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EXCAVATION AT THE BRUNNER COKE OVENS: JANUARY-FEBRUARY 1981

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The coal mining complex at Brunner, approximately 13 km north-east of Greymouth in the Grey River valley (map reference 841903, S44 Greymouth,5th edition 1977) was in operation from 1864 to the 1940s. As a result of interest taken in the site in the 1970s by Mr Brian Wood of Greymouth, the New Zealand Historic Places Trust declared it an historic site in 1978 and initiated a continuous programme of clearing, investigation, stabilisation, selective reconstruction and management for public access. High on the list of priorities for stabilisation and investigation were the beehive coke ovens. Recent excavations were organised and financed by the New Zealand Historic Places Trust, and were concentrated on the working area around the ovens.

Beehive coke ovens were by far the most common form of coke oven during the late 19th century and early 20th century. Apart from the important place of such ovens in the technological history of the coal industry, the construction of the ovens involved very skilled brickmaking and laying processes and the end result is visually interesting and attractive.

History

Coke production at Brunner began soon after the development of the mine as a commercial proposition. It was in 1864 that Matthew Batty obtained permission from the Nelson Provincial Government to work the seam that had been observed by Thomas Brunner during his West Coast journey of exploration in 1846-48. It was established by tests done for the Provincial Government by J.W. Tatton, Nelson (report of 20 April 1860), and more specifically by the Metallurgical Laboratory Government School of Mines, England (report of John Percy 14 May 1861), that the Grey coal from Brunner was a good coking coal.

The Nelson Coalmining Company sometimes referred to as the Ballarat Syndicate was granted a lease of the mine in 1866 and built the first coke ovens on the site. These two oblong ovens, still in existence, were all but complete when the lease was cancelled in 1868. The first coke was probably produced soon after the Nelson Provincial Government began operating the mine

(1868-74). The coke operation itself was let out to contract. The fact that these two ovens were not round or beehive ovens might be explained by the Victorian rather than British origins of the Company. Oven plans may have accompanied the firebricks which were of Australian origin. However, dissatisfaction with the oblong ovens may have helped ensure that any new ovens built would be of the beehive variety. In Britain the superiority of beehive ovens of the new improved variety had been recognised in the early 1860s.

The Brunner beehive ovens were built during the period that the Brunner Coalmining Company (1874-88) and Grey Valley Coal Company (1888-95) owned the mine. This encompassed the period of greatest growth and output from the Brunner mine although the year of peak production was 1901. A Greymouth merchant, Martin Kennedy, who had been involved in the marketing of coke before 1874, was owner and Managing Director of the Brunner Coal Mining Company. It had been observed in 1873 that 4-6 more ovens "would open up a profitable trade". Much of the optimism was directed at the Melbourne market.

The new location of the beehive ovens was largely a response to a resiting of mine buildings as a result of the building of the Brunnerton-Greymouth railway (opened 8 April 1876) and the Brunner suspension bridge which linked it with the mine. The ovens and mine buildings were located on what had been the township site thus necessitating the removal of houses. A lack of forward planning is similarly indicated by a slight change in alignment between the first three and second three ovens. Present knowledge points to the construction of the first three ovens before A pril 1875 with the six completed sometime before March 1877. Like all the beehives on the site they were made mainly from locally produced materials especially Brunner firebrick. The first firebricks were produced on the site in the early 1870s and were used in repairs on the oblong ovens.

The line of ovens was extended to twelve in the early 1880s. At this time there was increased investment in the mine generally and prospects of an expanding market. A steady increase in coal output from about 17,000 tons in 1874 to 44,000 tons in 1882 had become 104,000 tons in 1885. The increased amount of slack would have encouraged an extension of the coke ovens where the market was for whole coal and slack not used in coke manufacture was tipped into the river.

Beehive ovens in Britain and elsewhere were generally built back to back mainly to conserve heat and permit of a common flue - thus adding to efficiency and improving the quality of the coke. Topography made this difficult at Brunner where the hillside extended to the back of the first line of ovens. However, following the formation of the Grey Valley Coal Company in 1888 and a fresh infusion of capital the number of ovens was then doubled to give a complement of twenty-four. Considerable excavation was necessary. The aim was to capture the Broken Hill market but as Martin Kennedy, still Managing Director, was to explain in 1890 some disappointments were to be experienced in this regard. With an output of 60 tons a week from twelve ovens in 1884 a climb to 150 tons was being advertised in 1889 but the actual output in 1896-7 was only 66 tons per week.

The first six beehive ovens, at least, were initially loaded from the front as was the case with the earliest ovens. (Some British authorities considered that front loading was an important factor in maintaining coke quality, other things being equal.) Each oven had its own stack. That the apparent absence of dampers, flues and chimneys probably affected the quality of the coke is indicated by the presence of 'black ends' in the coke first produced. This incompletely burnt coke could also have been due to the presence of stone or dirt in the coal. This inferior coke was used in the engines on the Greymouth-Brunnerton line although most engines had been adapted to the use of coal by this time.

The loading or charging of ovens from the top probably began in the early 1880s. The expansion at this time included an enlargement and a new design of bins and screens to cope with the increased output. A tramway was built from these at a height to come along the top of the ovens. It skirted the brick kilns and was carried for much of its distance on trestles (see Plate 1). It probably had a small incline from bins to ovens if it was to the best British design. At a later stage the tramway was taken through the centre of the brick kilns. After 1906 when the St Kilda mine (1907-21) replaced the Brunner mine as the working mine in the area, the coal supply to the ovens came from the St Kilda screens and bins at the eastern end of the ovens. This was also the case in the 1920s when the coal came mainly from small co-operative mines in the area.

The increased number of ovens in the late 1880s also saw the provision of chimneys and a flue system which must have helped improve coke quality as well as reducing pollution. The use of a damper to control the flow of air during the coking process was one of the factors enabling the coke burner to supply the needs of a particular market. Coke burners at Brunner must of necessity have adapted to the different coal found at Brunner compared with that in Britain but it was acknowledged that beehine ovens were well suited to high swelling Brunner coals. Insufficiency of demand aside this might have precluded their replacement by new improved by-product ovens that were being developed.

A somewhat inefficient system by which the coke after being drawn and quenched (if not already quenched inside the oven) was thrown up onto platforms for bagging (Plate 2), could have been avoided if the ovens had been elevated and the platform built next to them as in some British plants. The ground level of the original ovens and the lack of overhead rails necessitated rails next to these ovens for the supply of coal and may have set the pattern for the later ovens and associated structures. Coke rakes have been recovered on the site but no prickers as yet. These were used to remove the quarles used in blocking up the oven entrance during coking. Iron frames were used to assist in the coke bagging. Features of coke production at Brunner may have had some distinctive New Zealand adaptations and this may have been one of them. It is to be hoped that further research, especially archaeological examination, may reveal others, especially features of oven construction such as oven floors and aspects of their mode of working. It would appear that lime burning operations were carried out in the coke ovens precinct and there is a reference in 1892 to the erection of a dross washing and briquette making plant and the intention to recover the by-product of the coke and use them in the manufacture of briquettes. This awaits further research and examination.

Foundries took a significant amount of the Brunner coke output but at least during the p eriod in which the St Kilda mine operated (1907-21) much was used in hop-drying kilns in the Nelson district. It is recorded that the Tyneside Proprietry Company which took over the mine in 1912 leased three of the ovens to Allan and Party in 1925 who turned out two tons

of coke per day. Coal output at this time was less than 2,000 tons per annum. In 1931 small quantities of coke were being produced by United Brunner Mines Ltd and intermittent production is reported in 1936 but also the demolition of some ovens for the sale of bricks by a sub lessee. The use of ovens to make charcoal during World War II has been orally reported. By then coal production from the Brunner lease had practically ceased.

Current state of the site

When the Brunner site was first visited by Brian Wood in the early 1970s it was completely overgrown. In recent years the major portion of the site has been cleared, making the surviving portions of the coke ovens visible. On the later (north) side the complete stone facade is standing and in good order. Two ovens are virtually complete and two others in reasonable order. Nothing visible remains of the other interiors. Parts of the retaining wall of the coke bagging platform are visible - sometimes fired blocks, sometimes stones. A brick lined drain entrance is also visible.

The facade and interiors of the southern line of ovens have been almost completely demolished. While small portions of wall are visible it is generally impossible to determine the precise position of individual ovens or the exact line of the facade. The position of the railway lines and the coke bagging platform were not generally evident although a portion of railway track was visible at the eastern end and parts of the stone retaining wall for the coke bagging platform on the far south side had been uncovered during an excavation in 1979. There was a large drain outlet in the bank of the river known to be connected to the drain entrance on the north side of the ovens. Both the large chimneys have been demolished, one of them not until the late 1950s.

Previous excavation

In 1979 there was some excavation along the edge of the river bank on the far south side of the coke bagging platform (see Fig.1) under the direction of Mr Ray Ansin who was site manager at the time. Parts of the stone retaining wall of the coke bagging platform were uncovered and remains of a railway track. At the very end of the excavation evidence was uncovered which suggested that there may have been an earlier railway track.

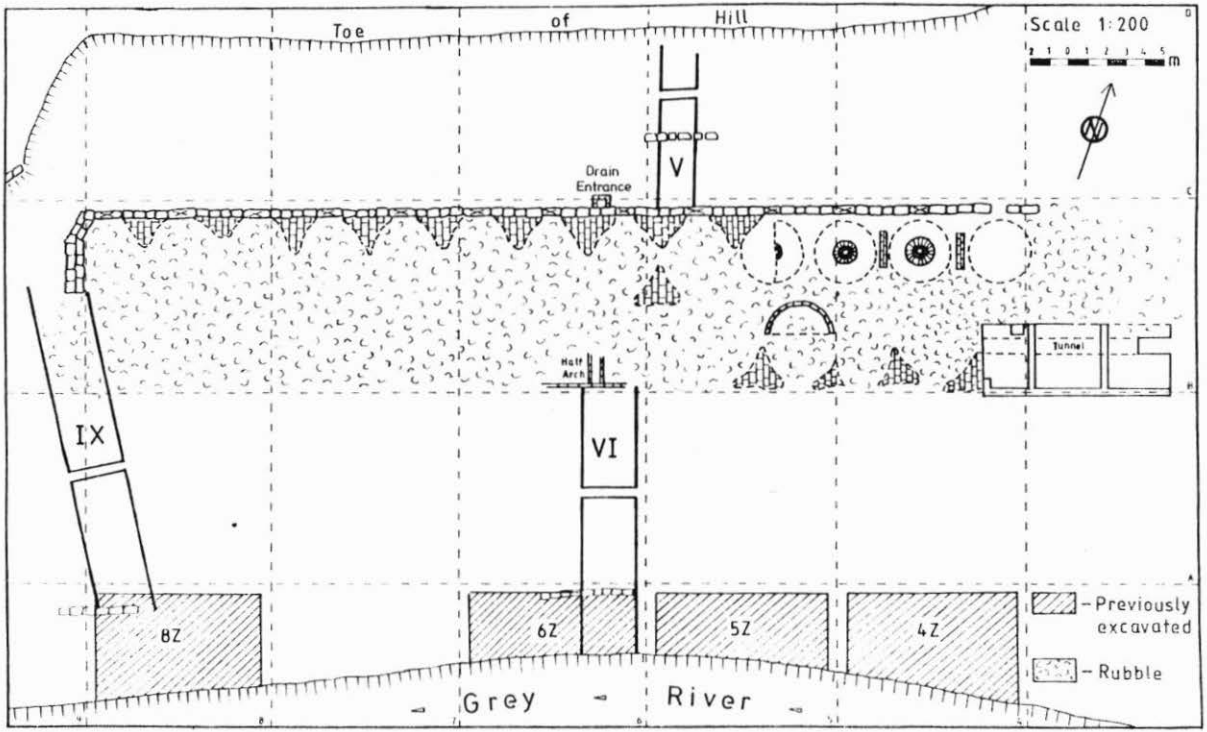


FIGURE 1. Brunner coke ovens excavation plan.

1981 excavation

The general objectives of the 1981 excavation were to provide the Historic Places Trust with: descriptive knowledge of the area around the coke ovens and its developments, and a basis of knowledge for future stabilisation of the area and its presentation to the public.

Excavation began on January 21 and concluded on February 15. It was carried out by an archaeological team of three, with seven assistants employed by the Temporary Employment Programme and Student Community Service Scheme.

Three trenches were opened (see Fig.1) to coincide with what are thought to be the three main periods of oven construction. Each trench extended from the base of the ovens at right-angles to cut across and locate the related work areas. Two of the trenches were on the south side where there had been a longer period of occupation: Trench IX adjacent to ovens of the 1876-77 period and Trench VI adjacent to ovens of the pre-1884 period. Both of these trenches were 3 m wide. Trench V was on the north side adjacent to the later ovens built around 1889 and was 2 m wide. It was expected to be a less complex area and this proved to be the case. The length of each trench was determined by the depth of the working areas they were designed to investigate and ranged from 8 to 18 m.

Trench IX (Plate 3) was placed to establish the position of the first oven, to investigate a partially exposed plaster floor (thought possibly to be the first oven) and to further explore features recently exposed in a cutting. It was angled to include as well as these, part of the railway track area in the far south which was far enough away from the edge of the river bank to be safely excavated (although in fact time did not permit excavation of this area).

Trench VI was positioned to investigate the area to the immediate south of a half arch visible in a remaining portion of facade. It was hoped to determine the function of the half arch and its possible relationship with the large north-south drain seen in the drain entrance on the north side of the ovens and the drain outlet in the river bank on the south side. The trench included the drain outlet.

Trench V was positioned to include the area immediately in front of an oven mouth and a visibly complete section of retaining wall.

Before work began piles of brick, stone and coke from recent tidying were shifted and recent regrowth of grass and weeds was cut back to ground level. The material in which we excavated was predominantly coke, brick rubble and clay. Although work generally proceeded by trowelling, small, strong picks were necessary for removing compacted coke deposits. In spite of an unusually fine summer, we had our fair share of 'Coast' weather.

The archaeologist in charge of each trench was completely responsible for direction of work in that trench and all recording. Work in Trench IX was directed by Janet Leatherby, in Trench VI by Peter Morgan and in Trench V by Robyn Oliver.

Artefacts were regarded as being of secondary importance at Brunner and have yet to be classified and studied. They consisted chiefly of rusted iron, generally related to the railway tracks. There was also broken glass, mainly from bottles, bits of shoe leather and very occasional small pieces of ceramic.

Results

As a result of excavation the position of most major features around the coke ovens was clarified, information was obtained about oven construction and use, three elements of a drainage system were revealed and on the south side earlier railway tracks were found to have preceded the later ones known from photographs. In Trench VI some features were excavated which appeared to belong to the early period of domestic occupation, although there was insufficient material for interpretation.

In Trench IX (Fig. 2) the first oven of the south row was located giving the position of the first row of three ovens which were known to have been on a different alignment from later ovens in the row. In the course of locating it, the oven itself was partially excavated. The foundations of the outer wall were stone, probably sitting in or on natural clay. The wall on top had been completely robbed, but is

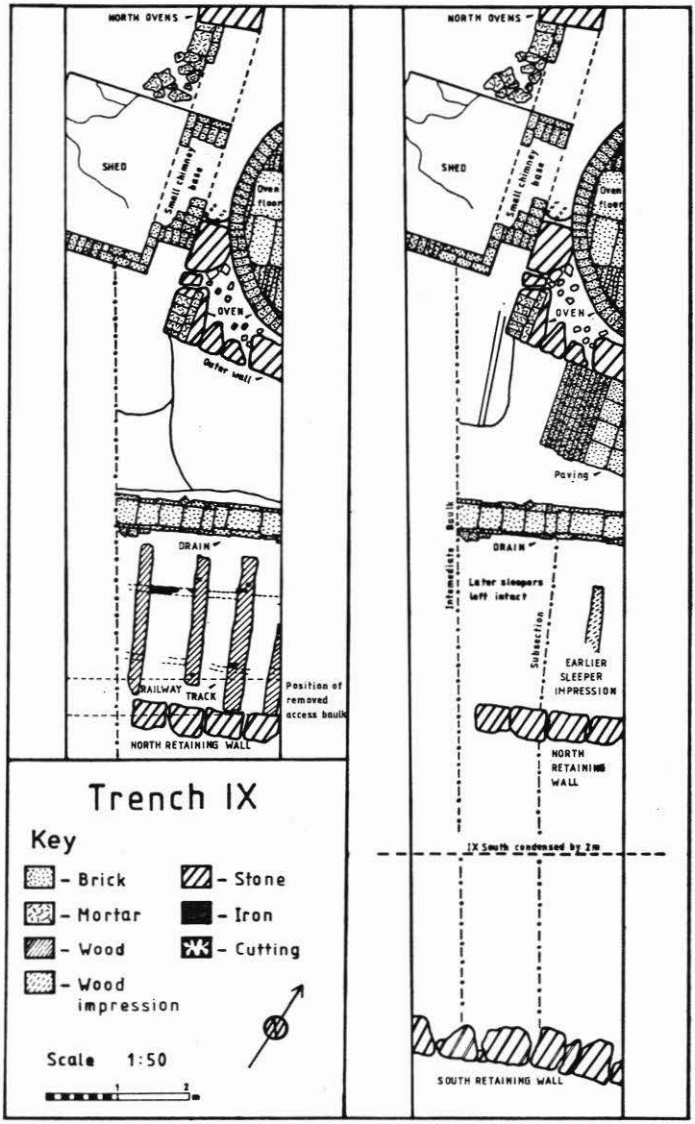


FIGURE 2. Trench IX excavation plan.

known to have been brick from brick impressions found in mortar on top of the stone foundations. It had been presumed previously that the south ovens had a stone facade matching that of the north. The base of the area within the facade walls was packed with insulating material of clay and stones - in places fired red. A raised circular floor of bricks and tiles was built on top, sloping down towards the mouth. Two badly burnt courses of bricks fanning out from the floor was all that remained of the inner beehive oven itself. Evidence elsewhere on the site suggested that the beehives were made of specially manufactured bricks in graduated sizes - some wedge shaped - with identification numbers impressed on them. The area between the inner and outer walls was packed with further insulating material, which had collapsed outwards when the oven was demolished. In front of the oven was a paved working area, over which working debris had gradually built to a considerable depth.

Directly adjoining this first oven to the west was a previously unknown structure, probably a shed of some kind. The partially visible plaster floor and two walls were excavated. The thicker east wall appeared to be the base of a small chimney which had not been noticed previously in photographs of the ovens in operation. The remains of the shed roof were found piled up against its south wall. The shed was built before the north row of ovens and its west wall had been continued north and faced with stone to provide the link between the north and south ovens at the western end. We found no evidence to suggest the function of the shed.

In the course of excavation four different methods of facade construction were found in the three excavation areas. In Trench IX of the 1876 period there was the brick wall on stone described above. Trench VI adjoined two ovens on either side of the half arch. Both of these ovens were thought to have been built in a single construction phase some time before 1884. However, two completely different methods of construction were seen. The west wall, probably contemporary with the earlier railway track, was built of light coloured fire bricks on a foundation of three layers, concrete with pebbles, large fired blocks and more concrete with pebbles. The lowest concrete foundations had been poured directly into a foundation trench cut into clay. The wall on the east side appeared to have been built quite a while later and probably postdated the building of the earlier railway track. It was on a different

alignment (see Fig. 3) to the west wall and was built of softer smaller red bricks on a foundation of concrete and brick splinters. The foundation trench cut into clay had been lined with wooden boxing before the foundations were poured. From this, it would seem that the order in which the ovens were constructed may have been more complex than previously thought.

In the north, the hillside which originally came right down to the back of the first row of ovens had been blasted back to bedrock to provide a reasonably level surface for the later north ovens and their related work area. The stone facade of the ovens was built directly onto a rise in the bedrock.

Air flow to the ovens during the coking process was restricted by bricking up the doors with 'quarles', three of which were found in Trench IX. These were square bricks with central depressions a few centimeters deep for levering out the bricks when coking was completed. In each area adjacent to the oven mouth was a buildup of fine compacted lime/clay and coke dust surfaces deposited during the bricking up of the oven mouths.

On the south side of the ovens remains of earlier and later railway tracks were found on both sides of the coke bagging platform (see Figs. 2 and 3). The earlier lines predated the existing stone retained coke bagging platform. In most cases the earlier tracks and sleepers had been completely removed before the later tracks were built and their position was marked by sleeper impressions and rust staining. They may be the tracks seen co-existing with a wooden coke bagging platform in an early photograph of the ovens. No evidence of the position of this platform was found in the excavated areas, nor evidence of an early roofed cover over the working area in front of the first six ovens.

The later tracks were built on the same alignment as the earlier ones. On the north side of the coke bagging platform the new line had been straightened and levelled when it was laid. On the south side of the coke bagging platform (only excavated in Trench VI) the later track had been raised substantially by the addition of a deep layer of coke. The iron tracks had been removed but the sleepers with points were still in position. These had been previously excavated by Ray Ansin

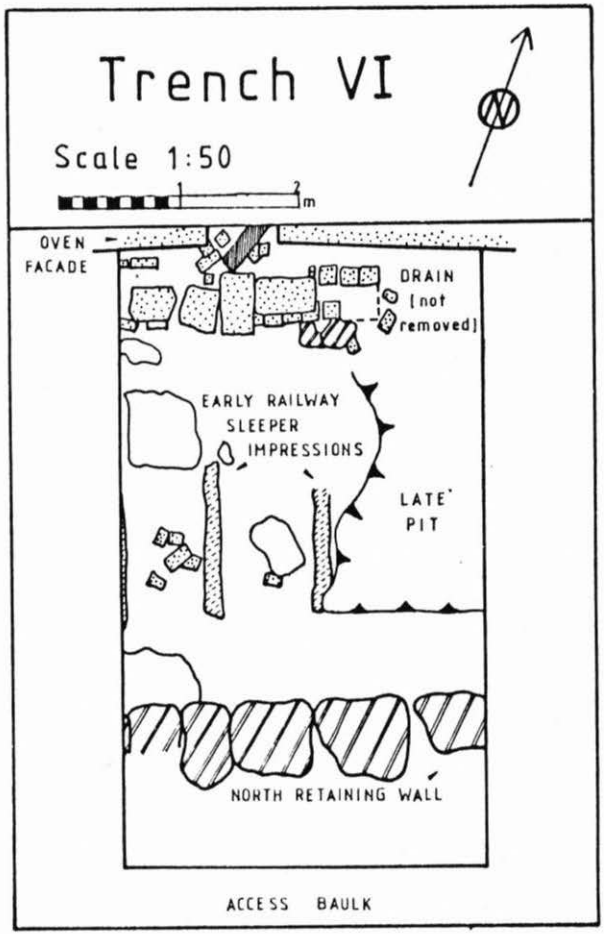


FIGURE 3. Trench IV plan.

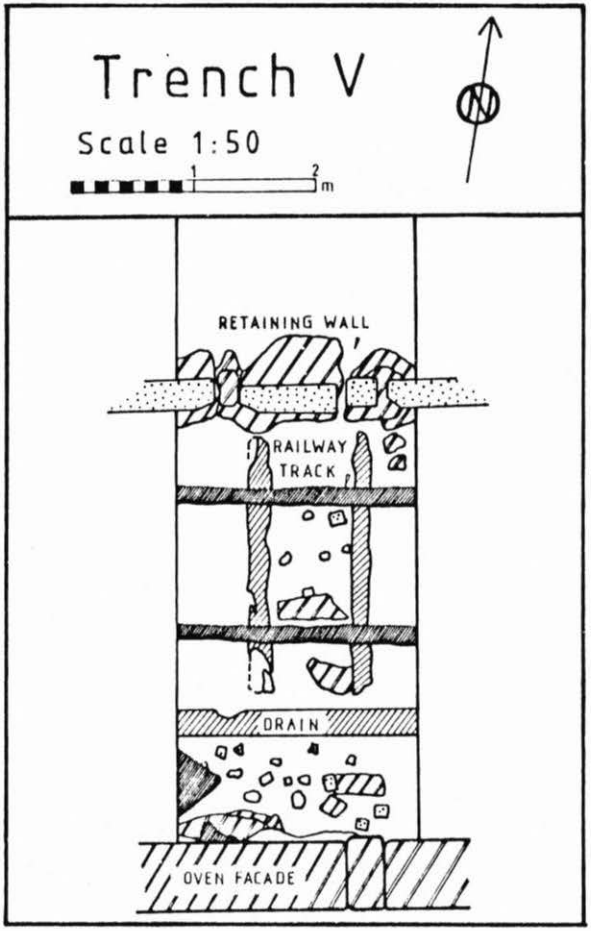


FIGURE 4. Trench V plan.

in 1979. In all cases tracks were laid on coke ballast and were surrounded by coke. Wherever possible materials produced on the site were used for structural purposes.

On the north side of the ovens there had been only one track (see Fig. 4), which was found complete with sleepers and rails. It was laid before the adjacent oven commenced operation. Towards the end of the working life of the adjoining oven it had been covered partially with a thick pad of clay, possibly deliberately as a bridge over the line after it had fallen into disuse.

Both retaining walls for the coke bagging platform on the south side of the ovens were of stone (see Figs. 2 and 3). On the side closest to the ovens it comprised a single course of roughly squared well fitted stone blocks. On the far side, in Trench VI, there were three courses. The bottom two were similar to the north retaining wall and had been laid at the time the earlier railway track was removed. The top course was rougher and was added after the later railway track was in position. The same wall in Trench IX was only one course deep. The area between the stone retaining walls had been filled and levelled with coke and coal.

On the north side of the ovens, the coke bagging platform was constructed differently (see Fig. 4). After blasting there was some further levelling with broken stone from the blasting. A slope in the position of the retaining wall was partially filled with soil and rubble before larger pieces of broken bedrock were placed to provide the edge of the coke bagging platform. This was backfilled to the north with more broken bedrock to provide the initial platform surface. Later when debris including an abandoned pile of lime lumps had built up on the platform, a further course of large fired blocks was added to the retaining wall. These were of unusual shape and had obviously been salvaged from some other structure for which they had been specifically designed. There was some deliberate levelling, then material built up again. There had been little attempt to keep the area tidy. Deposits were allowed to build up over the paved area in Trench IX, rubbish was abandoned in front of the half arch in Trench VI while the ovens were still in operation and in Trench V a pile of metal and other debris deposited when the railway track was new was never removed.

The large drain previously known from the drain entrance north of the ovens and the drain outlet in the river bank passed

under the eastern oven in Trench VI through an archway. It was not related to the half arch in the facade and excavation did not reveal the function of the half arch. A large pit (see Fig. 3) had been dug down to the drain after demolition had already begun on the site, causing the excavator many headaches as it cut through the relationship between the east oven and all other related areas. There was no evidence of an attempt to salvage material from the drain, and the presence of bits of broken drain at the bottom of the pit suggested that the pit was dug to repair the drain, probably during the 1920s or 1930s when some ovens remained in operation while dem lition began on others. Other disturbed material with broken drain pieces around the pit suggested that this was not the first time the drain had needed repair in this area, possibly because of the heavy usage of the track above the drain. The area of track adjoining the drain was supported on large lumps of stone, some of which had fallen into the pit. The drain was constructed of heart-shaped segments of fired material. The bank around the outlet was retained by dry walling of fused bricks and pieces of stone.

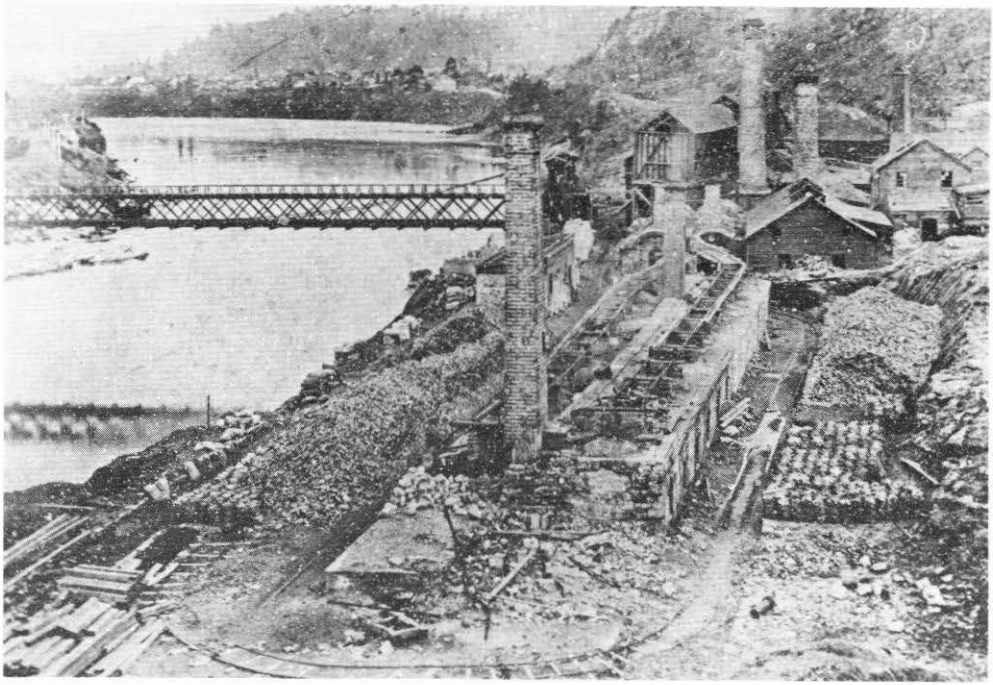
Smaller east-west drains were found on both sides of the coke ovens between the ovens and the bagging platform. They were both late features, postdating the later railway track in the south. The south drain had a tile cover (Figs. 2 and 3). In Trench IX and the eastern part of Trench VI it was of solid brick and tile construction. However in the intervening section of Trench VI under a rusted boiler plate the construction changed to a simple four sided wooden drain with rough brick retaining walls. No reason for the change was found.

In the north the drain was cut down to rock and covered with a wooden plank (see Fig. 4). It did not appear to have been lined although occasional pieces of what appeared to be insulating material were found in the build-up of silt under the plank. Further excavation would be needed to determine the function of these drains and to find their outlet points. They appear to be a feature peculiar to the Brunner beehive ovens.

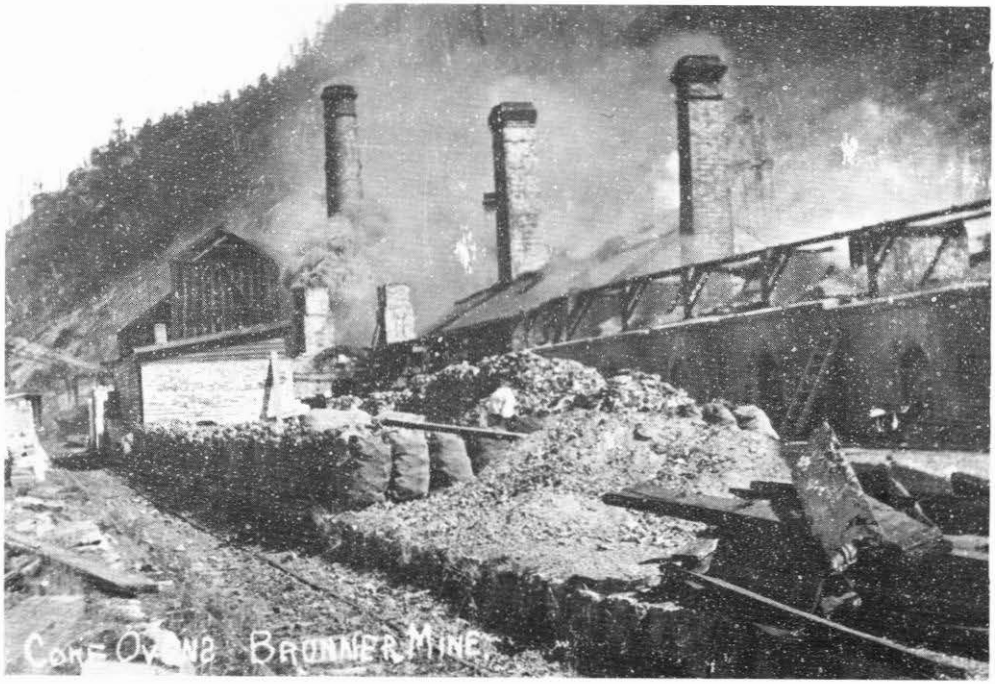
Acknowledgments

Excavation director Robyn Oliver would like especially to thank Assistant Directors, Janet Leatherby and Peter Morgan. The workforce consisted of David Greening, Mark Costello,

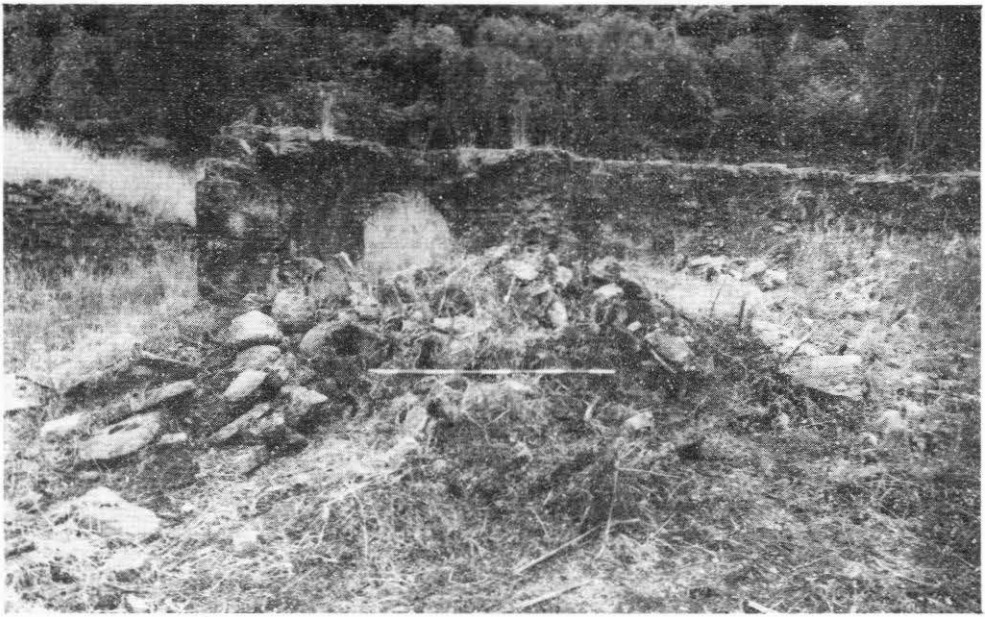
Cherie Inglis, Antony O'Kane, Peter Jones, Hiria Apanui, Julie Coggins, Tania Cairney and Philippa Hughes, all of Greymouth. Thanks are owed to them and also to Charlie Leighton and Ian Linnott who gave occasional assistance. Thanks also to site manager, Lance Beckford, who looked after the team on the site, and Ray Ansin, former site manager, for discussions on his 1979 excavation.



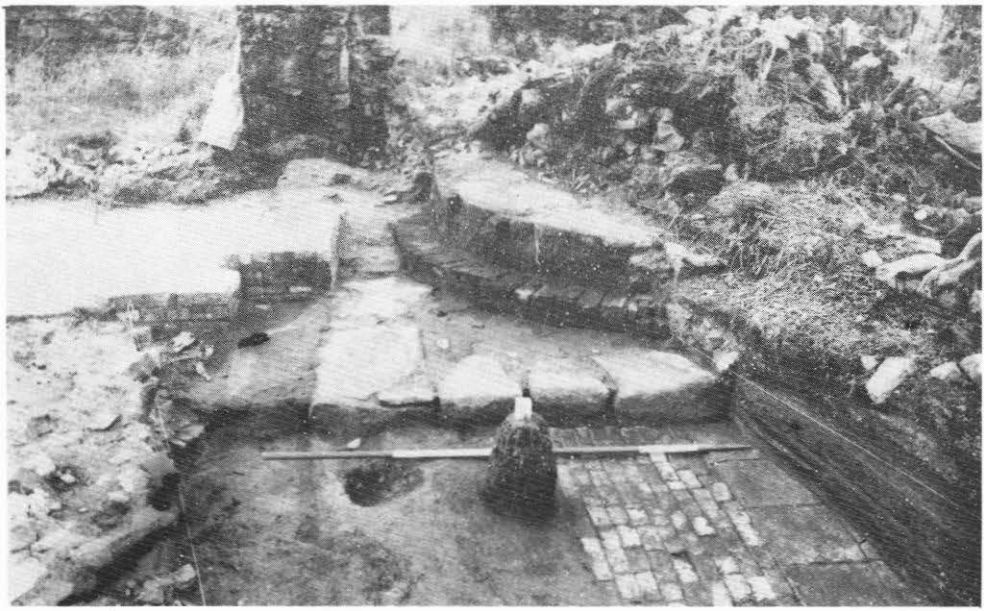
BRUNNER Plate 1. Coke ovens and bagging platforms, early 1900s. Beyond are the bins and brickworks.



BRUNNER Plate 2. Ovens and bagging platform early 1900s, showing stone retaining wall. Chimney at right services the ovens.



BRUNNER Plate 3. Trench IX area before excavation.



BRUNNER Plate 4. Trench IX showing oven and adjacent shed.