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The Hart's Shaft Cornish Plunger Pumps: Historical Archaeology in an Operating Underground Gold Mine

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It is rarely possible to re-enter the workings of abandoned underground mines for archaeological recording purposes. Flooding, decay and collapse of mine timbers; stress release in wall rocks, toxic gas accumulations, oxygen depletion and lack of natural or forced ventilation make old workings very dangerous places. Occasionally however, the re-opening of an historic mine provides a rare chance to document the remains of previous mining phases and the Tasmania Goldmine, in Beaconsfield, 40 km north of Launceston, Tasmania, is one such case. Water was a constant problem in the workings of the Tasmania Mine and the technological problems associated with its economic removal form one of the main themes in the mining history of the Beaconsfield Goldfield.[1] This paper describes the *in situ* archaeological recording[2] of two plunger pump units that were abandoned at the bottom of the Hart's Shaft when the mine closed in 1914. The machines were recovered from the mine in 1998 and now comprise the most tangible relics of the dewatering efforts of the Tasmania Gold Mine.

History of the later pumping machinery of the Tasmania Gold Mine (1903-1914)

James Roberts, a lime worker, discovered gold-bearing quartz in the Beaconsfield area, on the western shore of the Tamar River estuary, in 1847.[3] He initially failed to recognise what he had found but later prospected the area without success. It wasn't until alluvial gold was found in Brandy Creek by the Dally Brothers in 1870 that small-scale gold production began.[4] In 1877 the Dally's discovered the rich Tasmania Reef on the north slopes of Cabbage Tree Hill and this triggered larger scale prospecting and the opening up of the small but rich alluvial diggings. The alluvial gold was soon worked out but the Tasmania Reef was developed by the Tasmania Gold Mining and Quartz Crushing Company (formed in 1877) with five of the Dally brothers as shareholders.[5] The Tasmania Mine rapidly became the most successful gold mine in Tasmania and by the time it closed in 1914, it had produced 832,478 ounces of gold.[6]

In May 1903 the directors of the Tasmania Gold Mining and Quartz Crushing Company were approached by a group of English capitalists who wished to purchase their mine. They approached the Government Geologist about whether there was adequate geological reason to invest in the deeper development of their mine and received the advice that the reef was still living and strong at the 1000 Level. However, further development would require a major capital investment in even larger pumping machinery with a capacity to raise 6,000,000 [27,300,000 litres] to 8,000,000 gallons per day. On the strength of this advice, they decided to sell the mine and the Tasmania Gold Mining Co Ltd was incorporated on October 2, 1903.[7]

Additional pumping plant was decided upon and the extension of Harts Shaft (the ‘deep shaft’) was commenced to receive the first pump unit. The directors decided that the new pumping plant should consist of three horizontal compound condensing Hathorn-Davey pumping engines, each with 50 inch [127cm] high pressure cylinders, 108 inch [274cm] low pressure cylinder, using steam at 150 pounds [67kg] pressure, with each capable of working a double series of 20 inch [50.8cm] plunger pumps to a depth of 609m.[8]

By 1904, the company had made ‘a determined effort’ to control the water in the mine[9] with new pumping machinery that had a capacity of 6.5 million gallons of water per 24 hour period at normal working speed (eight million gallons at high speed).

During 1906, Harts Shaft was sunk a further 9.6m to a depth of 353m. At the 400 level, two balance-bob chambers were completed (each 11.6m by 3.9m by 8.8m) as were two chambers at the 900 level. The shaft was enlarged from the 1050 level to the 1100 level to make room for two 20 inch [50.8cm] plunger pumps (these machines were probably those transferred to the 1370 Level, where they were found in July 1998, see below). On the surface, the foundations for the second and third units of the pumping plant (Grubb’s Shaft) were completed and both engines were erected together with air separators, condensers and auxiliary engines. A flood gate was installed at the 1100 level.[10]

The elements soon put the new equipment to the test when heavy rains caused the Blythe Creek diversion channel to overflow. The approach of the water could be felt in the mine within 23 hours and the deeper levels eventually flooded. By the 30th of July the water had reached its highest point at 242m below the Main Shaft collar.[11] However, the investment in new plant paid off. It was found that the new units at Harts Shaft and the old pumps on Main Shaft could only lift 4,500,000 gallons [20,475,000 litres] of water per day when worked to their full capacity.[12] This was insufficient to cope with the water influx and large tanks were put to use in the winding compartments of Harts Shaft, which allowed an extra 500,000 gallons per day to be added to the mine outflow. This was still insufficient and it was not until the newly installed eastern pumping unit at the nearby Grubb's Shaft was started in early September that the water could be controlled and the level in the mine eventually reduced.[13] Within a week, about 8,100,000 gallons a day was being raised[14] but it still took some months to dewater the mine.[15] On the 6th of December 1906, the fourth unit on the west side of Grubb's Shaft was started and, like the eastern unit, lifted water from the 1000' level.[16]

Despite water inflows hampering the work, the tandem sinking of Grubbs and Harts Shaft continued through 1907 and 1908 and the workings of the two adjacent shafts were linked by a crosscut on the 1100' Level. This was used as a waterway between the two shafts when required.[17]

Eventually the old Main Shaft was decommissioned and the pumps dismantled and the Grubb's and Hart's Shaft pumps provided the primary drainage of the entire mine from the deeper levels, raising water at a rate of 4,500,000 gallons a day.[18] By 1908, the new pumps were easily controlling the water and the heaviest flow on any one day was 4,894,700 gallons [22,270,855 litres].[19]

As Grubb Shaft reached a depth of 419m another linking crosscut was commenced to Hart's Shaft from a plat cut at the 1250 Level.[20] Further sinking of the shaft was curtailed due to ore haulage demands and it was not until the new crosscut was completed in 1908 that sinking could be resumed.[21]

On the 3rd of June 1909 an extremely heavy burst of water (between 8 and 9 million gallons) was cut on the 1250 Level and the mine was flooded for eight weeks. Owing to a breakage of part of the pump pitwork, no ore could be produced and the battery had to close for 2 months. Apart from the pump repair work, all underground work ceased.[22]

As the sinking of Hart's Shaft passed below the 1250 Level, heavy water inflows convinced management to extend the shaft to 424m by rising from the deeper Grubb's Shaft development.[23] Grubb's Shaft was sunk to 424m and a westerly connecting drive was developed towards Hart's Shaft. Heavy inflows of water were encountered during this new development work but this was considered to be an advantage in that it minimised the danger of an overwhelming burst when the lode was cut.[24] It must have been after this connecting drive and rise were completed that the

Harts Shaft plunger pumps were installed on the 1370 Level; where they remained until July 1998. While water inflows could be managed, additional development delays were caused by coal shortages brought about by strikes in Newcastle.[25]

Grubb's Shaft was sunk a further 9.3m to a total depth of 474m in 1911 and a crosscut was driven at the 1500 Level. Permanent pitwork was installed in the new eastern pump chamber and the western chamber was nearing completion.[26] Presumably, this means that the original 20" plunger pumps were moved to this new deeper chamber. The deepening of Hart's Shaft continued a further 8.2m to a depth of 433.4m and a plat was cut at the 1370 Level.[27] This was probably the point at which the plunger pumps were moved from the chamber between 325m and 341m.

Despite all of the capital investment and development work, the mine does not seem to have made any significant profits and at the end of 1913, Mr Arthur Llewellyn, a mining engineer was sent from England to report on the mine. As a result of his investigations, which "fully coincided" with those of the Mine Superintendent, Mr C F Heathcote, it was decided to close down the mine. In April 1914, mining operations ceased and the pumping machinery was turned off.[28]

By May 1914, water was rapidly accumulating in the Hart's Shaft workings and urgent moves were taken by the local community and the State Government to reopen the mine.[29] A meeting of miners and company employees was held on Monday the 25th of May 1914 and a co-operative party was formed to work the mine. The pumping machinery was restarted and it took ten days to dewater the mine.[30] Their efforts eventually failed and the mine closed for the final time the on the 21st of November 1914.[31]

From November 1914 onwards the Tasmania Mine remained dormant and the company focussed on its tailing retreatment operations at the Middle Arm Battery. In 1918, the Regional Inspector of Mines reported that the work at the mine was 'concentrated on breaking up the machinery that is unsalable as such, and realising assets generally'.[32] By April 1919 the company's new low grade slime treatment plant had failed and the remaining 23 employees at the reduction works and mine were dismantling and breaking up any machinery that could not be sold.[33] This is probably when the rising mains were removed from Hart's Shaft. The plunger pumps must have had not saleable value and been too large to remove for scrap, so they were abandoned in the shaft.

Redevelopment of the Mine

The Tasmania Mine was re-developed by Beaconsfield Gold NL and Allstate Explorations NL in the 1990's and as dewatering of the workings progressed, many ferrous and non-ferrous metal artefacts were found preserved in good condition. The survival of organic materials is remarkable and well-preserved mine timbering, pump rods and iron flood prevention doors were found. Balance beams from a large pumping mechanism were discovered still in place during shaft rehabilitation, so it was thought possible that part or all of the original underground pumping mechanism may remain at the base of the shaft. If so, the machinery was likely to be in good condition, possibly salvageable, and would represent a very significant surviving part of the mining heritage of Beaconsfield.

Figure 1: *The right hand plunger unit of the Hart's Shaft plunger pumps.*

Source: The author.
The view shows the lower part of the cylinder and its connection to the cylinder limb of the 'H' piece. On the upper left of the unit can be seen the rising main clack valve box and the stub of the right hand rising main. The left hand unit can be seen in the background and the twin pump rods between the two units. Note shaft timberwork.

In June 1998, mine development broke through into the base of the Harts Shaft on the 415 metre level (the former 1370 foot level). Two well-preserved plunger pump mechanisms and their associated timber mountings were found to be still in place in a pump chamber but buried under rock, soil and timber rubble that had fallen down the shaft in the previous 82 years (Figure 1). Initial inspections by mine staff suggested that the pumps were probably salvageable. Mine personnel recognised the historic significance of the machinery, so the area was carefully cleared of rubble using pelican picks and shovels. During clearance of the chamber a felt or leather miner's cap of possible Cornish style (with preserved candle grease) and a pine gelignite box (containing several long bolts and some gasket fragments) were discovered. A wooden picket shaft gate was also found intact.

Redevelopment of the mine required the pump chamber area to be re-utilised to house modern steel work and a spillage chamber, so the historic machinery had to be removed. The company planned to salvage the mechanisms so that they could be restored and reconstructed as an exhibit at the adjacent Grubb's Shaft Museum, along with other items that were mentioned above. To facilitate this reconstruction, the company commissioned the author to undertake an archaeological survey of the machinery while it still remained in position. The work had to be carried out in an underground working environment, around an open shaft, with members of the mining crew present for assistance.

Underground mine archaeology

The pumps lay at the base of Hart's Shaft, the main access route to the operating mine. For safety reasons, work was restricted in the shaft while the archaeological survey was taking place, so all work had to be completed within a single 12 hour shift. The pumps were scheduled for removal four days after the survey and so there was only one opportunity for *in situ* recording.

No accounts were found in the available historical archaeology literature to guide the methods for an underground mine archaeological survey, so the author drew upon his previous underground mine geological mapping expertise to record the site features. The *in situ* positions of the machinery and major timber sets and planking were mapped using a tape measure and plans were compiled at the site on waterproof drafting film overlain on graph paper. Upright timber sets and cross bearers were first planned in and then used as the base lines for the rest of the survey. The positions of the machinery, timber platform decking and pump rods located within the centre of the chamber were all plotted by measuring their positions relative to the timber sets. Two scaled plans were produced (Figure 2). A second survey was undertaken to document the timber pump mountings after removal of the machinery and a third plan of the pump platform deck was produced. Details of the engine mountings, timberwork and the chamber were recorded photographically.

Pumping machinery of the Harts Shaft

The surviving Hart's Shaft pumping machinery is characteristic of the 'pitwork' of a Cornish pumping system as described by Drew and Connell, [34]though with some minor variations. The 1904 quotation document presented to the Tasmania Mine by the engine manufacturers, Hathorn Davey Co of Leeds (UK), still survives at the Grubb's Shaft Museum and refers to plunger pumps, balance beams, spear rods and rams; terms that are all typically used in a Cornish pumping system; so the pump component names defined by Drew and Connell for the South Australian mines are used in this paper.[35]

The historic pumping machinery and related infrastructure that remained *in situ* at the base of the Hart's Shaft on the fourth of July 1998 is shown in Figure 2A. It consisted of the following:

- A mirrored pair of 20 inch [50.8cm] cast and machined iron plunger pumps arranged across the short axis of a specially excavated pump compartment. The plunger pumps lay side by side, towards the side of the shaft, with the pump rods in between and with inspection hatches facing outwards. The paired pump rods were placed between the two pump units and continued past the units and into a timber-lined sump compartment below. At the time of discovery, the plunger pump casings were coated with a ferruginous concretion that had formed at the interface between the cast iron and the debris that had buried them. The iron castings of the valve boxes and some bolts were oxidised to a depth averaging around 3 centimetres. Some deeply oxidised components such as nuts and bolts were exfoliating iron oxide flakes. The arrangement of the machinery in Harts Shaft differs from a typical Cornish pumping arrangement in that there are two units in place, which operated in tandem, as a paired set.[36] While one unit was on the up stroke, the other unit was on the down stroke. When finally switched off in 1914, the left hand machine had been on the down stroke and the right hand machine was on the up stroke.
- A mirrored pair of offset assemblies that connect the pump rods with the plunger poles (pistons) utilising a wooden spacer beam. The assemblies were held together by four heavy 'U' bolts. In a Cornish pump, energy is transferred from the surface pumping engine to the plunger piston by a plunger 'offset' assembly.

Such assemblies were in place on both pumps in Hart's Shaft. Each plunger was attached to an offset rod that was bolted to the pump rod, but with a spacing beam between them. They thus formed a triplicate beam assembly. The assemblies were held together by four heavy, squared off iron 'U' bolts. The main pump rods continued downwards, past the offset assemblies, between the two cylinders and into the sump compartment.

- The stubs of a paired set of pump rods (with their strapping plates) that drove the plunger units. The rods were largely removed during the shaft clearance work but had once extended to the collar of Hart's Shaft and were projecting from the collapsed shaft when redevelopment commenced. The pump rods were connected to balance-bob mechanisms installed in excavated chambers higher in the shaft. Components of the balance bobs are now preserved at the Grubb's Shaft Museum.
- An excavated pump chamber measuring approximately eight by four metres that was formed by the belling out of the base of the shaft (Figures 2A and 3).
- Two shaft winding compartments with intact shaft timberwork that included sets, lining slats and cage skids; timber working platforms and decking planks.
- A remarkably well preserved timber pump mounting framework and timber decking,
- Twinned timber water cisterns with legible carved Roman numeral depth indicators,
- A fully timber-lined sump compartment below the pumps,
- Remnants of 2 severed cast iron pipes, projecting from the cisterns below the plunger pump platform, that may relate to the 14 inch bucket (suction pump) mechanism that is recorded as being present in 1906[37] or they may represent cistern overflow pipes.

Missing components of the pump mechanism

A Cornish pumping system typically consists of two components, the plunger pump, described above, and a suction pump or 'bucket'. The role of the suction pump is to draw water from the sump into the cisterns, from where it can be pushed up the rising mains by the plunger pumps. In July 1998, there was little evidence remaining for a suction pump or equivalent mechanism in the pump chamber at the 1370 foot level and no obvious means of raising water from the sump to the plunger pump cisterns was observed. A 14 inch [35.36cm] suction pump was recorded as being present in 1906 when the plungers were installed in a chamber between 1050 and 1100 feet [325m and 341m] in the shaft. So unless the suction pump was removed some time after the plunger pumps were transferred to the 1370 foot level (around 1909), then an alternative means of supplying water to the plunger pumps must have been developed.

If a suction pump (or pumps) was installed on the 1370 foot level, it must have been located within the timber-lined sump and would have been driven by the movement of the pump rods that continue below the plunger platform. However the rods end two to three metres below the pump rod guide immediately below the pump platform and there is no visible evidence that a driving mechanism for a 'bucket' was ever attached to them.

There is a slight vertical offset of the rods where they hang in the sump, which is of the same magnitude as the height of the plunger pistons (Figure 2A). The offset of the rods is the result of the opposing movement of the compound pumping mechanism which drove the rods; one on the upstroke while the other was on the down stroke. The offset of the rod ends suggests that they were the same length before the pistons and rods finally settled to their final positions. It also shows that salvagers did not sever the rod ends after the machinery stopped because this would probably have resulted in the rods being cut off at the same level.

There are wooden slats mounted on all four sides of each rod. They are approximately 4 metres long and only extend to just below the wooden rod guide. They do not extend all the way to the end of the rods. The slats fit accurately into 'female' counterparts in the wooden guide that is built across the sump (just below the platform). The function of the slats appears to have been to keep the rods accurately aligned while in motion.

The presence of the slats suggests that there have not been any sections removed from the rods during later salvage operations and adds support to the theory that the rods did not have a suction mechanism attached to their ends. The pump rods appear to have been designed to only extend to the pump rod guide below the platform and no further. There is no evidence that any suction pump mechanism was attached to the rods below the plunger pump platform.

Each plunger pump unit must have had separate rising mains to carry the water to the surface. It is likely that the mains were of a similar diameter to the rising main stumps that remained on the top of the 'H' pieces of each unit. Neither piping, nor corroded remnants of piping was encountered during the clearance and rehabilitation of the Hart's Shaft, so the rising mains were probably removed by salvagers, along with everything else that was saleable, at the time of the mine closure.

Plunger pump mounting platform

All underground machinery was bedded on a wood-decked platform that extended into the pump chamber from the level of the plat floor. When first exposed by modern development the decking was mostly obscured by mounds of accumulated debris that extended into the plat area and the plungers were buried to the bases of the rising mains. After clearing, the timber platform decking was found to be built from heavy wooden boards measuring 10 cm by 2 cm thick and of variable lengths, lain across the short and long axes of the sump, with some other timbering of variable sizes. This decking covered most of the platform, except for a central rectangular area where the pump rods passed through into the sump below. Many of the decking boards had been moved during operations to make the work area safe. Where this was obvious, the disturbed boards have been omitted from the drawn plans (Figure 2B).

A 3.5 metre long, roughly shaped beam lay across this opening on the winder compartment side. It had rough notches about 1.5 metres long cut into either end and was bolted to the supporting framework structure. This beam appears to have acted as a pump rod guide (Figure 2B). Two well-cut bearers lying between this beam and the central winding compartment each held an iron 'eye bolt' with circular iron ring which may have functioned as anchoring points for block and tackle cables (Figure 2B). Both beams were bolted to the underlying framework structure.

The wooden platform was built onto a framework of timber bearers (sets) built over the top of the sump. The plungers were mounted on this platform is such a way that they were suspended over the compartment and the pump rods could extend down into it (Figures 2A and 2B).

The square set framework supporting the platform probably consisted of four vertical, approximately 3 metre high, squared 30 x 30 centimetre timbers arranged at each corner of the underlying sump chamber. Only two vertical timbers were actually visible in the modern breakthrough area. The third and fourth vertical timbers are inferred to have been in place on the winding compartment side of the square set but were not actually seen. The height of these timbers is only estimated, as their bases were obscured by collapsed debris and mud. Squared timber cross bearers (30 centimetre by 30 centimetre) were extended between each standing bearer to form an approximately cubic framework.

The main load carrying strength of the square set frame was produced by continuing the 15 x 30 centimetre sump lining timbers upwards into the square set frame. This was done on three sides of the structure. Liners were extended 3 metres above the collar of the sump to the underside of the platform to close in the square set framework in a 3-sided box-like structure. The liners were carefully fitted together and were bolted to the timber uprights of the set.

Beneath the actual bed timbers of the plunger pump units were two (?) horizontal 30 x 30 centimetre wooden bearers which had been lain across the open sump compartment and rested on the stacked timber liners. They were probably bolted to the liners. These timbers probably formed the base for the actual wooden pump bed beams which lay directly above them.

The extended lining of the sump appear to have formed the main load carrying role in the structure as the machinery was seated directly onto it. The timber sets supported the decking timbers and provided the attachment mountings for the liners.

The 'H' pieces of each plunger unit were bedded directly on timber. The rising main limbs of the 'H' pieces of both units were bedded at either end of the same two 3 metre long squared off beams that sat one atop the other to a height of 60 centimetres. The plunger beds probably sat atop the two bearers located directly beneath them, which had been lain over the sump compartment between the two cistern sides. In this arrangement, the rising main sections of the 'H' pieces actually overhung the sump chamber while resting on the timber bearers. The piston/cylinder limbs of the 'H' pieces were supported by the windbore base plate which rested directly on the timbers of the sump lining.

What is most notable about the timber pump beds is that there was no evidence found to suggest that the plunger units were held in place by mounting bolts. No such bolts were seen by the miners removing the plungers, none were in evidence during the first survey and none were exposed after the pumps had been removed. So it is likely that the plunger units were held in place by their own weight, that of the missing suction pump units, the rods and the fine balance of the entire mechanism.

Higher up in the shaft, each plunger unit did have a heavy iron 'U' bolt that was mounted around the cylinder, just below the stuffing boxes. Associated with the 'U' bolts on each cylinder were rectangular metal plates against which wooden chocks were placed to brace the units against a shaft set. The 'U' bolts were anchored to a timber shaft set. Another timber set stretched across the shaft at the ladder way may also have helped to support the plunger cylinders at the 'U' bolts as the stuffing box flanges appear to have partly rested on it.

The 'U' bolts were corroded through by the time of the survey and appear to have mainly served to steady the upper part of the cylinders, possibly at the location where greatest movement in the units might occur during operation, and a cross piece that extended across the chamber

Wooden Cisterns

A mirrored pair of rectangular wooden cisterns, constructed from heavy timber planking, was built into the edges of the pump chamber below the level of the decking that surrounds the plunger pumps. Each cistern measured approximately 3 metres by 2.5 metres by 2.5 metres deep, though they could not be seen in their entirety. Their central walls abut the timber lining of the timber lined sump chamber and they are set back into an excavated chamber.

One cistern serviced each of the plunger pumps and ‘S’-shaped wind bores were fed into each cistern from the base of the ‘H’ piece of each plunger unit. The tops of the cisterns were decked over with timber planking which was contiguous with the decking of plunger platform. Depth indicators, in the form of Roman numerals, were carved on the inner surfaces of the tanks and suggest that inspection hatches were present so that the water levels in each of the tanks could be checked.

Shaft sump (rise)

A timber lined rectangular sump compartment, measuring approximately 2.2 metres x 3.5 metres, extends below the plunger pump platform and support framework. At the time of inspection it was filled with debris to within approximately 8 metres of the modern level breakthrough. It appears to have been partially shielded from falling material by the overlying pump platform.

The sump is lined on all four sides by closely fitted, horizontally lain planks of timber measuring 30 x 15 centimetres (where they can be seen). On the winding compartment and cistern sides of the chamber, the sump lining extends upwards into the square set support framework of the pump platform, forming a box-like structure. On the fourth side of the sump compartment, where the modern breakthrough occurred, the timber liners were absent. Here, they appear to have been omitted so that access could be gained to the sump compartment and any machinery that was in place there.

Old mine plans and reports of Inspectors of Mines suggest that the sump seen on the 1370 foot level of Harts Shaft was connected to a crosscut on the 1530 foot [465m] level of Grubb’s Shaft by a rise. So any water that reached the sump was channelled to the Grubb’s Shaft pumps.

If the sump was open to the 1530 foot level then it would add further weight to the theory that no suction pump was installed on the Hart’s Shaft. Drainage water from the Hart's Shaft 1370 foot level could have been channelled into the cisterns where it could be raised directly by the plunger pumps. Any excess flow would have dropped to the 1530 foot level and been raised to surface at Grubb's Shaft. A suction pump would only have been of use in a blind sump.

Immediately below the plunger platform, approximately central to the rectangular pump rod opening in the decking, there was a timber pump rod guide mounted across the sump and probably bolted to the cistern sides of the chamber.

The pump chamber

The Hart's Shaft has four compartments (ladder way, pumping compartment and two winding compartments), the largest of which is an excavated pump chamber measuring approximately 8 metres by 4 metres that has been formed by the belling out of the base of the shaft above the narrower sump.

Figure 3: *Timber lining and backs support in the plat area in front of the winding compartment, as it appeared on 4 July 1998.*

Source: The Author.

A short crosscut extends from this position into the main development drive of the level. The preservation of mine timber was remarkable and it retained much of its original strength. The survey instrument in the foreground is standing on rubble that has partially filled the area after spilling out of the shaft.

In horizontal plan view, the pump chamber is contiguous with the plat area located in front of the two winding compartments (Figure 3). However it extends approximately 3 metres below the level of the plat floor to the level of the modern breakthrough. The timber plunger platform framework was built into this 3-4 metre deep, widened chamber.

Discussion

It is likely that the salvage teams that were breaking up the machinery between 1918 and 1919 removed everything from the shaft that was easily moveable and had a resale value. Historic records show that a buyer could not be found for the pumping engines and this was probably the case for the plunger pumping units as well, so they were abandoned.

The plunger pump units in the Hart's Shaft do not appear to be larger than those installed on Cornish mines at a similar period – for example, at the Waihi Gold Mine in New Zealand.[38] So when historic records speak about the large size of the Beaconsfield pumps, perhaps they are referring to their installation as multiple units in the pitwork of the Tasmania Mine, rather than the size of the actual pump units. What may have been so unusual about the machinery of this mine is the successful employment of a paired set of pumping units that were driven by the very large Hathorn-Davey engines required to drive them at such depths.

The salvaged machines are now on display at the Grubb Shaft Museum at Beaconsfield and form an important part of the mining history of Tasmania.

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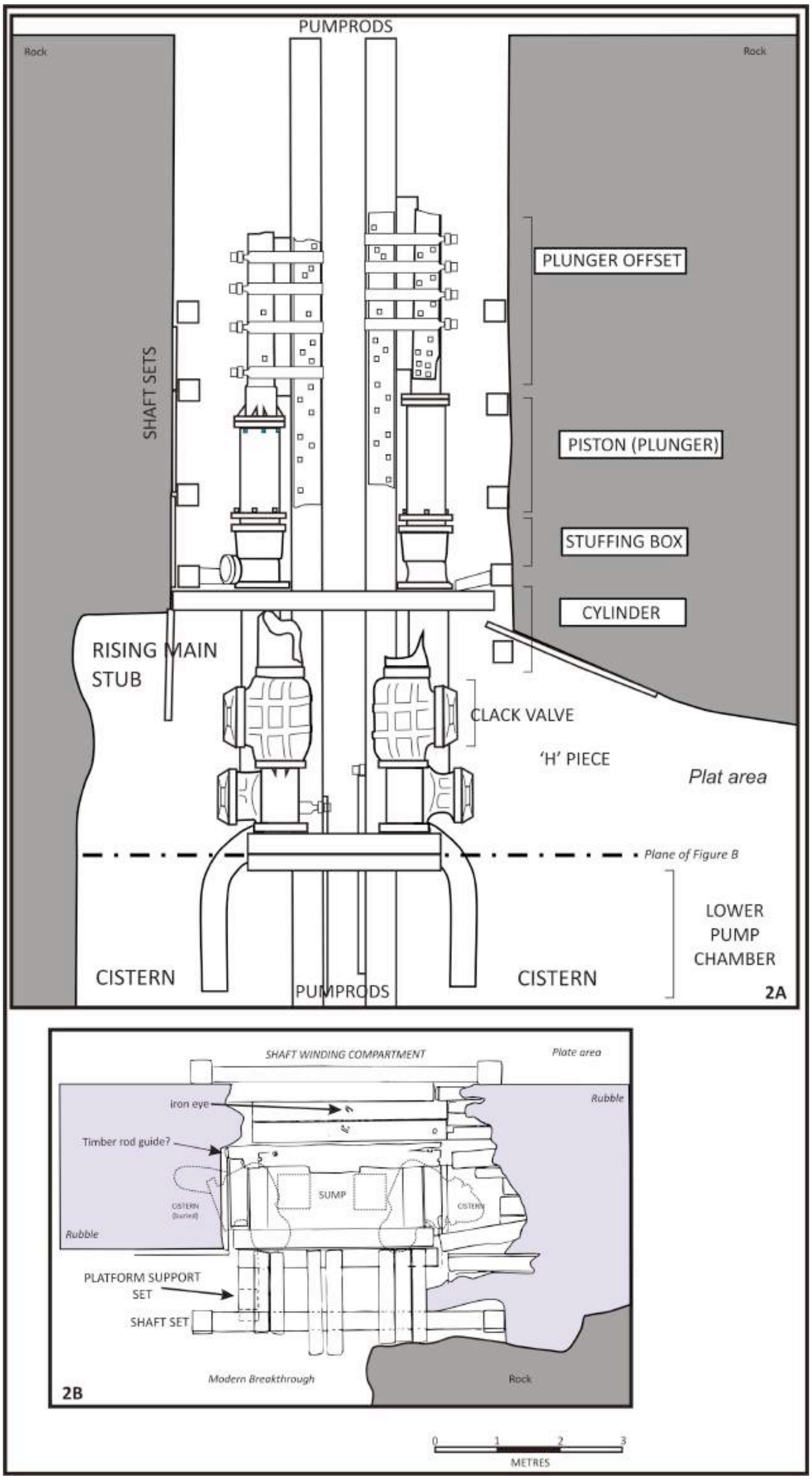
Figure 2A: *Simplified elevation view of the mirror imaged plunger pump units within the pump chamber of the Hart's Shaft, as they appeared on 4 July 1998.*
Figure 2B: *Plan view of the Hart's Shaft plunger pump timber platform deck after the machinery was removed, 9 July 1998.*



Source: The Author. The view is drawn from the shaft ladderway, looking towards the pump compartment and the winding compartments (behind the machinery). Shaft lining timbers and sets are shown in section. The plunger offset and rod assemblies were arranged normal to the view while the plunger pumps themselves were angled slightly inwards to the centre of the view. The rising main limb of the 'H' pieces dominate the lower part of the machinery in this view. The cisterns and plunger pump platform framework are not shown. Note the two 3 metre x 30 centimetre x 30 centimetre beams that form the beds for the rising main limbs of the 'H' pieces (foreground). The shaft ladderway lies on the side of the chamber where the modern breakthrough occurred.

The first is an elevation view of the two plunger pump units drawn from the shaft ladderway, which shows their positions relative to the shaft walls, pump rods and offset arrangements. The elevation diagram of the pumps was produced by marking one metre spaced lines on the machines from their bases to their tops and then drawing them to scale from various positions in the shaft ladderway. Direct measurements of the distances between the shaft walls and vertical components of the pumping machinery were made using a tape, where possible. When it was too dangerous to access an area directly for measurement, the distances were estimated.

Figure 2B
Source: The Author.
Plan view of the Hart's Shaft plunger pump timber platform deck after the machinery was removed, 09 July 1998. The positions of the two pump 'H' pieces that rested on this platform are shown in dotted outline. Debris clearance had exposed the wooden cisterns and timber decking. The removal of the machinery and pump rods exposed the opening into the sump compartment below. The modern breakthrough is at the top of the plan and the original plat area is at lower left. A rise in the carbon dioxide gas levels cut short the survey and so an elevation view of the timber supporting framework for the pumps could not be recorded graphically. However, most visible details of the structure were recorded photographically.

Endnotes

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