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EXCAVATION OF THE PHOENIX QUARTZ MINING COMPANY'S DYNAMO SITE, SHOTOVER VALLEY, CENTRAL OTAGO

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In January 1985 an excavation was conducted at the site of Phoenix Quartz Mining Company's dynamo generating plant in the left hand branch of Skippers Creek, a tributary of the Shotover River. The site has special historical significance because its commissioning in March 1886 marked the first time that hydro-electricity was used in New Zealand for industrial purposes. Reefton, the first town in New Zealand to be illuminated with electric lights was not 'lit up' until 4 August 1888 (Thornton, 1982:144).

Although the historic merit of the dynamo site was appreciated when it was recorded in 1979, it was not until late 1982 that renewed interest in the remains was initiated by Mr R. Aspden, a senior engineer in the Ministry of Works and Development's head office, Wellington, during the course of a private research project on early New Zealand generating plants. His interest also stemmed from a desire to see the plant restored or interpreted in some form to highlight the historical and technological significance of this first industrial use of hydro-electric energy in New Zealand. He approached other government departments and suggested a timely deadline for any form of restoration project would be March 1986, i.e. one hundred years since the generating plant was commissioned.

In early 1983 the author was approached to undertake a more detailed field assessment of the remains and produce a report on behalf of all the agencies interested in the generating plant so that a more definite course of action could be initiated. A report, which summarised the history of the plant, detailed its operation and components and presented restoration, interpretation and management options was produced (Ritchie, 1983).

During 1984 an 'Electricity Generation Centennial' committee was established (with representatives from N.Z.E.D., M.W.D., N.Z.H.P.T., L. and S. and the regional Power Boards) to investigate ways of celebrating the centenary of the two events, i.e. the first industrial and public uses of hydro-electricity in New Zealand. Several events are planned. With regard to the Phoenix dynamo, a decision was made in conjunction with the land managers, the Department of Lands and Survey, that a fitting and constructive way to celebrate the Phoenix Company's achievement was to reassemble the main components of the plant on-site, in a manner which facilitated interpretation

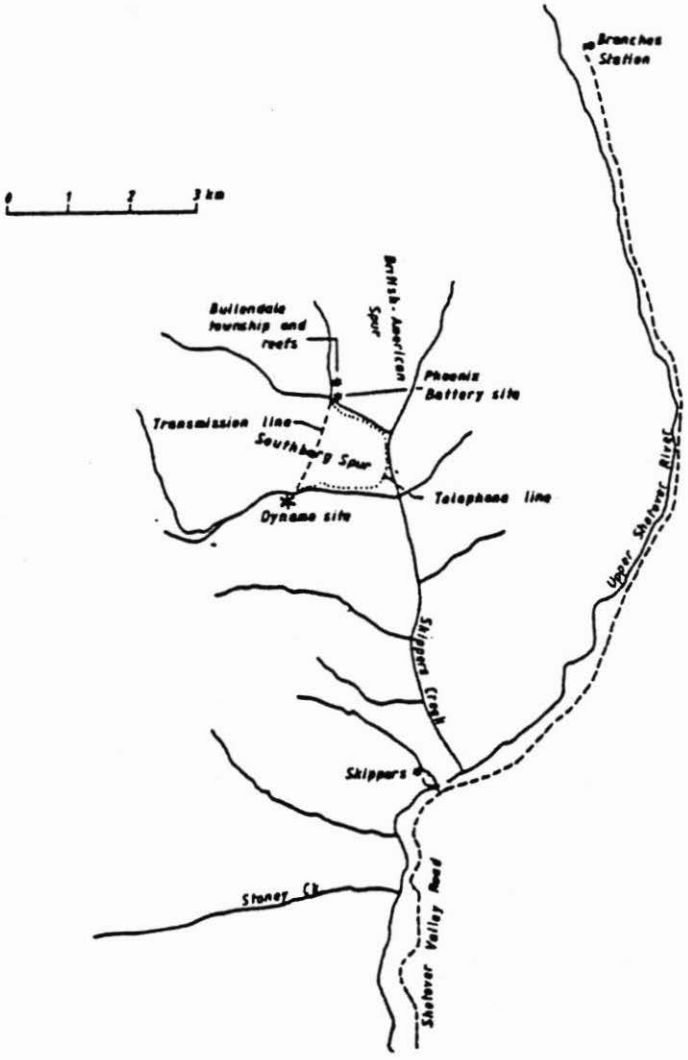

FIGURE 1. Pheonix Dynamo site location map.

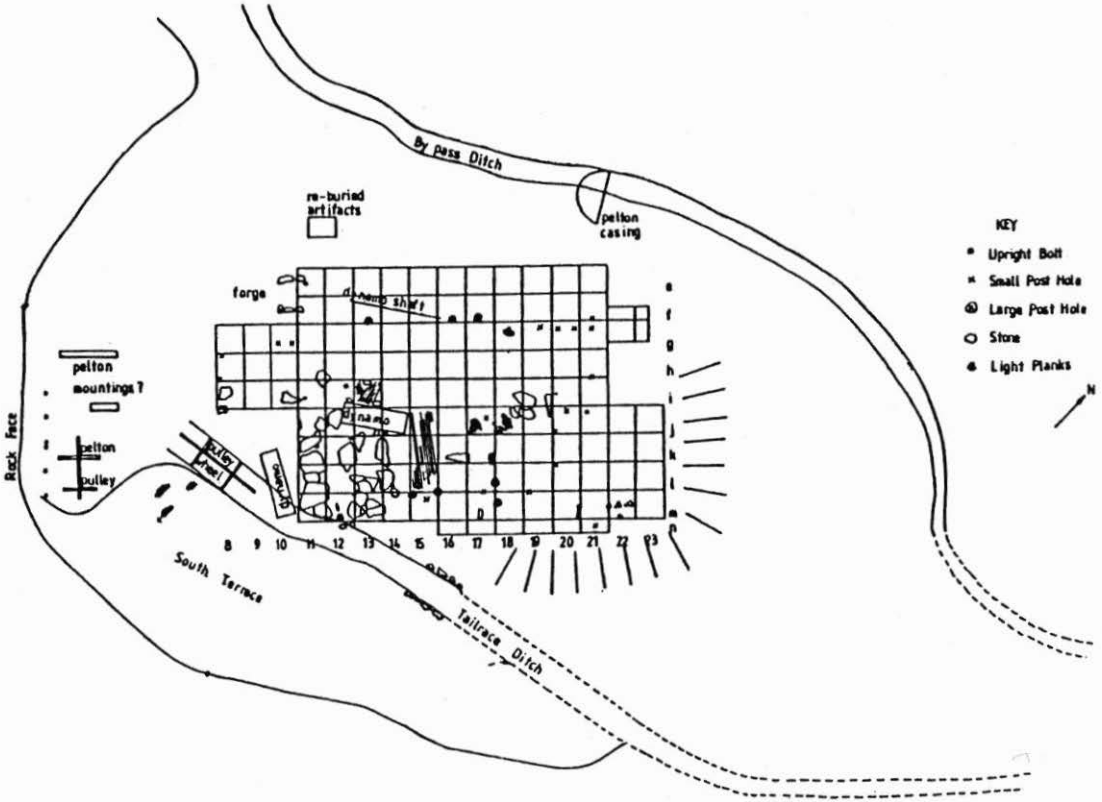

FIGURE 2. Pheonix Dynamo site excavation plan.

and required minimal maintenance. This proposal was possible because the major components of the original generating plant were never removed, although they have been repositioned over the years by people in quest of the copper windings and other non-ferrous fittings. However, although the general position of the power plant was evident from field observations, specific locational details, which were needed in order to faithfully re-establish the plant on-site were lacking. To provide this information, the Trust's Cromwell office was commissioned to carry out an archaeological excavation on the site. This work was conducted in the week 14-21 January 1985.

The objectives

The specific objectives of the excavation were to:
1. clear the site and determine the position and orientation of the powerhouse structure,
2. determine the position of machinery as evidenced by mountings, etc.,
3. map site features,
4. recover portable artefacts or missing pieces of machinery, and test midden deposits, and
5. make recommendations for on-site development and interpretation.

The setting

The Phoenix Company's power scheme utilised water conveyed 2 km in an open race from Skippers Creek to a point at the top of a steep rock face behind the generating site. From here the water descended through pipe penstocks (with 186 feet of head) into a powerhouse building where it drove two pelton wheels, which in turn powered twin electric dynamos. The water was then discharged into a tailrace which diverted it back into the creek below the powerhouse. The DC electricity was carried by a 6 km line to the Phoenix Company's battery, mining site and settlement at Bullendale (refer fig. 1).

The excavation

The structure. Before the excavation there were no surface indications or visible remnants of the wooden framed, corrugated iron building which originally housed the dynamos. It was demolished about 1930 and the materials used to build four structures elsewhere in the Shotover, including the nearby Dynamo hut (which was used as quarters by the archaeologists). However, the general layout of the scheme was apparent. The powerhouse was situated on a small partially levelled terrace at the base of the penstock slope (marked by steel stanchions which

supported the pipes). The maximum extent of the powerhouse was demarcated by the perimeter of the terrace, the position of the tailrace and heavy machinery components such as the pelton wheels, drive pulleys and shafts and the dynamo mountings. The floor area of the original building was also known, 50 x 20 ft (Lake Wakatip Mail, 2 April 1885).

Using this information as a guide to the extent of the structure, a random pattern of test pits was excavated across the site in an attempt to find traces of wooden or stone flooring or wall footings which might still be in situ. Although several isolated stone slabs were located, no coherent pattern could be detected, except in the south-east corner where several were exposed on the surface. However, in the course of this work some post holes and post butts (beech) were encountered. In order to make sense of the post butt/hole pattern, the terrace area was systematically deturfed. The result was a rather bewildering pattern of largely unaligned post holes and shallow foundation butts, although the two long walls of the building were reasonably clearly defined (Fig. 2). These gave the building a north-east - south-west orientation and indicated that it was built square to the penstock slope, although there was still some doubt with regard to the exact positions of the end walls. After the excavation, a previously unknown photograph of the powerhouse (an exterior view) was located. This confirmed the orientation of the structure and showed that it extended up to the base of the rockface.

It was concluded that the floor of the original dynamo building was made of heavy timber (long removed) supported by a rather unsystematic pattern of foundations consisting of solid beech posts (buried ca. 50 cm deep) along the side walls and shallow post butts in the interior. The random pattern of stone slabs and interior post butts possibly indicates that the floor sagged and was propped up in places at a later date. Two angled steel stanchions with dangling remnants of No 8 wire were found ca. 2 m beyond the inferred north-east end of the structure. A similar stanchion was found ca. 3 m out from the north-west wall. They suggest that the building had some external bracing added at some stage.

The collapsed remains of a stone forge were uncovered about 1.5 m beyond the north-west side of the structure. Although it may have been covered by a roof or lean-to, there was no evidence of postholes in the immediate vicinity.

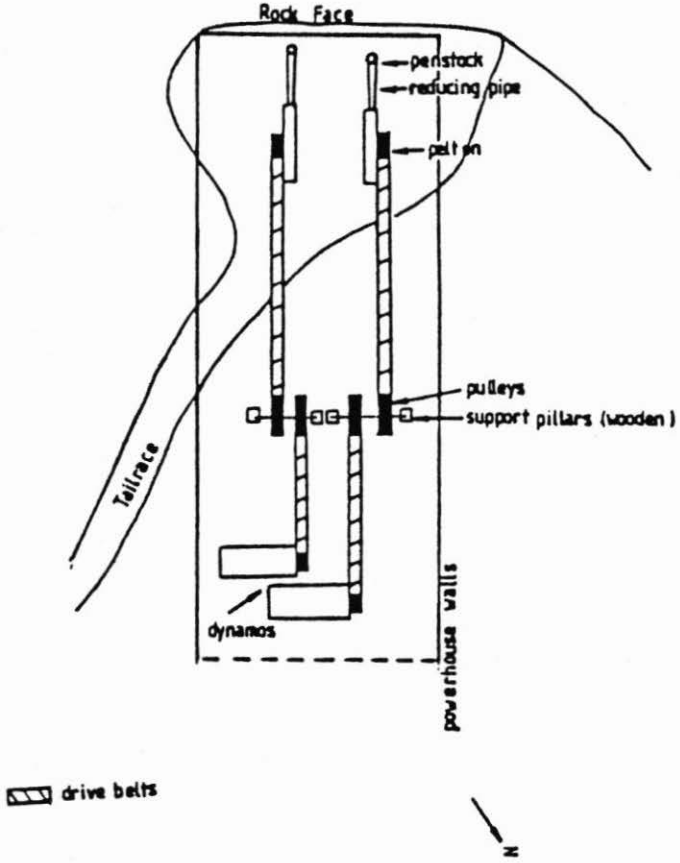

FIGURE 3. Schematic plan showing position of the main components.

Internal layout. Few positive indications of the exact positions of the machinery were uncovered. The inferred positions are as depicted on Figure 3. The pelton wheels were located at the rear of the powerhouse. They were mounted on a heavy timber framework (part of it still remains) which was built out over a depression (the water discharge basin) at the foot of the penstock slope. The penstocks were connected to each pelton wheel by reducing pipes (one was recovered). The motive power from the peltons was transmitted via separate drive belts (ca. 5 m long) to large double pulleys mounted on two elevated pillars. The energy was then independently transferred via further drive belts (ca. 4 m long) to the two dynamos (Ritchie, 1983:9). In the absence of 'built in' concrete or other heavy mountings, the machinery must have been securely bolted to a wooden floor which has been completely removed from the site. This contention is supported by the fact that in the south-west quarter of the structure ten threaded steel shafts protrude 50 cm above the ground. As the distance between them does not correspond to that of the bolt holes in any of the machinery mountings, they would appear to be additional floor supports, and were probably used to support the actual dynamos. Each dynamo unit weighed three tons (Lake Wakatip Mail, 19 March 1886).

During the excavation several lost components of the generating equipment were uncovered. These included a shaft from one of the dynamos, two keyed clutch units, a worm drive, pulley shaft mountings and the brackets believed to have been used to secure the dynamos.

Stratigraphy and artefact distribution. Prior to the excavation the site was covered with a dense turf mat ca. 9 cm thick. The sole cultural layer (Layer 1), a compact brown soil was immediately below the turf zone. Layer 1 had an average depth of 6 cm and overlay of clayey, gravel-rich natural soil (Layer 2). Many of the artefacts were found on the Layer 1 and 2 interface. Part of the tailrace ditch was also excavated after test pits revealed portable artefacts and machinery fittings.

The distribution of portable artefacts indicates that the south-west end of the structure was the powerhouse proper, whilst the north-east end was an open area used for repairs and maintenance. The extent of the work area was inferred from the distribution of the artefacts, which included broken insulators, fragments of mica insulators, H shaped armature spacer plates, miscellaneous electrical fittings and tools. A second work area was defined along the north-west side of the structure, and to the north of the forge. Here, con-

centrated in rows/squares E and F12 to 15, considerable numbers of artefacts were uncovered. These, in the main, consisted of nails (both roofing and structural), broken ceramic insulators, occasional pieces of sheep bone, glass (particularly Symington's coffee bottles), tin cans (predominantly tobacco and condensed milk), 'H' shaped armature spacers, numerous metal offcuts, bolts, nuts, washers and worn horseshoes. Roofing and structural nails were widely scattered across the site. Most of them were probably discarded during the demolition of the abandoned powerhouse. Pieces of the unique drive belts made of leather links connected by steel rods were also widely scattered over the site. Only artefacts which were reasonably complete, or were deemed to be useful for illustrative, comparative or displayable purposes were removed from the site. The others were recorded and reburied in a pit beside the forge.

Discussion and conclusions

Although the structural evidence (particularly the positions of stone slabs and the posthole patterns) was not as clear-cut as we would have liked, the excavation achieved its basic objectives in confirming the orientation and position of the powerhouse building. It is clear that the machinery was mounted on raised wooden decking (probably a one level floor) which was demolished and removed, along with the rest of the building, ca. 1930. The inferred layout of the plant is depicted in Figure 3.

Artefacts were widely scattered within the building site but concentrated in the two areas described above. Another small concentration of refuse was located on the smallterrace on the south-west side of the tailrace. Although the artefacts have not been studied in detail yet, seven 'use categories' or activities are represented

1. Structural remnants: principally nails (n=343, both wood-nails and lead headed types for securing corrugated iron), nuts and bolts.
2. Machinery components: the main machinery components plus securing brackets, pulley mountings, bearing shells, a lock pin, drive belting, etc.
3. Electrical components: ceramic insulators, copper and tin armature spacer plates, sheet mica insulators, miscellaneous electrical fittings and carbon electrodes.
4. Repairs and maintenance: an improvised oil can, a solvent tin, nail or paint drums, tools (including engineers hammers, files, screwdrivers, a machine spanner, a reamer, a crank handle, a shovel, a wedge and a drill bit), plus numerous

bits of slag and metal offcuts around the forge.
5. Sustenance: sheep bones (only a few bore evidence of butchering), coffee bottles (Symington's of Edinburgh), condensed milk and meat cans, worcester sauce bottles (Lea and Perrins, and Holbrook's), pickle jars, a salad oil bottle, and whisky and beer bottles (11).
6. Personal and miscellaneous: wax vesta boxes (3), medicine bottles (including Davis Vegetable painkiller and an 'A J White of London'), tobacco tins, teaspoons, tin (2) and ceramic cups (2), pocket knives, fragments of leather work boots, braces adjusters, shirt buttons (2), belt buckles and fragments of linoleum. The only identifiable matchbox was a Bedford Type 9a which postdates 1895 (Bedford, 1985).
7. Horses: discarded worn horseshoes (21, in 2 sizes) and numerous horse shoe nails scattered around the forge, and harness buckles.

Most of the artefacts are types one would expect to recover in an isolated 'machine' site which was used ca. 1900. They reflect the construction of the building (a timber framed, corrugated iron clad structure), the operation and maintenance of the machinery, and remains of the clothing and food used by the plant operators. The food remains are probably derived from the operators' lunches and smokos, rather than the refuse discarded by anyone who lived permanently on the site. The contents of the alcohol bottles may have been partly used for fortification against the winter cold. (An alternative explanation could be that the recorded frequent breakdowns of the overloaded machinery drove the operators to drink). The concentration of discarded horseshoes and horseshoe nails around the forge suggests that one or more of the plant operators was a farrier or blacksmith and may have regularly shoe'd his own or the company's horses whilst keeping an eye on the machinery.

Recommendations for on-site development

These have been presented separately to the agencies concerned. Briefly, they recommend the establishment of an 'on-site monument' using the major components of the generating plant which are still there. They would be repositioned and secured in their original contexts with appropriate pictorial and historical interpretation on nearby photo-metallic plaques. The powerhouse building would simply be depicted by four corner 'posts'. If the re-establishment work is to be completed in time for the centenary of the plant's commissioning, it must be finished by March 1986.

Acknowledgements

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