Chapter 6

The industry leader

A reason for prominence

By early 1858, within months of beginning work, the Port Phillip mine had become the foremost gold mining operation in Victoria. Despite the rapid growth of Victoria's quartz mining industry, and the Port Phillip Company's willingness to share its technical advances with its contemporaries, few other large quartz mines developed over the next two decades. Certainly there were no other operations of a comparable size in terms of overall mining and ore treatment. This raises an obvious question. If the industry leader was prepared to share its technological advances in a burgeoning market, why did other companies not seize the opportunity to compete with, and even outdo it?

The most likely answer is location. The Port Phillip mine was developed on an extensive area of private land, far larger than the 'average' mining lease on Crown land. The mine controlled the richest part of a relatively high-grade goldfield, contained in a quarter-mile long zone of multiple quartz reefs. Mining leases on other goldfields, such as Bendigo and Ballarat, were of more limited extent and usually owned by different companies. Unless a number of these smaller leases had been amalgamated and worked as one by a central management, there was little likelihood of rivalling the Port Phillip Company.

Two quartz mines in Victoria ultimately produced more gold than the Port Phillip, the Long Tunnel mine at Walhalla and the A1 mine at Woods Point.¹ Both were the largest mines on relatively small but high-grade goldfields. The Band of Hope and Albion Consols Company at Ballarat produced some 10,000oz more gold than the Port Phillip Company from more extensive mine workings.² The bulk of its production however, came from the mining and treatment of deep lead alluvial gravels.³

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¹ Bowen, An analysis of gold production data, p.16.
² Ibid., p.18.
³ Baragwanath, The Ballarat Goldfield, pp.78-80, 121-125.
Continued growth of the treatment works

All four stamp batteries were connected to the new Neath Abbey engine by March 1860. With rain finally falling in early April, the treatment works progressively worked up to full capacity as the water supply to the batteries improved. The quantity of quartz crushed rose from 898 tons during the month of March, to 2,866 tons during May 1860. Throughput would not fall below 2,000 tons per month for the next 20 years, until ore supplies began to decline in the early 1880s. A fifth battery of 12 stamp heads (No.5) went into operation in mid-September 1860, bringing the total to 56 stamp heads, capable of crushing in excess of 750 tons per week.4

As a result of the increased capacity of the treatment works, essentially all of the quartz in the reefs was now taken as ore, with little selectivity. Although the average gold grade per ton decreased as a result, the number of tons mined and ounces of gold produced both rose steadily, due to the increased scale of both mining and milling operations. Profits for both companies also increased with the economies of scale, the Port Phillip Company declaring a dividend of 1s 6d per share in January 1862. Each shareholder had by then received a total of 5s 6d in dividends on their £1 shares.

The increasingly discredited theory that gold values in Victoria’s quartz reefs would decrease rapidly with depth was still a cause of some government concern over the future of the quartz mining industry as late as 1862. In July of that year, the government established a Royal Commission into the conditions and prospects of the goldfields. Robert Brough Smyth, the Secretary for Mines, was instructed to establish what the Port Phillip Company’s attitude was to deep mining. Bland replied that the mine had been worked for some time to a depth of 260 feet (with profitable results) and shaft sinking was now under way to reach a target depth of 600 feet.5 His inference was obvious. The Port Phillip and Clunes companies had complete faith in the continuity of the Clunes oreshoots at depth and were developing the mine accordingly. Rivett Bland and Charles Harvey were among the expert witnesses who later gave evidence before the Royal Commission.

4 Star, 10 August 1860.
Technology on display: the model stamp battery

The progress of mining technology was an important theme at the Victorian Exhibition held in Melbourne during October-November 1861. Displaying all manner of local products and resources, the exhibition demonstrated the colony’s progress during its first decade. An extremely significant event in its own right, it also served as a ‘curtain raiser’ to an International Exhibition held in London between May and November 1862. Prize-winning exhibits in various categories were sent from the Melbourne exhibition to London to showcase to the world, the colony’s resources, progress and prosperity. As the leading gold mining operation in Victoria, the Port Phillip Company was the logical choice to demonstrate and promote the colony’s most important industry.

A meeting of all the quartz mining companies working at Clunes agreed in principle to support the construction of a working model battery, for display at the International Exhibition in London. It would be a two-thirds sized version of one of the Port Phillip Company’s 12-head batteries, constructed in Clunes from local materials and funded by the local mining companies and businesses. The Exhibition Commissioners in Melbourne endorsed the project, particularly as the battery would feature all the latest technological innovations and be “…of Colonial manufacture.” A sum of £900 was set aside for the project, contributed to by the Port Phillip Company, the landowners, and presumably other industry sponsors.

Construction of the model battery began at the Port Phillip works in June 1861, in a shed built especially for the purpose. Company craftsmen used local timbers and castings made in the nearby Clunes Foundry. As its contribution to the project, the Clunes Company mined and freighted 25 tons of quartz to be crushed by the battery while it was on display. The heavy framework of the battery was skillfully constructed from local boxwood. Lightwood (a species of wattle) was used for the feed hopper, and colonial cedar for the strakes and amalgamating barrel. Carefully finished and varnished, the woodwork was reported to be of furniture-making standard. Similarly high levels of craftsmanship had gone into the castings made at the Clunes Foundry, and the metalwork undertaken by Rees Davies’ engineering department. Completed

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7 Colonial Mining Journal, vol.3, 6 June 1861, p.150.
8 Clunes Advertiser, 22 November 1861, in Dicker’s Mining Record, vol.1, 21 December 1861, p.7.
10 Clunes Advertiser, 22 November 1861, in Dicker’s Mining Record, vol.1, 21 December 1861, p.7.
in November 1861 at a cost of about £600\textsuperscript{11}, the battery drew high praise from Exhibition commissioner John Knight who, like journalists and many of the residents of Clunes, inspected it prior to its despatch to London.

Practical gold mining in Victoria was to be presented at the International Exhibition in two displays: traditional treatment of alluvial washdirt by panning and cradling, and the crushing of gold-bearing quartz. In effect, the gold rush methods of the early 1850s contrasted with modern mining technology. While difficult to see due to overcrowding, the alluvial gold washing display in the main exhibition building was an instant success, presumably embodying the popular myth of the digger’s life during the gold rush.

It was a different story however, for the model battery representing progress and the Colony’s future prosperity. A steam engine was necessary to power the battery. Normal practice would have been to use a portable engine to drive the battery via a flat belt. The Royal Commissioners baulked at the idea due to the fire risk, refusing to allow the battery to be operated in the main building, or even in the machinery display annexe. The battery was banished to an outdoor area, nowhere near the rest of the Victorian gold display. Even here fires were not permitted, ruling out the use of a steam engine.

Finally, the Royal Commissioners arranged ‘…at much expense…’ for the installation of a water turbine to drive the battery.\textsuperscript{12} The turbine however, proved too weak to operate the battery at anywhere near its full potential.\textsuperscript{13} In spite of the enthusiasm and high hopes of the Victorian mining industry, and the best efforts of its exhibition representatives, bureaucracy and lack of forward planning triumphed. \textit{The Times} newspaper report of the affair deplored the attitude of the British authorities, coming out firmly in support of the colonials.\textsuperscript{14}

The only recorded critic of the Port Phillip Company’s model battery was Robert Hunt, professor at the Royal School of Mines in London, and a judge at the Exhibition. Hunt argued that bringing a Cornish battery back to Britain did not represent anything new. His criticism ignored Joseph Robson’s extensive improvements on the basic design:

\textsuperscript{12} \textit{Mining Journal}, vol.32, 23 August 1862, p.574.
\textsuperscript{13} \textit{The Times}, 17 September 1862, p.5.
\textsuperscript{14} Ibid.
cast-iron cam barrels, wrought iron stamp shanks, removable bed-plates, amalgamating troughs, and so on. At the time, the battery was probably the most efficient in the world. Thirteen years later, Robert Hunt was to cite this same battery design as an example of world’s best practice, enumerating its principal advantages in a treatise on mining methods and machinery. This was a complete reversal of his earlier opinion, reflecting the worldwide reputation that the company had established by the 1870s.

In addition to the sign proudly promoting the colony, the photograph above shows the model battery and its associated equipment. A massive cast-iron cam barrel with its tooth-like lifting cams is visible just above the platform, extending across the front of the battery and driven by gearing at its right hand end. As the cam barrel rotated, its cams raised the stamp shafts by engaging corresponding tappets (lugs), visible just above the cam barrel. Each stamp was raised and dropped three times during each revolution of the cam barrel (a total of 70-80 drops per minute).

16 La Trobe Picture Collection, LTAEF82, State Library of Victoria.
With an adequate power supply the battery could crush 66-70 tons per week. The water-powered turbine drive provided by the Exhibition commissioners is not visible. It was probably situated behind the battery.

Quartz was fed into the battery box from the hopper, visible behind the man at the right of the platform. Amalgamating troughs are situated below the mesh-covered escapes at the front of the battery box, followed by strakes sloping away from the battery box. Four of the six rows of strakes were covered with blanketeting while the centre rows used mercury-covered copper plates, to demonstrate the relative merits of both methods of gold collection. In the left foreground is the amalgamating barrel with a shaking table below, to separate amalgamated gold from unwanted sand. Sacks of quartz to be crushed lie in the right foreground.

**Richard Daintree’s exhibition photographs**

Government geologist Richard Daintree visited Clunes during the second half of 1861, taking two photographic panoramas of the town and its mines. The photographs were displayed at the Victorian Exhibition in Melbourne in late 1861, and subsequently at the International Exhibition in London during 1862. Although three years had passed since the construction of Carl Nordstrom’s model of the Port Phillip operation, most of the surface features depicted in the model are still easily recognisable in the photographs.

The panorama on the next page shows most of the mines of North Clunes, with the large battery house of the Port Phillip Company directly in the centre. The headframe of the South (Engine) shaft is situated on the hilltop, above the right hand end of the battery house. The inclined tramway down which the ore was transported runs diagonally to the left, ending near a small ‘sentry box’. Weathered or soft ore was sent directly to the battery house, while large lumps of ore went firstly to the kilns to be roasted and broken. The kilns are a flat-topped masonry structure, just uphill from the battery house.

The North shaft, with its heavy, cross-braced headframe and nearby square-based chimney-stack lies just to the left of centre. Ore from the North shaft was transported southward on a horizontal tramway before being transferred to the inclined tramway down to the treatment works. Today, the mullock dumps (waste heaps) are the most
Port Phillip and Colonial Gold Mining Company’s Works at Clunes

17 Photographs by Richard Daintree, 1861, LTGN 185f.26, 185f.27, La Trobe Picture Collection, State Library of Victoria.
prominent features remaining on the hillside. Their beginnings are visible at the top of the hill between the two shafts. The upper and lower adits, in which mining began in 1857, are located at the left-hand ends of two horizontal tram-roads. These in turn connected to the inclined tramway down to the battery house. Mine headframes further to the north (left), are those of the Yankee and Victoria Quartz Mining companies.

Diagonally uphill to the right of the battery house is a small white building. This is the police station and lockup built in 1857, during the troubles with the outsiders. It was now disused, replaced by a new police station and courthouse built on the southern hill, from where these photographs were taken. Parts of the fence erected in the early days to define the Company Paddock are visible to the right of the lockup, diagonally below it, and across the top left-hand corner of the panorama. Houses at the extreme left of the view are probably those built for Charles Kinnear and the mine manager, while those higher up the hill have more of the appearance of workers’ houses.

At the left-hand end of the battery house is the engineering workshop, and a little further to the left are the blacksmiths’ and carpenters’ workshops. The fairly tall building with a new corrugated iron roof, near the carpenters’ workshop, is probably where the model battery was assembled. Buildings in the centre of the left-hand photograph are the Port Phillip Company’s offices, assay office and store houses. Between the office buildings and the creek are piles of 8-foot lengths of firewood, to feed the boilers of the steam engines. Firewood was a significant item of expense for the company. The treatment works consumed an estimated 222,232 tons of firewood during its 31 years of operation\(^\text{18}\), or around one ton of wood for every six tons of quartz crushed. Considerable quantities of better quality timber were used as well, for shaft lining and underground support.

Miners’ cottages, the Port Phillip Hotel and a restaurant line the road to Clunes just outside the Company Paddock. Parts of the Criterion and Clunes United Quartz Mining companies’ works are visible near the right-hand edge of the panorama. The south (near) bank of Creswick Creek is lined with miners’ cottages and abandoned alluvial shafts. A double tramway leads down to the creek between the houses near the lower right-hand corner. The tramway and the old shaft and whim in the bottom corner of the photograph were part of the workings of the John Bull Company. The

\(^{18}\) Bland, History, 1888, p.2.
tramway curving to the right and ending at a puddling machine in the building near the creek, is probably that of the Southern Light Company. In the extreme lower left corner, the tramway may have belonged to either the Haphazard or the Live and Let Live Company.

‘Burning’ of quartz is discontinued

The introduction of less selective mining techniques in 1861 to keep the expanded treatment works supplied with ore meant that poorer grade quartz, previously left on the walls of the old stopes, could now be ‘stripped’ and sent for treatment. One of the drawbacks of the new mining regime was the increased proportion of oversize ore, including large slabs of quartz produced by stripping the stope walls. All oversize ore required reduction to fist-sized pieces before being fed into the stamp batteries. The old method of kiln-roasting the quartz, followed by quenching and hand-breaking, became too slow and inefficient so the Port Phillip Company installed a rock-breaking machine (crusher), which began operating in June 1862.

Typical of the company’s commitment to new technology, the moving jaw of the Victorian designed and patented Chambers’ crusher was operated hydraulically instead of by the more traditional mechanical drive. Oversize quartz was delivered to the crusher by a separate tramway. A 12-horsepower steam engine drove a double-action hydraulic pump, which used water as the recirculating hydraulic fluid. Two hydraulic rams alternately pushed the top and bottom ends of the centrally pivoted moving jaw, crushing the quartz between it and a fixed jaw. A water jet suppressed dust created by the crushing operation. Operated by the Port Phillip Company, which charged the Clunes Company 1s 2d per ton for its use, the rock breaker proved extremely successful, operating only 3-4 days each week to do the equivalent work of the kilns it replaced. An advertisement showing a sectional view through a Chambers’ crusher is shown on the following page.

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19 Reports of the Mining Surveyors: Creswick Division, August 1861, p.312.
Considerable health benefits were an added bonus of discontinuing the quartz roasting process. Apart from the backbreaking work of loading and raking out the kilns, the workers and to some degree the nearby residents, were regularly exposed to clouds of sulphurous fumes. In wet or humid weather these evolved sulphuric acid. Worse still, the fumes contained significant quantities of arsenic, lead, zinc and copper. The company had used kilns solely as part of the process of size reduction, and the crusher offered a healthier and more cost-effective alternative. While the health risks were quite well understood at the time, the practice of ‘burning’ quartz to decompose its contained sulphide minerals, rather than as a method of size reduction, continued for many years in some Victorian districts, most notably at Maldon.

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21 Ibid., vol.6, 13 February 1866, p.cxvi.
The Clunes Accident Relief Fund

Free medical services for work-related complaints had been provided to the working shareholders when the Clunes Company began operations in 1857. Although the company changed to a work force of paid labour and sub-contractors the following year, the services of the doctor were maintained, covering all men working in the mine. In March 1862, the Clunes Company announced that all of its workers would in future be required to make a weekly contribution of 6d, to establish an accident relief fund. Other mining companies at Clunes immediately took up this initiative.

Charles Harvey chaired a meeting of the managers and employees of the Clunes, Criterion, Clunes United and Victoria companies on 27 March 1862, at which the Clunes Accident Relief Fund came into being. A majority of those present voted to make payment of the 6d levy compulsory, no man being permitted to work in the mines unless he was a financial member of the Fund. In return, an injured miner was assured of financial assistance ranging between 15s and £1 10s per week, depending on the severity of his injury.

Provision of medical services from 1857 and initiation of the Accident Relief Fund in 1862 distinguish the Clunes Company as one of the first Victorian mining companies with a social conscience. Much of the credit for this progressive attitude must go to the company’s chairman and manager, Charles Harvey. By the time of the Fund’s first annual meeting on 11 April 1863, 277 Clunes miners had enrolled as members, and mining companies at Bendigo, Ballarat and Staffordshire Reef had set up similar funds.

Construction of the second battery house

Deepening of the mine’s North shaft commenced in mid-1861, to reach the quartz reefs that plunged northwards below the existing workings from the South shaft. Anticipating a further increase in production when the new deep levels were opened out from the North shaft, Bland and Thompson planned the construction of a second

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22 Star, 12 March 1862.
23 Ibid., 29 March 1862.
24 Ibid., 13 April 1863.
battery house, to begin operating in late 1863. It would house a second rock crusher and two new locally made 12-head batteries with heavier stamp heads (and therefore greater throughput) than their predecessors. The new plant would be powered by another steam engine ordered from the Neath Abbey Iron Works in Wales.\footnote{Ibid., 24 November 1862, p.2.}

Estimated to cost £7,000, the second battery house would raise the company's total crushing capacity to about 1,400 tons per week. Progressive improvements over the years to the five existing batteries had raised the average amount crushed per stamp-head each day from 1.5 tons in 1857 to 2.7 tons in 1863.\footnote{Ibid., 24 December 1863, p.263.} Once the second battery house began operating, the new heavier stamp heads would each be capable of crushing almost 4 tons per day.

Earthworks for the second battery house were begun during April 1863. Partly cut into the hillside, the site lay to the north of the old battery house and somewhat higher up the hill. Construction commenced in late May, the weatherboard-clad battery building measuring 70 feet by 68 feet and standing 32 feet high.\footnote{Star, 6 May 1863.} Work on the building finished in early August and the two 12-head batteries that it housed were completed a month later.

The new 60-horsepower Neath Abbey steam engine and boilers to power the machinery had been installed by late November 1863. Equipped with Gifford feed-water injectors and preheating tubes that utilised the heat of the exhaust steam to raise the feed-water temperature, the boilers had the latest improvements in boiler technology.\footnote{Ibid., 5 December 1863.} Apart from a second inclined tramway to deliver ore to its feed hoppers, the new battery house was virtually complete when the engine was started for the first time in December. Little ceremony appears to have accompanied the event, although this was the tenth engine successfully commissioned for the company by Rees Davies.\footnote{Ibid., 21 December 1863.}

Unexpected delays had occurred in deepening the North shaft, caused by heavy water inflows and difficulties in sinking through a great thickness of the Old Man reef. Shaft sinking work dragged on throughout 1862 as a result, throwing the Clunes Company's mine development plans badly behind schedule. Opening out of the new
deeper levels from the North shaft, at depths of 300 feet (No.3) and 372 feet (No.4), was held up for several months, and by late 1863, the delays had compounded. Ore production slowed to such an extent that it would have been uneconomic to operate both battery houses. As a result, although the new battery house was essentially complete by December 1863, it did not go into service until early the following year. Once started however, the new batteries performed well, crushing 389 tons of ore in late February.31 Continuing shortages of ore then led to the suspension of work in the old battery house during March 1864, and the retrenchment of nine battery hands.

A change of management

The Clunes Company had struggled to continue the North shaft development program throughout 1863, while producing ore from southern part of the mine. By year’s end, accessible ore supplies had dwindled, causing the slow-down at the treatment works. Worse still, the average grade of the ore mined during the second

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31 Ibid., 1 March 1864.
32 Photograph by Charles Nettleton, 1865-6, f.8, Clunes Museum.
half of 1863 from the traditionally poorer-grade southern end of the mine had fallen by about 20% to just below 10dwt per ton. This had the effect of cutting profits by a similar 20%.

Coming on top of continuing development expenditure and the cost of upgrading the North shaft ore-handling facilities, the profit drop forced the Clunes Company into financial straits by April 1864. Its directors approached the Port Phillip Company to negotiate a reduced rate to treat the so far largely unworked Old Man reef. While the reef contained large, easily accessible resources of quartz, its gold grade had to date been only marginally economic at best. A reduction in treatment costs, coupled with the increased throughput of the new crushing plant could make all the difference. The Port Phillip Company however, was reluctant to reduce its charges without first establishing the true grade of the reef by trial crushings at the existing rate.

Intensive negotiations during May 1864 resulted in a compromise arrangement. Subject to the necessary shareholder approvals, the two companies would amalgamate their interests in the operation. Each would retain ownership of its existing plant and equipment, but these would be used for their mutual benefit. Management of the entire operation would be taken over by the Port Phillip Company, which would receive 65% of the net profits as a result.

The scheme offered the Clunes Company a solution to its financial problems. Its share of future profits would be reduced to 35%, but at the same time it would be relieved of running the mining operation. More importantly, it would avoid the cost of sole-funding the ongoing deep mine development program, particularly in ‘lean’ years.

For its increased profit share, the Port Phillip Company assumed the added responsibility and expense of the mining works. With the entire operation under the Port Phillip Company’s management however, it should be able to make significant savings. Most importantly, as the mine workings went deeper, one central management could achieve the best balance between development, mining, and crushing to secure maximum utilisation of the entire operation. This aspect had been concerning Bland and Thompson for some time, particularly since the newly enlarged

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33 Star, 10 May 1864.
crushing plant had been idle for lack of ore earlier in the year. Development work resumed as soon as the amalgamation proposition was agreed upon, the South shaft being deepened and re-equipped to take advantage of previous development work by the Clunes Company.

Systematic testing of the upper section of the Old Man reef and other surface resources soon followed. Although quite low grade, parts of these easily accessible shallow resources were mined, thereby keeping both batteries fully employed. By the time that the Clunes Company's shareholders formally approved the amalgamation scheme in October 1864, the future seemed considerably brighter. Henry Thompson was appointed as a director of the Clunes Company while its chairman, Charles Harvey, left the board but retained his position as mine manager. Thompson resigned from the board the following year and Rees Davies, chief engineer of the Port Phillip Company, was appointed in his place.

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34 Ibid., 7 April 1864.
35 Photograph by Charles Nettleton, 1865-6, f.6, Clunes Museum.
36 Star, 8 October 1864.
37 Ibid., 25 July 1865.
The problems of water supply

An adequate supply of water for the Port Phillip Company’s treatment works was a frequent source of concern during the first decade of its operation. In addition to water for the steam engine boilers and various other uses around the works, each stamp head required about 8 gallons of water per minute. With 44 stamp heads at work by 1858 this represented a total consumption of around 0.5 million gallons per day, rising to 1 million gallons per day in 1864 when all 80 stamp heads were operating.

The treatment works were situated at the foot of the hill containing the mine, and close to Creswick Creek. This minimised water pumping and used gravity to transport the ore downhill from the mine and then progressively through the treatment process. There was however, a drawback in locating the works in the valley. The creek was used as both the water supply and the waste disposal for the tailings from the treatment process. Tailings frequently choked the creek, greatly reducing its capacity as a water supply, until floods from winter rains swept them downstream into Tullaroop Creek and thence towards the Loddon River. More than two million tons of tailings passed along Creswick Creek in this fashion over a 40-year period, including 1.3 million tons from the Port Phillip Company’s works.

Neighbouring mining companies, both up and downstream, used Creswick Creek in a similar fashion. The creek could not be dammed close to Clunes to form a reliable, year-round water supply owing to the presence of the mines, their treatment plants, and the town itself. As a result, both the mines and the town experienced repeated cycles of winter flood and summer drought along Creswick Creek.

Mining activity at Clunes first put heavy demands on the water available from Creswick Creek in late 1858. By then, three other companies (Criterion, Clunes United and White Flat) in addition to the Port Phillip works, were drawing water for quartz crushing, together with six puddling machines treating washdirt from the recently discovered southern deep leads. To make matters worse, sludge from the

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puddling machines clogged the creek downstream from the town as far as the Port Phillip works.\textsuperscript{40}

In the first attempt to improve its water supply, the Port Phillip Company began construction of a ‘Big Dam’ on Creswick Creek in early 1859, upstream from the town, near the present-day showground. Estimated to cost £1,200, it was to have sufficient capacity to supply all four quartz-crushing plants at Clunes. The other three companies agreeing to pay for their share of the water.\textsuperscript{41} In late May, the still unconsolidated dam wall failed after heavy rains. The resulting flood swept away three bridges across Creswick Creek and the accumulated sludge from the puddling machines, but caused little damage in the town itself.\textsuperscript{42} Winter rains then provided ample water supplies, enabling the treatment works to return to full production around mid-1859. The company later accepted Mr Muir’s tender to repair the breached dam wall.

The repaired Big Dam proved adequate for the next two years but by the summer of 1862 it had lost storage capacity, silting up as a result of mining activities further upstream. Government funding was sought to bring water to the town by a water race or pipeline from Birch’s Creek, about one mile to the east of Clunes, but with no success. The Clunes Company had struggled to lower the water level in the North shaft throughout 1862, even to the extent of using some of the surplus water in a bathing house installed for the miners near the shaft head.\textsuperscript{43} Elsewhere in Clunes however, the quartz crushing plants had again run short of water by early 1863. In addition to a constant supply piped from the North shaft into a large tank behind the battery house, the Port Phillip Company resorted to damming the creek near the works and recirculating as much water as possible.

Construction began in February 1863 on a government and mining company-funded dam on Coghill’s Creek, to the south of Clunes. Intended primarily to supply water to the mines at Clunes, it seemed unlikely that there would be enough excess capacity to provide a domestic supply for the residents, some of whom were paying ‘…5s to 25s per week for water.’\textsuperscript{44} Construction had scarcely been completed when heavy rain on 6 June 1863 caused the worst flooding yet seen in Clunes. The dam wall

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\textsuperscript{40} Star, 21 December 1858.
\textsuperscript{41} Ibid.
\textsuperscript{42} Colonial Mining Journal, vol.1, June 1859, p.162.
\textsuperscript{43} Star, 14 January 1863.
\textsuperscript{44} Ibid., 18 February 1863.
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survived after the spillway washed away relieving the pressure, but most of the stored water was lost.

The Port Phillip Company’s Big Dam on Creswick Creek was breached on the same night, flooding most of the houses alongside the creek and sending a 3-foot high wall of water through the business district along Fraser Street. A large amount of property damage was caused and the flood washed away all the footbridges over the creek. Lessons had been learned however, from a severe flood in 1860. The shaft collars of the Criterion and Clunes United companies, the two mines closest to the creek, had been secured to prevent the floodwaters rushing down them. Had this not been done, the effects on the adjoining mines, including the Port Phillip, could have been catastrophic. As a further precaution, all companies suspended work underground for some days until the floodwaters subsided. 45

The cycle of winter floods and summer droughts continued between 1863 and 1866, compelling the company to resort to a variety of water conservation measures. A settling dam was constructed on Creswick Creek in early 1864, a little downstream from the works. The dam was fitted with sluice gates that could be opened at times of high creek flow. Water was pumped back to the batteries for re-use once the tailings had settled out. The question of a town water supply was again raised late in 1865. All six quartz mining companies then working in Clunes agreed to pay 1d per thousand gallons if a government supply was laid on. 46 Despite a survey by the Water Supply Department, 47 which costed the scheme and highlighted its benefits to both the mines and the community generally, nothing eventuated.

Increasing production levels at the Port Phillip works in early 1866 prompted the installation of Barnes’ patent hydraulic pumps in the settling dam on Creswick Creek. As tailings accumulated, the pumps raised them 26 feet into an elevated launder (trough) which carried the tailings well downstream of the works before depositing them back into the creek. Even this did not solve the problem entirely. Tailings still accumulated in the settling dam at such a rapid rate that in September 1866, a dredge had to be installed to maintain the dam’s capacity. 48

45 Ibid., 8 June 1863.
46 Ibid., 18 December 1865.
48 Reports of the Mining Surveyors and Registrars, Melbourne, Department of Mines Victoria, Quarter ending 30 September 1866, p.12.
Water supplies began to dwindle once again with the approach of summer in late 1866. At maximum production, the mine and treatment works together required about 1,000,000 gallons of water per day. Mine water had recently been used in the boilers in an effort to prolong supplies but its dissolved salts had caused incrustation and corrosion. Rivett Bland resolved that the company’s water problems must now be quickly and permanently overcome.

Birch’s Creek had a much larger catchment area than Creswick Creek and was not used for mining purposes, so it potentially had more water available. Bland decided that a site on Birch’s Creek, selected for several earlier but uncompleted water supply schemes, was also the best source of water for his plan. He purchased an 8-acre allotment to gain access to the creek and provide a pumping station site. The site was only about 1½ miles east of the mine over almost level ground, so water could be conveyed most of the way at little cost in a pipe or aqueduct. Raising the water nearly 70 feet from the creek to the top of its valley had proved the undoing of the earlier schemes but Bland was not deterred.

He purchased a steam locomotive that had operated previously on the Geelong-Ballarat railway line and had it set up alongside Birch’s Creek as a ‘portable’ steam engine. Supported so that its driving wheels cleared the ground and acted as flywheels, the 100-horsepower engine powered two 12-inch double acting pumps. Water flowed along a tunnel from the creek to a well housing the pumps. The pumps forced the water along a 17-inch diameter wrought-iron pipeline that ran up the creek bank and then rose vertically to a flume, or wooden aqueduct, standing 35 feet above ground level. Capable of carrying 1,000 gallons per minute, the flume crossed overhead above the nearby Smeaton road before reaching ground level and discharging into a water race. Continuing along the northern boundary of the Clunes pre-emptive right, the water race discharged into a holding dam just east of the present road to Mt Cameron. From there it was piped down to the treatment works.

Costing £4,840, the scheme commenced operating on 20 April 1867 and proved an immediate success. From being short of water, the company could now bring more than it needed to North Clunes, recouping the capital cost within one year through

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49 Dicker’s Mining Record, vol.9, 25 July 1867, p.23.
increased production. The company subsequently laid pipes from the holding dam down to Fraser Street, supplying water to part of the town.51

Water from a government-funded town water supply scheme eventually reached Clunes in about mid-1876. The water was collected in a dam at Newlyn, on the headwaters of Birch’s Creek, then travelled downstream along the creek before being diverted to Clunes via a pipeline engineered by Octavius Langtree. In the September quarter of 1876, nearly 90 million gallons of water were used for mining purposes, at a cost of 1½d per 1,000 gallons.52 The Port Phillip Company was amongst those that drew water from the new scheme, closing down its Birch’s Creek pumping plant at some time prior to early 1878.

50 Bland, History, 1888, plate 3.
51 Reports of the Mining Surveyors and Registrars, Quarter ending 30 June 1867, p.9.
52 Ibid., Quarter ending 30 June 1877, p.26.
Introduction of grade control

For nearly a decade the outcropping portion of the massive Old Man reef had been considered too poor to be worth treating, based on sporadic testing. It had not been subjected to systematic sampling until the period of ore shortages in early-mid 1864, when an effort was made to identify better grade sections that could be successfully treated. Trial battery crushings from the surface of the reef yielded nearly 4dwt of gold per ton but mining did not eventuate at that time, presumably due to better prospects elsewhere in the mine. Later trials from underground exposures of the reef gave better results of around 6dwt per ton and by the late 1860s, a considerable amount of ore was being mined from the Old Man reef.

Rivett Bland instituted regular, systematic sampling of all the reefs throughout the mine in June 1865. This was one of the consequences of the entire operation now coming under one management and had its origins in the ore shortages of 1864. The sample results enabled a global resource inventory to be built up, to better plan the mining sequence, and the development work necessary to stay ahead of production.\(^{53}\)

One battery (No.3) was devoted almost exclusively to the trial crushing work, treating bulk samples of up to 40-50 tons each. These large samples gave a much better indication of the true grade of a reef than the earlier methods of visual inspection, or dollying (hand crushing) and panning a few handfuls of quartz.

Rather than simply taking all the quartz in any particular reef, uneconomic portions could now be accurately identified and left in place. Over time, the sample records allowed the positions of the richer oreshoots to be traced from level to level. Once the attitude of an oreshoot had been established, its position on the succeeding level could be predicted in advance, as could the amount of development work necessary to reach it and open it up for stoping.

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\(^{53}\) The Times, 16 August 1865, p.7.
The photographs of Charles Nettleton

Well-known Melbourne photographer Charles Nettleton was commissioned by the Clunes Borough Council to take a series of photographs of the town during 1865-6. The photographs were displayed at the Intercolonial Exhibition of Australasia, held in Melbourne from late 1866 to early 1867.

The classic view of Victorian mining enterprise on the next page, showing the Port Phillip mine in its heyday, was taken around mid-1866. It shows the newly installed elevated launder to carry tailings downstream from the building at its right-hand end. This housed the hydraulic pumps used to elevate the tailings from the settling dam visible in the right foreground.

Both headframes and winding houses of the Port Phillip mine can be seen, the North shaft at the extreme left. Inclined tramways run down the hillside from both shafts to the new battery house, which is built into the hillside. This contained the two 12-head batteries of heavy stamps. Tailings leaving the new battery house were conveyed downstream by another elevated launder, emerging from the bank beneath the building. The small two-storey building to the right of the new battery house contained two hydraulic rock crushers to reduce oversize quartz to the fist-sized pieces fed into the batteries. To the right of the crusher house are the old quartz roasting kilns, not used after the introduction of the first rock crusher four years earlier.

In front of the kilns is the old battery house containing the five earlier stamp batteries. At the right-hand side of the old battery house is an inclined reverberatory furnace for roasting pyrites (described in the next chapter), with its ground-flue leading up the hill to a square chimney. The fence that had marked the boundary of the Company Paddock during the ‘outsider’ troubles of a decade earlier is now falling into disrepair. A large crater to the right of the ground-flue marks where an extensive section of the shallow workings on Robinson’s reef subsided in late 1861.

The Port Phillip Hotel was still open for business at this time, flanked by a small cluster of miners' cottages, while the battery house and mine of the Criterion Quartz Mining Company now dominate the creek bank behind the hotel. Some idea of the quantity of tailings deposited in the creek can be gained by comparing this photographic panorama with that taken by Richard Daintree five years earlier.
Port Phillip and Colonial Gold Mining Company, Clunes\textsuperscript{54}

\textsuperscript{54} Photographs by Charles Nettleton, 1866, f.1, f.2, Clunes Museum.