35, the cost of erecting the latter not long since being £300. Three salt pans, which cost £70 each, sold for £3.15s. each. A large quantity of coke lying on the ground realised £24'. Similar prices were paid for the rest of the plant, and in total the sale brought in between £160 and £170.¹⁴

The coke ovens and other plant

From its inception the business was planned to produce a variety of products in an integrated set of processes, but the coke ovens were undoubtedly to be its mainstay. In 1876 the first set of four beehive ovens, each having an internal diameter of 13 feet (about 4 m), formed a unit some 70 feet (21.3 m) long, which indicates that the four were set in line rather than back to back. As soon as this first set was at work the partners set about adding more, until there were twelve ovens in two blocks of six. The two required to complete the first unit were under construction in May 1876, and the remaining six were to be proceeded with 'as soon as possible'. The actual date of construction of this latter set is not recorded but, since the potential market for coke from this operation all but disappeared when the Tasmanian iron works brought its ovens into production in September 1876, it is almost certain that it was built between May and September, at a cost of £300.¹⁵

The operation of the coke ovens is relatively well documented. They were charged with 7 or 8 tonnes of slack coal and fired in the manner already described, except that for some reason not explained by the newspaper account each charge was burned for six days instead of the three to four days normally required elsewhere. On the other hand, almost nothing is recorded concerning the other facets of the enterprise. The stock of products on hand when the firm was sold up included both coke and bone dust, which is evidence that these had in fact been produced. The production of bone dust, possibly for use as fertilizer, was a belated addition to the undertaking, apparently as a means of utilising the millstone and drive gear from Palmer's Mill. However, the fact that no comparable evidence is to be found for the production of either salt or firebricks generates a suspicion that plans to produce these items were never brought to fruition. It is known that

three iron evaporating pans, each measuring 14 feet 2 inches x 12 feet 2 inches x 2 feet (4.3 m x 3.7 m x 0.6 m), had been purchased for boiling salt, and that a 'Californian' force pump had been obtained, but there is no evidence that the salt pans were ever used for their intended purpose, or that they were even installed. Of course, while the ovens were not in full and regular employment the salt pans could not be worked, because there would not be an adequate supply of heat for the purpose. Progress had also been made towards the goal of producing firebricks, by the acquisition of a clay mill, but once again there is no positive indication that the requisite kiln for burning bricks was ever constructed.¹⁶

By 1879, the little site by Belmore Basin must have been crowded with the structures and appurtenances required for the assortment of operations which were part of the grand vision of Ahern and Osborne. In addition to the coke ovens, salt pans, pump, clay mill, and bone mill already mentioned, there was a boiler and steam engine housed in a slab-sided shed, and a blacksmith's shop. The last-named structure indicates that Ahern practised his craft at the coke works, initially, perhaps, to make such ironwork as was necessary for the construction of the works, and possibly, in the years following the closure of his original 'fariery establishment' in 1876, to supplement income from coke sales.¹⁷

Causes of failure

To the extent that the Wollongong Harbour ovens produced coke of marketable quality they were a success but this technical success did not bring with it the commercial success the proprietors had sought. The failure of the project can be attributed to an over-optimistic assessment of the potential market for coke on the one hand and excessive diversification on the other. The end result of both of these factors was over-investment in fixed capital and ultimately liquidity problems. The partners seem to have held the naive belief that once they had a product of good quality, sales would automatically follow. However, they quickly found that glowing endorsements from Sydney foundries were not orders in their books; foundry proprietors apparently were unwilling to sever ties with established suppliers in favour of an untried manufacturer. Similarly, the promise of a large and steady market in Tasmania proved to be nothing more than a chimera. Spurred on by the illusion of potential markets, the partners pushed ahead with the construction of additional coking capacity in anticipation of demand, to the extent that by the end of the first year of operation their ovens were idle for want of sales. It is not surprising that with much of its capital locked up in unproductive ovens, and more in equipment for ancillary enterprises which were either unfinished or unable to provide an adequate cash flow, the partnership was soon in financial difficulty. As has already been suggested, this is the likely reason for Ahern selling up his farrier's shop in 1876, for his need to borrow from his coke-burner, Payne, and ultimately for the mortgagee's sale in 1879. Paradoxically, the desire to maximise efficiency by integrating operations seems to have contributed materially to the failure of the enterprise.

1880 AND AFTER

Enter William Ashley

Events associated with the Wollongong Harbour coke works site in the years between 1879 and 1884 are obscure. No contemporary records have been found, and the few secondary sources, which for the most part make no reference to the sources of their information, are demonstrably in error in almost all important respects.¹⁸ Eardley states that in 1879 Ashley took over the ovens from Ahern and that he then built additional ovens. Cousens also mentions Ashley, giving no date for his arrival, but by context indicating that he came onto the Wollongong scene well into the 1880s. The *Gazetteer of historical industrial sites, Wollongong/Shellharbour/Kiama Districts*, (misquoting a press report from 1884) asserts that 'M Moriarty, Assist Eng Harbours and Rivers, wants to rebuild old Coke Works idle many years', while Sellers states that the works of Ahern and Osborne

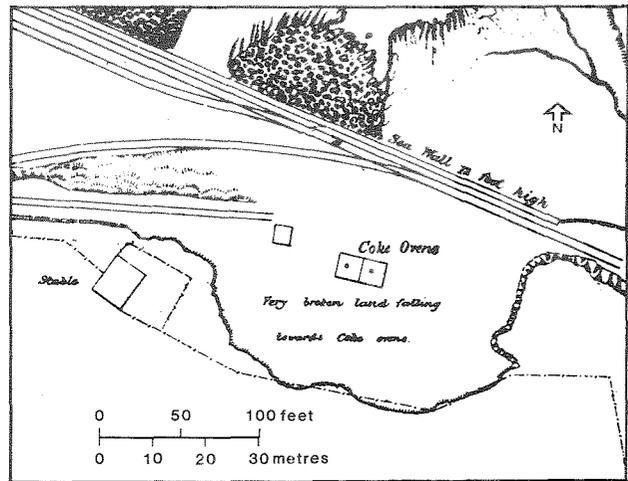


Fig. 5: Enlarged section of Chart of Wollongong Harbour as surveyed in 1885 by Commander Howard, R. N., showing details of the site of Ashley's coke works as they were at the beginning of that year. The position of the ovens shown accords closely with the position of those excavated in 1984. (Source: Wollongong Reference Library.)

were taken over by Ashley. Gardiner-Garden asserts that a local contractor, Patrick Lahiff, erected the first two ovens, which first came into production in 1876, and continues: 'During the existence of the ovens, their ownership twice changed hands and four additional ovens were built'. On the other hand, the official account by Harper asserts that the first coke works at Wollongong Harbour were built by Ahern and Osborne '...in September 1878 and were worked by them to June in the following year, after which they were carried on more successfully by Mr. W. M. Ashley'. It can readily be seen that the only consistent element in these quite confused and confusing reports is the reference to Mr Ashley. They are seriously at odds in important details, such as dates, and the relationship between the plant operated by Ashley and that of Ahern and Osborne. In addition, some carry the implication that the original ovens remained in operation after their sale in 1879, and this is difficult to reconcile with the report in 1879 that they were sold for demolition. Given the greater consistency of the contemporary press, it must be accepted as giving the most reliable, if incomplete, account of the revival of the Wollongong Harbour coke works. Gaps in this record leave many unresolved questions, two of which are of particular importance for the assessment of the significance of the remains uncovered in 1984.

Following the liquidation of Ahern's assets in 1879, no further reference is made to coke-making in the vicinity of Belmore Basin until 1884, when a brief press item announced that a Mr Ashley had applied to the Harbours and Rivers Department for permission to '...rebuild the coke works which have been lying idle for so many years'.¹⁹ In the context, the use of the term 'rebuild' could be construed as either reconstructing derelict ovens already on site, as could be implied by the reference to the ovens 'lying idle', or it could mean that new ovens were to be built on the site previously used for the same purpose, which of course would be the case if the original ovens were substantially demolished in line with the 1879 reports. If evidence could be found to show that the first of these alternatives was indeed the case, it would give the site added heritage significance, and the search for such evidence was the principal motivation for the archaeological investigation undertaken in 1984.

While newspaper reports indicate that only two ovens were active on the site following its resurrection by Ashley, the secondary sources referred to above created some confusion concerning the number actually in existence after 1884, and evidence to support that of the press was considered to be desirable. This was provided in part

by a chart of Wollongong Harbour which was surveyed early in 1885.²⁰ The section of the chart included here as Figure 5 shows the coke works as an outline of what appears to be two ovens, which are located on the site uncovered in 1984. As the survey for the chart was undertaken between February and April 1885, it can be inferred that Ashley had commenced operations with only two ovens and that these had been constructed by the beginning of that year. While it provides some corroboration of the press reports, the evidence from the chart is by no means conclusive as to the number of ovens on the site after April 1885, because it takes no account of any ovens which Ashley might have added subsequent to the harbour survey. Clarification of this point, like the resolution of the question of whether these ovens were entirely new or a restoration of part of the original works, rested on the results of archaeological investigation.

The archaeological investigation²¹

Discovery of remains of coke ovens on the site in 1984, raised the exciting prospect that if it could be shown that they were part of the ovens built by Ahern and Osborne they would be the earliest known evidence of coking operations in New South Wales, and in addition it offered opportunity to resolve some of the problems arising from the historical record, through archaeological evidence. Anxious to assess the heritage significance of the site, and to clarify its history, the Illawarra Heritage Committee invited Edward Higginbotham to conduct an investigation of the remains. He was asked to determine the number of ovens and record details of their construction, to define the extent of the site, and, if possible, to clarify the relationship of the extant remains to the original coke works. These objectives were to be attained with minimal disturbance of the archaeological remains. Because only limited funds were available, because the engineer in charge of the works was anxious to complete roadwork in the vicinity, and because of the limited objectives of the investigation, it was necessary to complete site work in a single day. The availability of a backhoe for the heavy excavation, and of a small team of experienced volunteers to assist with manual cleaning and measuring, made this task feasible.

In the process of this brief excavation three trenches were dug (Fig. 6), none of which disturbed primary deposits or previously intact structures. The first trench (1a), on the western end of the oven block, was excavated to remove demolition debris resulting from the initial exposure. It revealed half of an oven base, provided a north-south cross-section of the remains of an oven dome and exposed part of the front wall of the block. This initial clearing also exposed the eastern side of an oven doorway, and, in front of the oven, and below the level of the oven floor, a surface of bricks laid on their sides. To determine the extent of the whole oven block an exploratory trench (2) was excavated to the east of, and parallel to, Trench 1a, at a distance estimated to be slightly less than that required to accommodate three ovens. Although earthmoving operations undertaken for construction work immediately to the west of the site were such that they would have revealed any remains of additional ovens, or of foundations of an earlier set, nothing of this kind was found to the west of Trench 1a. In these circumstances it was expected that if more than two ovens had existed on the site, Trench 2 would intersect their remains. No evidence of ovens was found in the trench; the only material unearthed was part of a horizontal brick surface similar to that already revealed in front of the oven in Trench 1a, and subsequently revealed also by a third trench, 1b. This latter excavation, which extended eastward from Trench 1a along the front wall of the oven in an attempt to locate the north-eastern corner of the structure, revealed the doorway of a second oven (Fig. 6). Excavation work was halted at this point because of the need to record the site and permit backfilling before nightfall. At this time it was believed that there was insufficient space between Trenches 1a and 2 for a third oven, and consequently that there was nothing to be gained from further excavation. While it was subsequently found that it was in fact possible for this space to accommodate a third oven, the evidence

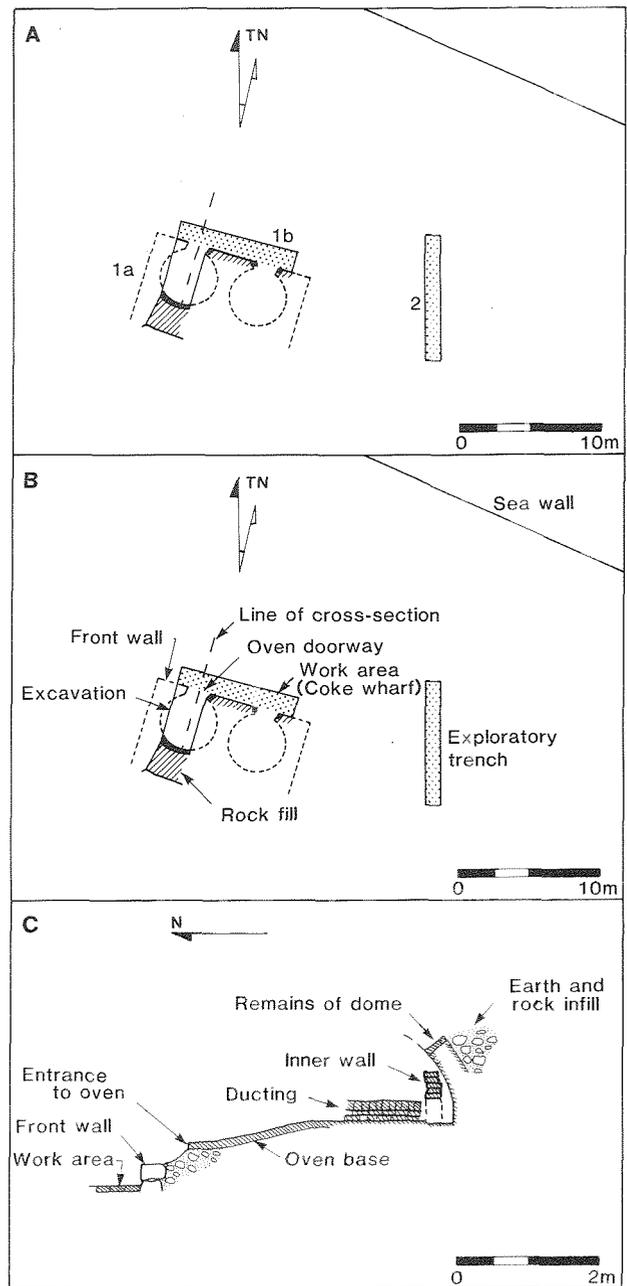


Fig. 6: (A & B). Plans of the excavation at Wollongong Harbour in June 1984, showing the relationship of the several trenches and the general arrangement of the oven unit. Stonework is indicated by hatching, brickwork by black infill, and exposed paving by stippling. (C). Cross-section of the western coke oven, showing the brick-paved work area, stone casing, oven brickwork, and rubble infill. (Adapted from an original by E. Higginbotham.)

taken as a whole permits it to be confidently stated that the block contained only two.

The excavation was particularly significant in determining that the remains now lying buried on Flagstaff Point have no direct connection with the ovens built by Ahern and Osborne. The fact that no evidence of foundations was found either to the east or to the west of the excavated remains, suggests strongly that they were not rebuilt on the remnants or the foundations of one of the earlier structures, which would have been fully 100 feet (30 m) long.²² This interpretation

is supported by the fact that the 14 feet 6 inches (4.4 m) foundation level diameter of the excavated ovens makes them significantly larger than those built in 1875, which were reported to have had a diameter of 13 feet (4 m). This difference makes it unlikely that the ovens could have been rebuilt on the remnants of an earlier structure. Further support for this view is to be found on the 1885 harbour chart, which makes it clear that the site excavated coincides with that of Ashley's ovens as they were in 1885, and, as can be seen in Figure 5, this chart gives no suggestion of any extension of the oven block, or of any remains of earlier structures.

Ashley's coke ovens

In addition to providing evidence specifically relating to the questions already discussed, the excavation produced interesting information about the construction of the ovens, which is not available from documentary sources. The two ovens were encased in thick walls of roughly dressed stone on at least three sides; the fourth side was not located and it may have been formed by extension of the side walls into the low cliff immediately to the south of the site (Fig. 2). When viewed from the front, the oven block would have had an appearance similar to that of the Rix's Creek structure shown in Figure 4. Between the stone casing and the brick dome was a packing of stone rubble and sand to conserve heat (Figs 6 & 7). The dome itself was constructed of sandstock brick and had a thickness of one and a half bricks (300 mm). Extensive deep fusing of the inner surface of the dome testified to the intense and prolonged heat produced during the coking process. The oven floor was a single layer of bricks supported on a series of ducts, which were intended to conduct hot gases from the dome to heat the charge from below and thereby ensure more uniform burning. Associated with this ducting was an internal half-wall, which extended around at least the rear of the oven (Fig. 7), to

create a flue between the dome and the charge of coal, by which the gases could reach the underfloor ducts. Higginbotham notes that similar features were used in brick and pipe kilns, where they were called 'bag wall' and 'chequers' respectively. He points out that the presence of these features is an indication that Ashley was technologically innovative, although there is nothing to indicate whether these additions to traditional design effectively enhanced the performance of the ovens.²³

A pavement of bricks laid on their sides and packed with some form of grouting or bonding material, was found on three sides of these ovens. The section immediately in front would have formed the 'coke wharf', which was the area for receiving and quenching the incandescent coke as it was drawn from the oven. On either side of the ovens, this surface would have been used for storing the quenched coke.

The business

By any standard, Ashley's business was on an extremely small scale. Assuming that the ovens were operated in the manner which Harper suggests was normal in New South Wales (see Note 5), with firings alternating between 3 and 4 days, including discharging coke and recharging with coal, each oven could process two firings of about 8 tonnes of coal per week, giving a total of 32 tonnes per week for the battery. With a yield of between 50 and 60 per cent of the weight of coal fired, the output of the works would have been in the vicinity of 16 to 20 tonnes of coke a week, or a maximum of 1000 tonnes in a year (allowing two weeks each year for repairs and maintenance). Operating at this capacity the ovens would have consumed a maximum of 1600 tonnes of slack coal annually, an amount which would have been an insignificant proportion of the quantity brought out of the local pits.



Fig. 7: The interior of the western oven, showing details of its construction. The oven base, falling towards the doorway to the left of the photograph, supports the brick ducting and the working floor of the oven. Above the 1 m scale can be seen the remnant of the interior wall, and beyond this the vitrified brickwork of the dome itself. Surrounding the dome and extending back towards the original cliff-face (top right), is the stone and earth packing which provided heat-conserving insulation. (Photograph: E. Higginbotham.)

With this meagre output Ashley supplied 'coke, suitable for household purposes, especially in stoves' at 'five shillings per load' delivered. The coke was regarded in some quarters as a very superior product, 'and pronounced by experts to be the best colonial coke manufactured'. Whether this quality attracted buyers from outside Wollongong is not made clear but, whatever the source of demand, it was sufficient to keep Ashley's ovens in constant use and four or five hands employed.²⁴

Because he had managed to remain solvent for almost six years, in a business which had put his predecessors in serious financial difficulty in only a few months, Ashley was credited in the press as being 'the father of the Illawarra coke industry'. Two factors which seem to differentiate his undertaking from that of Ahern and Osborne are technical knowledge and entrepreneurial skill. At first sight, the fact that Ashley had had practical experience in the English coke industry prior to commencing operations at Wollongong, while Ahern and Osborne had no comparable knowledge, would seem to be of significance but, since the latter were able to draw on the expertise of an experienced coke-burner, it is doubtful that such technical considerations made a fundamental difference. On the other hand, it is clear that Ashley was the more successful entrepreneur, especially in judging his market and making decisions about resource allocation. Ahern and Osborne had not only miscalculated the extent of the market and over-invested in coking plant but they were also over ambitious in their investment in equipment for related activities, which in turn tied up a great deal of their capital and exacerbated their liquidity problems. Whether by intent or simply in consequence of not having funds to do otherwise, Ashley chose to keep his investment small, and was content to supply the known and reliable market for coke in Wollongong, and thereby managed to avoid such difficulties. There is no way of determining whether his ability to remain solvent was matched by profitability. The fact that Ashley neither renewed the lease of his Flagstaff Point site when it expired in 1890, nor re-established his coke works on a new site, suggests that possibly the returns were not great, but it is also possible that his decision may have simply reflected his awareness of changing market conditions. In that year the Australian Coke-making Company was erecting the first large-scale coke works in the district, and it must have been obvious to Ashley that he would not be able to compete with a large-scale producer. Instead, he accepted the management of the new works and remained in that position until he retired in 1902.²⁵

CONCLUSION

Prior to the excavation described above it was known that coke works had operated on Flagstaff Point in the periods 1876–1879 and 1885–1890: what was uncertain was whether ovens from the former period survived reported demolition to become the basis of the second coke works, as was asserted by a number of secondary sources. The archaeological investigation demonstrated that it is unlikely that the oven remnants found in 1984 contain structural elements from those built by Ahern and Osborne in 1876, although it is possible that they do contain materials from these earlier ovens. By clarifying these matters, archaeological evidence has been instrumental in resolving quite serious discrepancies noted in secondary sources, and uncertainty arising from the contemporary press reports. In conjunction with documentary evidence, and in particular the chart based on the 1885 survey of Wollongong Harbour, this work also permitted the dating of the excavated remnants to 1885 with some confidence. Details of the interior structure of the ovens gave insights into their operation and attest the innovative approach taken by William Ashley. In these ways archaeological study has made an important contribution to the understanding and evaluation of the Wollongong Harbour coke works.

In addition to resolving some significant historical questions, the excavation also assisted in the assessment of the heritage significance of the site. Despite the very small scale of both of the coke works near Wollongong Harbour between 1875 and 1890, their importance for the industrial history of the Illawarra region, if not of New South Wales, is undeniable. The first undertaking reflected a growing spirit of enterprise and experimentation with technologies not previously used in the region. Ahern and Osborne were amongst the pioneers of the coking industry in Australia and, while their venture was financially unsuccessful, the importance of their vision and willingness to innovate must not be underestimated. It is clear that they were able to achieve technical success, if not profitability. Had the excavation shown that the coke oven remnants now reinterred on Flagstaff Point were part of this pioneer undertaking, they would have represented the oldest surviving relics of the coke industry in New South Wales. While dating from a later period and lacking both the scale and the fascinating diversity of their forerunners, the heritage value of these remains is nevertheless considerable. With these ovens, William Ashley was able to add commercial success to the technical achievements of his predecessors. Ashley's subsequent association with the first major coke works on the Southern Coalfield, provides a direct link between his unpretentious little business and the large-scale operations which became a major part of the Illawarra economy from 1890.

ACKNOWLEDGEMENT

The author very gratefully acknowledges the valuable assistance of Edward Higginbotham, who gave permission for the use of his survey report and illustrations for this paper. Responsibility for the use made of this material must of course rest with the author.

NOTES

1. Rogers 1984.
2. Harper 1916: 11–13. It should also be mentioned that Whitmore 1981 gives an account of coke ovens built near Ipswich, Queensland, in 1869.
3. *I.M.* 30/7/1875.
4. Wilson & Wells 1950: 2–3; Groves & Thorp 1889: 159–62; McCall 1971: 52.
5. Wilson & Wells 1950: 1–5, 138–41; McCall 1971: 21–4. Harper 1916: 23 notes that for convenience burning was normally arranged in alternating 72 hour and 96 hour periods, the longer firing tiding over a Sunday shift.
6. *I.M.* 30/7/1875.
7. 'Osborne, Pat Hill', *Australian Dictionary of Biography* 5: 376.
8. Wilson & Wells 1950: 1–5, 138–41; McCall 1971; Harper 1916: 21–4.
9. Jervis 1942: 132–3; *Australian Handbook and Almanac for 1880*: 174; *T.C.J.* 23/8/1879; Robinson 1977: 69–81.
10. *I.M.* 30/7/1875. Jervis 1942: 105 mentions that Palmer had erected a mill in 1840.
11. *I.M.* 8/2/1876, 25/2/1876, 7/3/1876, 9/5/1876.
12. Southern 1986: 78–9; Southern & Platt 1986: 42.
13. *I.M.* 1/9/1876; New South Wales Department of Mines 1877: 133.
14. *S.M.H.* 12/4/1877; *I.M.* 13/6/1879, 17/6/1879.
15. *I.M.* 7/3/1876, 9/5/1876.
16. *I.M.* 17/6/1879, 24/6/1879.
17. *I.M.* 12/6/1879.

18. The few secondary sources which mention the Wollongong Harbour coke works are all quite brief in their treatment of the subject. The specific references are Cousens 1948: 179; Eardley 1968: 26; Gardiner-Garden 1975: 39; Harper 1916: 11-13; McCarthy 1979: 19; Sellers 1976: 25. Each of these sources can be shown to be seriously in error so far as their discussion of the coke works is concerned. For the most part the errors can be traced back to Harper's report, which merely repeats undocumented information from the secretary of the Illawarra and Western Coke Proprietor's Association, which in turn was almost certainly based on hearsay and the undocumented recollections of persons in the industry in 1915.
19. WA. 17/4/1884. It is this report that is misquoted in McCarthy 1979, wrongly attributing the proposal to rebuild the ovens to Mr Moriarty.
20. *Chart of Wollongong Harbour, 1885.*
21. Higginbotham (with Rogers) 1984.
22. It was reported in 1876 that the first four ovens formed a block 70 feet long; the addition of two more, each with an internal diameter of 13 feet, would easily make up a further 30 feet or more and bring the total length to at least 100 feet. See *I.M.* 7/3/1876.
23. The need for a uniform burning of coke had led to many experimental designs, which served to provide bottom heat to the charge, as well as the top heat provided by normal burning. Coming from England in the 1880s, Ashley would have known of some of these arrangements.
24. *I.M.* 28/7/1885; Cousens 1948: 179.
25. *I.M.* 9/4/1902.

BIBLIOGRAPHY

Published sources

Australian Dictionary of Biography 5.

The Australian Handbook and Almanac 1880, Gordon and Gotch, London.

Chart of Wollongong Harbour, 1885 (Surveyed by Commander Howard, R.N.), Harbours and Rivers Department, Sydney.

COUSENS, A. 1948. *The garden of New South Wales*, Producers Cooperative Distributing Society, Sydney.

EARDLEY, G. 1968. *Transporting the black diamond*, Traction Publications, Canberra.

GARDINER-GARDEN, C.W. 1975. *The port of Wollongong*, (3rd ed.), Illawarra Historical Society, Wollongong.

GROVES, C.E. & THORP, W. (eds) 1889. *Chemical technology*, Vol. 1, Churchill, London.

HARPER, L.F. 1916. *The coke industry of New South Wales*, New South Wales Department of Mines (Mineral Resources No. 23), Sydney.

JERVIS, J. 1942. Illawarra: a century of history, *Royal Australian Historical Society Journal* 28: 65-107, 129-56, 193-248, 273-302, 353-74.

McCALL, B. 1971. Beehive coke ovens at Whinfield, County Durham, *Industrial Archaeology* 8: 52-62.

NEW SOUTH WALES DEPARTMENT OF MINES, 1877. *Annual report for the year 1876*, Sydney.

ROBINSON, R. (ed.) 1977. *Urban Illawarra*, Sorrett, Melbourne.

ROGERS, B. 1984. Salt making in New South Wales to 1900, *Illawarra Historical Society Bulletin*, May: 24; June: 30-32; July: 39-40.

SELLERS, G. 1976. The Illawarra coal field—a history to 1905, *The Australian Institute of Mining and Metallurgy Conference, Wollongong, 1976, Papers.*

SOUTHERN, J.L.N. 1986. The history of iron smelting in Australia, *Illawarra Historical Society Bulletin*, December: 77-9.

SOUTHERN, J.L.N. & PLATT, J.E.A. 1986. *The history of ironmaking in Australia*, The Australian Pig Iron Club, Port Kembla.

WHITMORE, R.L. 1981. *The coal industry in Queensland: the first fifty years*, University of Queensland Press, St. Lucia.

WILSON, P.J. & WELLS, J.H. 1950. *Coal, coke and coal chemicals*, McGraw Hill, New York.

Unpublished sources

HIGGINBOTHAM, E. (with ROGERS, B.) 1984. Preliminary investigation of remains of coke ovens, Belmore Basin, Wollongong, N.S.W., Edward Higginbotham Consultant Archaeological Services, Camperdown.

McCARTHY, K. (compiler) 1979. *Gazetteer of historical industrial sites, Wollongong/Shellharbour/Kiama Districts*, Illawarra Industrial Archaeology Society, Wollongong.

Newspapers

Illawarra Mercury (I.M.)

Sydney Morning Herald (S.M.H.)

Town and Country Journal (T.C.J.)

Wollongong Argus (W.A.)