

6.2.1 Archaeological evidence of the cableway

The site of the cableway was recorded as S123/148 by N. Ritchie in 1979. The cableway ran from the site of the Phoenix Battery (see section 7.1) to a point just over British-American Spur. The cable is no longer on site, but along its line



Figure 10. British-American Spur cableway ore bucket and hook assembly (held by A. Braden).
Photo: P. Petchey.

eight ore buckets were found lying in the tussock (Fig. 10). The pylons that supported the cable have also now gone. At the point where the cableway crossed the spur there is a scatter of iron artefacts (bolts, rods etc.), some of which have been wired together.

The upper terminal is located on a small spur running into the head of a side gully of Old Man Creek, below the crest of British-American Spur. The upper return wheel is still sitting on the small area of relatively flat ground (Fig. 11), although its timber support frame has long since collapsed. The cast iron wheel itself is in very good condition. It was cast in sections, with the mating faces numbered to aid reassembly. A brake band is attached, to control the speed of the cable as discussed in the contemporary account quoted above. Some other equipment is scattered about, including ore buckets and hangers.

A short adit is located directly above the wheel, below the shoulder of British-American Spur, and a collapsed corrugated-iron structure lies half buried in scree slightly above and to one side of the cableway terminal. A benched track leads away from these sites, around the spur, and across the hillside towards the battery site. This is probably the tramway built by the British-American Company (Perry, Watt and Co.) in about 1866.



Figure 11. Aerial cableway terminus wheel on British-American Spur, 1996.
Photo: P. Petchey.

6.3 MINE SHAFTS

Despite the extensive underground workings of the mines at Bullendale, remains of only two shaft-head structures and one further possible collapsed shaft were recorded during the archaeological survey. This lack of surface infrastructure is due to the fact that much of the winding and pumping at the mine was done underground; an engine shaft sunk on the main lode in 1886–87 was equipped with a Tangye pump at the bottom, and a Tangye winding engine in a chamber near the top. Both were driven by compressed air supplied by electrically-driven compressors in the battery house (AJHR 1887 C5: 46). Contemporary mine plans (see Fig. 7) show that there were at least two underground winding engines at the top of underground incline shafts. Ore was taken from the winding shafts to the surface along the Adit Level. Thus, much of the archaeological evidence of winding and pumping will be buried in the mine. Some evidence of the use of compressed air can still be found; in particular, several compressed air tanks near the Phoenix Battery site and a compressed air rock drill in Murdochs Creek (these are discussed further below).

The surface features that were found in 1996 were the site of the New Main Shaft of 1896 and an earlier shaft beside Murdochs Creek. A large slump near Bakery Flat might be a collapsed rise or ventilation shaft.

6.4 WINDING HOUSE, NEW MAIN SHAFT

In 1896 the Achilles Company sank a new main incline shaft, dipping north at 45°⁸. It was constructed by sinking from No. 2 Level of the mine to a depth of 117 ft, and then rising from the same level to the surface (AJHR 1896 C3: 108). Double lines of rails were laid, with a stairway down one side. The winding was powered by a Pelton wheel that, presumably, used the same water source as the battery (AJHR 1898 C3A: 61). A corrugated iron shed housed the equipment and covered the shaft mouth (Fig. 12).

Figure 12. New Main Shaft winding house. One of the poplar trees on Bakery Flat is visible to the right.
Photo: Hocken Library.



⁸ In 1898 this was given as 54°, steepening to 60° (AJHR 1898 C3A: 61).

Ore was not lifted to the surface level, but rather to 137 ft below the shaft mouth (probably the Adit Level), from where it was taken out along a tramway to the battery (New Zealand Mines Record No. 11, 1901: 466)⁹.

By 1899 when the Mines Inspector visited the site, the shaft had reached a depth of 556 ft (No. 5 Level), reaching 627 ft (No. 6 Level) in 1900 (AJHR 1899 C3: 97; 1900 C3: 25). A new 30-h.p. electric motor was installed near the brace of the shaft to supply power for pumping and winding should the water supply for the Pelton wheel fail. The shaft eventually reached No. 7 Level before the mine closed in 1901 (AJHR 1902 C3: 61). The Mt Aurum Gold Mining Company did not dewater the mine when it acquired the ground in 1903, but instead concentrated on the high ground on British-American Spur.

In the inventory of the machinery, plant, materials and stores on hand at the site in January 1903 (see Appendix 2), the engine house was valued at £400, the winding and pumping gear at £600, and the Cornish Pump at £500, indicating that this site represented a significant investment of capital (Hocken Library, ms 1270, 3-3-8).

6.4.1 Archaeological evidence of the New Main Shaft

The New Main Shaft winding house site is located above the true left bank of Murdochs Creek, just below Bakery Flat (see Fig. 8). It was recorded as site S123/147 by N. Ritchie in 1979. It is covered by regenerating beech forest, but otherwise is easily accessible.

This site is the best-preserved industrial area at Bullendale, with some major mechanical components remaining in situ (Fig. 13). It consists of a 90 ft × 30 ft (27 m × 9 m) terrace cut into the hillside with a track leading past on the downhill side. To the north the track is level, but only runs for a few hundred metres, and to the south it descends slightly and leads towards the site of the Phoenix Battery. Where the track passed the winding house, contemporary photographs (Fig. 12) show a covered loading area.

The mouth of the main shaft (now collapsed and blocked) is at the northern end of the terrace. Two large shallow depressions 2 m in diameter probably mark the shaft entrance. In the middle of the terrace, in line with the shaft depression, are the stone foundations for the main winding gear (Fig. 14). These foundations consist of three parallel supporting walls, each 12 ft 6 in long and 3 ft 9 in high (3.8 m long, 1.1 m high). On these walls is a cast iron winding drum and an intermediate drive shaft. These were originally mounted in bearings bolted to timber members along the tops of the support walls, but the timbers are now rotten and the bearings have been stripped to recover the bearing metal. The main winding drum is 6 ft 1 in (1.85 m) in diameter, and is embossed with its maker's name 'Cossens & Black, Dunedin'. No heavy winding cable is to be seen at the site, and it is likely that this was released down the shaft at some time.

On the north side of the winding gear, beside the shaft mouth location, are the jumbled remains of the shaft head framework, Cornish pump drive and cable guides. The winding house did not have a 'classic' head frame¹⁰, standing high

⁹ The mouth of the shaft is uphill from the battery site.

¹⁰ Surviving head frames of a more conventional nature can be seen at the Golden Progress Mine near Oturehua (Central Otago) and the Big River Mine near Reefton (Westland). These served vertical shafts, and were designed for supporting loads in a different direction to an incline shaft. In particular, they had to support the full weight of the cages hanging below.

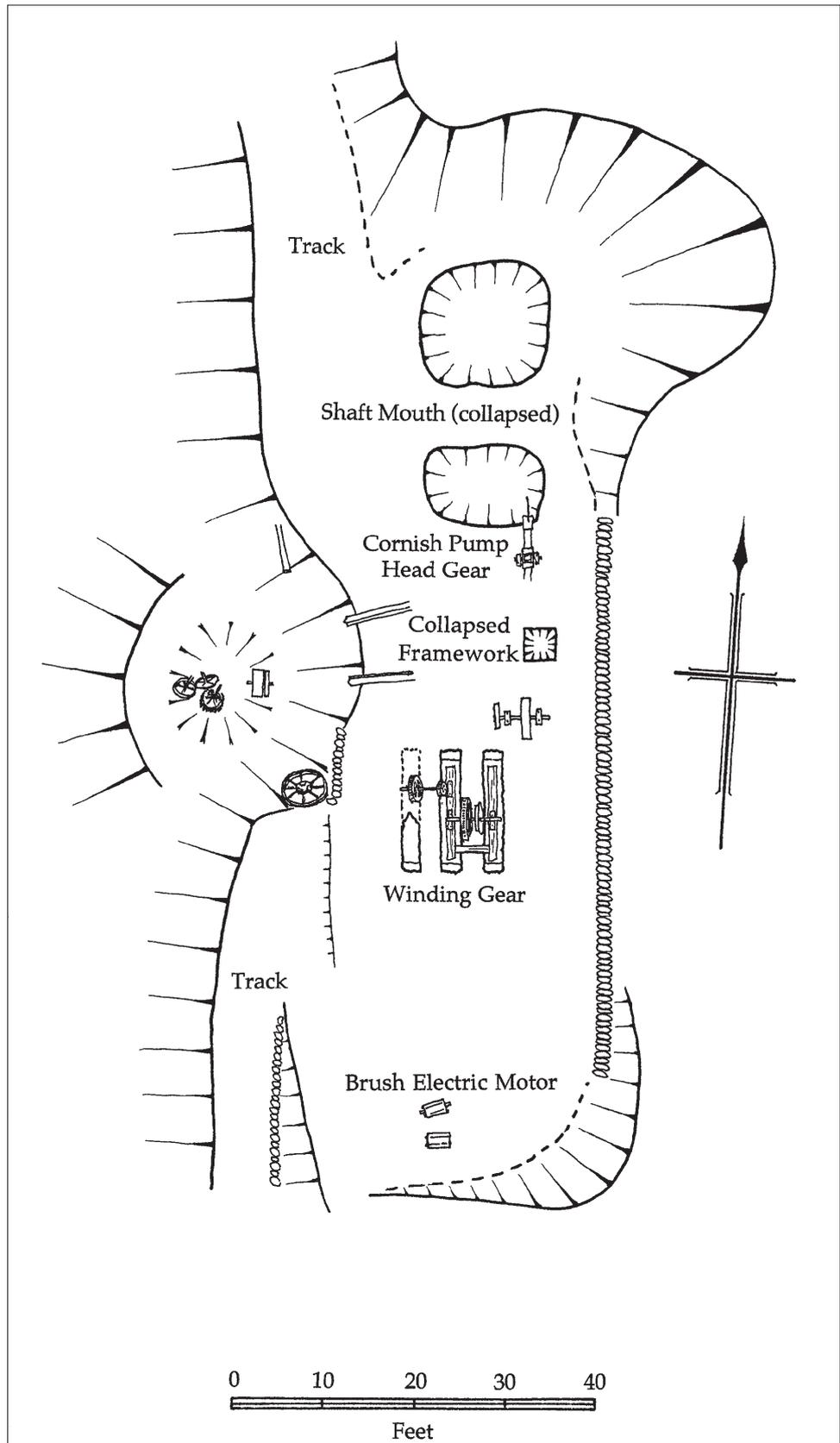


Figure 13. Plan of New Main Shaft winding house site, 1996.

above the shaft mouth, as this was an incline shaft. A low lantern-light roof visible in contemporary photographs (see Fig. 12), together with the jumble of surviving timber framing, suggests that a heavy but low timber head frame was constructed on the south side of the incline shaft.

Near the southern end of the terrace are the dismantled remains of a Brush Corporation electric motor. This is of considerable interest, as it matches exactly contemporary photographs of the original 1886 motor installed in the battery house, and is discussed in more detail below (section 8.2).

There is also a sizeable depression on the west side of the terrace, into which some winding gear had either collapsed or been dumped (Fig. 15). Subsidence into this depression has damaged some of the stone foundations of the winding gear. This depression was recorded as a collapsed shaft in 1979, but no evidence for such a feature is shown on mine plans found to date. The closest likely feature is 'Neill's Winze' on the Otago Level of the mine (Achilles Mine plan 1900).

Figure 14. New Main Shaft, 1996. Cossons & Black winding drum and foundations.

Photo: P. Petchey.



Figure 15. New Main Shaft site, 1996. Collapsed winding equipment on west side of terrace.

Photo: P. Petchey.



Over most of the site there are sections of framing timber, bolts, etc. sticking up through the left litter, suggesting that a considerable jumble of debris lies on the floor of the winding house.

6.5 SHAFT HEAD, MURDOCHS CREEK

The history of this shaft is hard to determine accurately. It is probably the shaft sunk in 1886 or 1887 by the Phoenix Extended Company after they bought the ground from the Otago Company. The shaft was dug to a depth of 150 ft (46 m), and measured 10 ft 3 in × 3 ft 6 in (3.12 m × 1.07 m). It was divided into three compartments, two for winding and one for ladder access (AJHR 1890 C3: 61). A crosscut dug to the south for 100 ft (30.5 m) was not successful, and the ground was sold to the Phoenix Company, who drove to the north, cutting the lode. Mining operations were then carried on for a period using both this shaft and the New Main Shaft (discussed above, section 6.4). An inclined hauling winze connected the north cross-cut to the lower levels of the mine (Levels 2, 3, 4 and 5). A contemporary photograph of a shaft head at Bullendale (Fig. 16) is possibly of this site.

Figure 16. Murdochs Creek shaft head and mine workers.
Photo: Hocken Library.



6.5.1 Archaeological evidence

The site of this shaft is on the true right bank of Murdochs Creek, immediately below the site of the New Main Shaft winding house on the hillside opposite (see Figs 8 and 17). A cutting has been made into the side of the creek bank to accommodate the head frame. The shaft is now blocked at a depth of about 2 m. A pipe (possibly a compressed air line) protrudes from the blockage. Two 64-in (1.63-m) diameter cable pulleys are sitting beside the shaft. These would have been mounted on the top of the head frame to guide the main winding cables going down the shaft. A scatter of iron artefacts in the streambed downstream from the site at the time of the survey included the remains of several shaft cages.

6.6 SHAFT NEAR BAKERY FLAT

A depression to the south of Bakery Flat may be the result of a mine collapse. The location is approximately above an underground winding chamber at the head of an incline shaft, and it is possible that the depression is a collapsed ventilation rise. The 1900 mine plan (Fig. 7) shows a rise from a cross-cut on the Adit Level close to the winding chamber.

6.7 OTHER SURFACE WORKINGS

Although the British-American Spur workings are now the most visible surface evidence of underground mine workings at Bullendale, the most extensive workings were actually those of the Phoenix/Achilles Mine, which reached a depth of over 600 ft (180 m) below Murdochs Creek. The main access to these workings was by the two shafts discussed above (sections 6.3 to 6.6). A number of the upper levels were accessible by cross-cuts from the surface, and although all of these had collapsed by the late twentieth century, three were reopened in 1991 by L.A. Baker of Aurum Reef Resources (Baker 1992).

These three adits were still open in 2005 (Fig. 8), although they were not re-entered during the archaeological survey. Baker's (1992) report provided the following description of the Adit Level:

'The Adit Level [Baker called it the 'Low Level' adit] stood in good condition for a distance of approximately 250 m. The cross-cut to the vertical and incline shafts was blocked by what appeared to be detritus from the blocked shafts. Entrance to the Adit Level stopes was blocked by a fall at the compressed air chamber.'

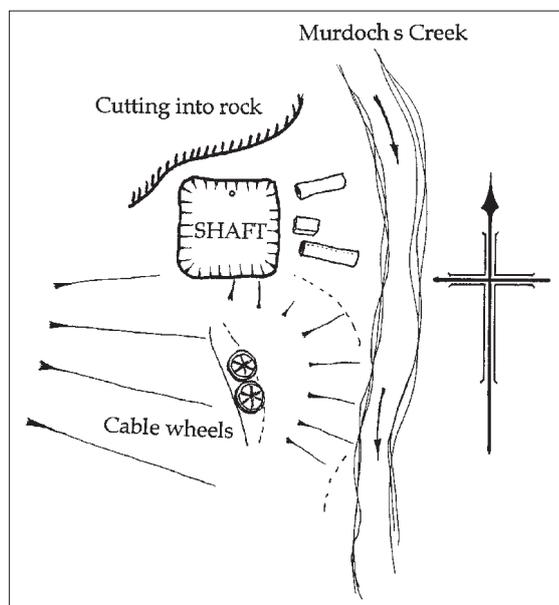


Figure 17. Site plan of Murdochs Creek Shaft.

In 2005 this adit was discharging mine water into Murdochs Creek.

Baker (1992) found that the Otago Level adit was blocked a short distance underground at the first stope. The No. 3 Level adit appeared to intersect a low-grade reef about 20 m from the entrance. Access to the south lode reef drive and the cross-cut to the middle lode was gained, but both were blocked by falls within 200 m of their intersection (Baker 1992). Tramway rails were visible in place in this adit in 2005.

Two Holman Bros. compressed air rock drills were lying beside Murdochs Creek near the mouth of the Otago Level adit at the time of the 1996 survey, but by 2005 only one could still be found. These illustrate the use of compressed air for underground mining operations, using air supplied by compressors in the battery house.

7. Battery sites and associated features

Two battery sites are easily located at Bullendale: the Phoenix Battery and Southberg's Battery. A third battery—the 1866 20-stamp mill of the British-American Company (AJHR 1866 D14: 5)—was located on the true left of Skippers Creek downstream from the Phoenix Battery site. The 1866 topographical map of Skippers Creek District (S.O. 1513) shows 'Perry's Machine' in this location, but the site was not found during the 1996 field survey. All of the machinery has probably been removed from this site.

7.1 THE PHOENIX (ACHILLES) BATTERY

The first reference to a battery being set up at Bullendale (then referred to as the 'Scandinavian Reef') was that of the Scandinavian Company in 1864. This was a 4-stamp mill powered by a water wheel, both of very rough construction. It was working by May 1864, although with little success (AJHR 1866 D14: 4). Presumably this battery was on the site of the later Phoenix Battery, as the Scandinavian Company later became the Phoenix Company. New machinery was ordered from Melbourne in 1866 (AJHR 1866 D14: 5) and installed in 1867 (AJHR 1875 H3: 53), this being the 30-stamp mill that was in use (with numerous modifications, renewals and upgrading: see Appendix 1 for the recorded changes) until 1907 (Fig. 18). There were many alterations made to the battery throughout its working life, the most historically significant being the decision to power the mill by electricity. The first mention of this plan was made in 1884, in response to the lack of water for the water turbine during dry weather because of a shared water right (presumably with the Otago Company) (AJHR 1885 C2: 11; *Lake Wakatip Mail*, 5 Dec 1884: 2).

As this was the first time that a battery had been powered by electricity in New Zealand (if not the Southern Hemisphere), and the battery had earlier been for a period the largest such mill in Otago, it aroused a great deal of interest. As a result, the Phoenix Battery was described in detail a number of times during its life, which included the publication of a sectional elevation of the plant in the 1887 Handbook of New Zealand Mines (Fig. 19). However, electric power was never the solve-all that was hoped, and in the last years of the mine's life (under the ownership of the Mt Aurum Company in 1904-07) the battery was solely powered by water.

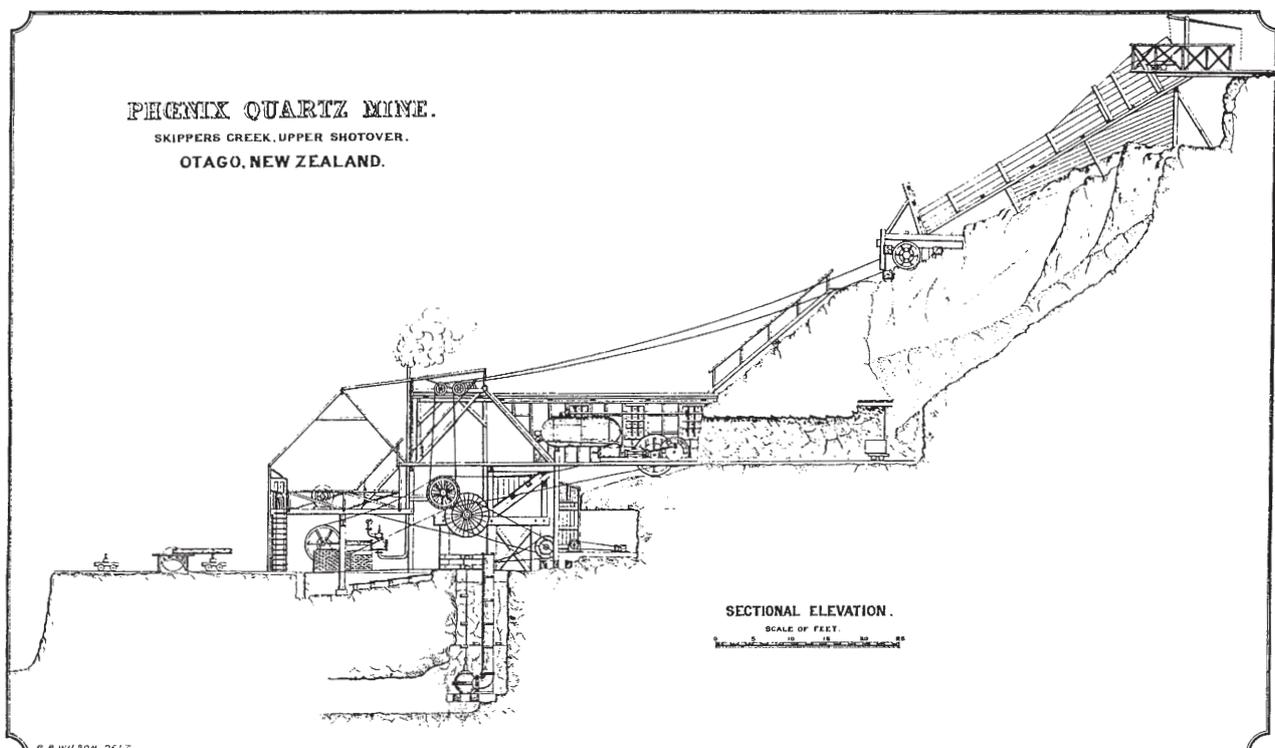
A description of the battery in 1886 reproduced in De La Mare (1993: 26-27) stated that the battery house measured 45 ft × 85 ft (13.7 m × 26 m), with the turbine sunk 20 ft (6 m) below the floor. The 1887 cross-section of the building (Fig. 19) shows that the electric motor and the water turbine were in place at the same time. It also shows a steam engine in use, powering the rock crusher and air compressor (see also Handbook of New Zealand Mines 1887: 54). Contemporary photographs (Fig. 18) show the building as a large timber structure built on a revetted terrace at the junction of Murdochs and Skippers Creeks. A curious roof line and gable end suggests that the building was originally a slightly smaller double-gable structure that was modified and enlarged at least once, with the valley between the original twin ridges being roofed over to increase the internal space.

An inventory made of the machinery, plant and materials of the Achilles Company in 1903 lists all of the machinery in the battery house, winding house and mine. The 30-stamp battery was valued at £200. Also listed were three electric motors (one old, £60¹¹; two new, £664), two air compressors (£350), one amalgamating barrel, one shaking table, one stone crusher (£80, presumably the Kincaid & McQueen machine of 1886), six Pelton wheels (two of these wheels were possibly those at the dynamo site), one berdan pan, plus numerous spare stamper shoes, tappets, tools, pumps etc. The list is reproduced in full in Appendix 2.

Figure 18. Phoenix (Achilles) Battery, c. 1887.
Photo: Hocken Library.



Figure 19. 1887 elevation of Phoenix Battery.
Illustration: *Handbook of New Zealand mines, 1887.*



¹¹ This was probably the original 1886 electric motor.

The battery closed for the final time at the beginning of the winter of 1907, as the Mt Aurum Gold Mining Company did not resume operations the following spring. It is not certain how much material was sold or removed at that time, but much of the heavy machinery was simply left in the battery house as it stood.

As previously described, the battery house was burnt down in about 1920 by P. Lynch to retrieve the ironwork from the roof. It is likely that much of the easily portable material and equipment was removed during the shortages of World War I, when many of the nearby houses were shorn of their iron.

7.1.1 Archaeological evidence of the Phoenix Battery

The Phoenix Battery site is at the confluence of the Right Branch of Skippers Creek and Murdochs Creek. It was recorded as Site S123/140 in 1979 by N. Ritchie. Figure 20 shows the site as it was in 1996, and can be compared with Fig. 18 that shows the battery house in c. 1887. Figure 21 is the site plan as recorded in 1996. As these views show, the site has been badly disturbed. While some of this is due to human agency, most damage to this site has been caused by flooding of Murdochs Creek. A schist spur shields the site from the force of the flood waters from Skippers Creek, but also serves to turn the Murdochs Creek waters across the site. As a result, a channel has been scoured through the



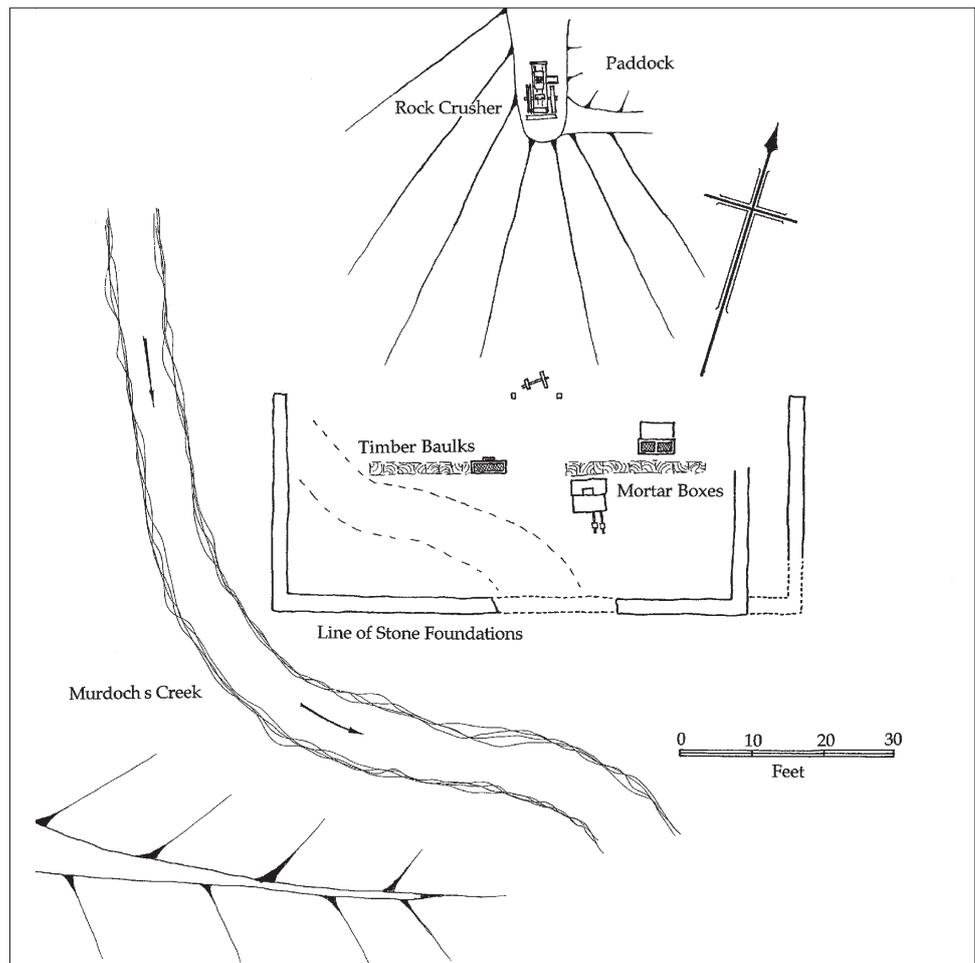
Figure 20. Phoenix Battery Site. Rockcrusher is on knob in upper centre of view. Fallen stampers and flood damage visible on flat. Note items of machinery lying in creek. (B. Ahern, now deceased, but formerly with DOC Queenstown, in foreground.)
Photo: P. Petchey.

site of the battery house, although the schist foundations for the building remain relatively intact. They measure 65 ft 6 in × 31 ft (20 m × 9.5 m), and are 28 in (0.7 m) wide. While this is smaller than the 85 ft × 45 ft quoted in De La Mare, this may be due to the full extent of the foundations no longer being visible, particularly at the back of the site where material has slipped from the slope above. Alternatively, the figures given by De La Mare may refer to an enlarged battery house that extended beyond the original foundations. The wall foundations only just stand proud of the present ground surface, but a section exposed where the stream has cut through shows them to be some 4 ft (1.2 m) in depth.

At the back of the battery house, against the foot of the hillside, there are the decayed timber baulks for a 30-stamp mill. Only one iron mortar box is still standing on these, while two others lie fallen, one containing two stamper shafts. One mortar box measured 62 in × 16 in × 53 in high (1.57 m × 0.40 m × 1.35 m). They were constructed with cast iron bases, and sheet iron upper halves, so they could be dismantled for the haul into Bullendale¹². In the centre of the stamper foundations is a gap, behind which are two charred posts standing in the schist scree from above. Between these posts lie (partially buried) two belt pulleys on a shaft. The well for the water turbine that was located in the gap between the two banks of stamps has filled with debris and is not apparent. Several turbine rotors

¹² While discussing the difficulties of transporting equipment along the Skippers Road, the Mines Inspector in his annual report commented that 'the heavy castings have to be made in pieces, and bolted together when they reach their destination, which is not a desirable thing in stamp boxes, as the vibration caused by the stamps loosens the bolts, and causes them to wear and allow the crushed material to go through the bolt holes, carrying with it gold.' (AJHR 1885 C2: 3).

Figure 21. Plan of Phoenix Battery site.



were found scattered about the site (two Whitelaw rotors in Murdoch's Creek and an outward flow radial rotor in Skippers Creek), but firm association of an item with any single particular site is not now possible.

On a schist knob above the battery, sits the Kincaid & McQueen rockcrusher that was installed in 1886 (Fig. 22)¹³. It is still in good condition and reasonably intact, although several pieces have gone missing in recent years. However, its timber supporting frame has decayed, and the unit is sitting at an angle, supported on one side by its flywheel resting on the schist spur. Between the crusher and the battery site was the paddock for the ore, from which material was fed to the stampers via an ore pass (see Fig. 19). This ore pass has either collapsed or is full of loose material, and cannot now be located. The end of the tramway that supplied the crusher has largely slipped away. Nothing remains of the ore chute or tipper mechanism for the ore carts.

The flat on which the battery house is situated runs along the true left bank of Skippers Creek for about 35 m past the east wall of the battery. At the eastern end of this flat there is a stockpile of battery fines. These are coloured orange, and are probably quite poisonous, as there is no plant colonisation even after 90 years¹⁴. Two tanks are located beside this stockpile, both made from cut-down fire tube boilers. One is lying on its side, while the other is upright and filled with battery sands.

¹³ It was recorded as site S123/141 in 1979.

¹⁴ Peter Mason reported that he had an assay done on these fines in the early 1970s, when they proved to contain very high concentrations of arsenic (P. Mason, pers. comm. 1996).

Figure 22. Kincaid & McQueen rockcrusher. Note decayed support timbers.
Photo: P. Petchey.



A considerable amount of other machinery lies scattered about, much of it half buried in the streambed gravels. The visible items of machinery are listed in Appendix 3. Some items may be associated with the shaft sites and Southberg's Battery site up Murdochs Creek, having been washed downstream during floods. To the west of the Phoenix battery house, on the right bank of Murdochs Creek, sits the lower cable wheel from the 1904/05 aerial cableway to British-American Spur. This is discussed in more detail above (section 6.2). An iron berdan lies three-quarters buried in front of the battery house, while two compressed-air tanks and a water turbine rotor (mentioned above) lie downstream of the battery site. The air tanks are identical in appearance to those shown in Fig. 19. The depth to which some of this equipment is buried suggests that a great deal more equipment is also likely to be obscured under stream gravels.

Thus, although the battery site has been badly disturbed by flooding and scouring, some of the major features have survived. The surviving timber posts bear evidence of the 1920 fire which destroyed the building, while the timber stamper foundations confirm the 30-stamp size of the mill. Despite the stream having at one time cut through the battery house, the stone foundations have survived well. As the 1866/67 battery was constructed with 30 stamps, and was never expanded beyond this size despite numerous modifications, it is likely that the basic layout as visible in 2005 dates from that time. Of the original 1864 battery there is no sign. Presumably it was on the same site, and hence completely destroyed during the construction of its successor.

7.2 SOUTHBERG'S BATTERY

The Otago Quartz Mining Company (of Southberg, Murdoch and Olsen) erected their battery in 1865 or 1866; mining surveyor Wright commenting that 'the excavation for the battery site is a heavy piece of work, cut in the solid rock' (AJHR 1866 D14: 6). It was located in Murdochs Creek, above the Phoenix

Company's battery site, and was powered by a Whitelaw turbine (2 ft 6 in diameter), with three arms, working under a 57-ft head of water (Otago Gazette Vol. XI, 1867: 228). The tramway to the battery from the mine workings was constructed entirely of timber.

In early 1875, G.H.F. Ulrich visited the mine during a survey of the quartz mines of Otago, and wrote a good description of the battery and gold-saving appliances (AJHR 1875 H3: 52-53):

'The crushing plant of the Otago Company consists of sixteen heads of revolving stamps, in four batteries, fed by hand, and driven by a turbine at a speed of about 60 blows per minute; weight of stamps, 6 cwt.; lift, only 5 to 6 inches; gauge of gratings, which are punched, 122 holes per square inch. The arrangements for gold saving for each battery are as follows: The stuff passes in succession over a shallow mercury ripple, two and a half feet of copper plate; two blanket strakes, four feet long; a rather narrow mercury ripple, with a five inch drop; and two blanket strakes of six feet in length. Both the lower and the upper strakes are two feet wide, and lie, in front of two batteries, at an inclination of one inch and a half per foot; in front of the other two, at one inch and a quarter per foot. The blanket-sand, which is very rich in pyrites, after being merely washed by tin-dish and in a strake, is left to decompose by exposure to the atmosphere, and is then passed again through one of the batteries, with gratings of 225 holes per square inch. Mr. Southberg knew that on account of the large quantity of pyrites much quicksilver was being floured and a great deal of fine gold lost, and he seemed inclined to adopt the Clunes system of appliances I recommended.'

Little mention is made of the company throughout the latter half of the 1870s, but in 1880 'Southberg & Co.' found some good stone after extensive work in opening a cross-cut that had been destroyed in 1878 (AJHR 1880 H26: 27). However, this does not appear to have come to much, and the battery (and presumably the ground) was bought by the Phoenix Extended Company in the late 1880s. In 1889 the battery was sold for removal, and the ground sold to George Bullen (of the Phoenix Company) (AJHR 1889 C2: 57).

Only one contemporary view showing the battery house was located (Fig. 6), and this is quite indistinct. It shows the battery house in the cutting down beside Murdochs Creek.

7.2.1 Archaeological evidence of Southberg's battery

The site of Southberg's battery is on the true right bank of Murdochs Creek, a short distance upstream from the Phoenix battery site. It was recorded as site S123/143 in 1979. As reported in 1866, the site has been cut into solid rock, the cutting measuring 60 ft × 35 ft (18 m × 11 m) (Fig. 23). It is above the level of Murdochs Creek, and so has escaped bad flood damage. However, the scatter of iron artefacts in the creek bed immediately downstream of the site suggests that some material has been lost, probably as a result of erosion of the site.

While the site is easily accessible, it is overgrown with grass and ferns, so that much ground detail is hidden. Also, material spalling off the rock cutting has built up around the back of the site. Two fallen mortar boxes are lying beside their timber foundation baulks at the south end of the site (Fig. 24). They are both constructed from cast-iron bases with sheet iron tops bolted together. Three stamp rods are in one mortar box, while a two-piece camshaft carrying eight cams