
Rallinga Mine processing plant.

Image: Marie Willson

Modern tin mining and processing at Melaleuca, Port Davey, Tasmania

A unique story of a small-scale mining operation in the remote reaches of South West Tasmania

Marie Willson

The first recorded discovery of alluvial tin (cassiterite) in South West Tasmania was near Point Eric, Cox Bight in 1891. In 1935, cassiterite was discovered on the Melaleuca plain (near Port Davey) and the deposits were exploited by a succession of small-scale operations. In 1941, the lease was purchased by Charles King who worked the deposit alone until 1945 when he was joined by his son Deny King.

In the summer of 1973, Peter and Barbara Willson and their young family sailed into Port Davey for a holiday and returned to Hobart having purchased part of the King lease and other leases in the area.

Peter Willson was a mining engineer and cray fisherman who came to Tasmania's South West after working in the coal mines of England and Norway and the copper mines of Zambia. As a qualified mining engineer, Peter and his wife Barbara used modern alluvial mining, processing and smelting techniques to produce tin from the peat soils of Melaleuca.

Life at Melaleuca

Peter started mining at Melaleuca in 1974 with just a pan, pick, shovel and wheelbarrow. He continued to fish in the crayfish season and Barbara, a qualified teacher, taught full-time in primary schools in Hobart. As Melaleuca was accessible only by boat, bushwalk or light aircraft, Peter transported goods and materials for the construction of the house and outbuildings into Port Davey on his cray boat *Flicken*. By the end of 1974, Peter had built the house and outbuildings and pegged out and planned the mine workings in Melaleuca.

It became clear that the *Flicken* was not suited to the mining operation; a vessel capable of carrying heavy loads and bulky materials safely was required. In collaboration with Bernard Wilson, a fisherman and boat builder in Triabunna on Tasmania's east coast, Peter designed the new boat. Peter and Barbara helped Bernard to build the boat and the *Rallinga* was launched in 1979.

The mining operation was gradually expanded with purchases of heavy machinery: a backhoe, excavator and dump trucks. These were transported to Port Davey via barge, the *Rallinga* or a fishing boat of sufficient size and then driven several kilometres overland and across creeks to the mining operation. To increase production, Peter designed and built a processing plant and later a tin smelter.

Peter and Barbara provisioned dry goods, meat, eggs and fuel for six months at a time during half-yearly trips on the *Rallinga* to Hobart. Barbara's garden was the primary source of fresh food. Fish and firewood were obtained during monthly trips out to Port Davey. Power for the house was provided by windmill and solar panels. A six-cylinder Lister diesel generator and alternator provided power for the mine. Smaller diesel generators provided power for Peter's workshop and the smelter.

Mining

At Melaleuca, alluvial tin (cassiterite) is found in the gravel sands that lie between bedrock and the overlying peat topsoil. Strip mining proved to be the most economic and practical method of winning the cassiterite-bearing coarse gravel sands.

A small excavator, two small front-dumpers and two portable pumps were used in the mining operation. To reach the gravel sands, the peat topsoil of a strip 5-7 m wide and up to 100 m long was carefully removed and placed to the side of the strip. The reach of the excavator and the depth of the peat topsoil limited the strip width. Topography and the distribution of cassiterite limited the strip length. The gravel sands were removed down to bedrock, transported to the processing plant via dump truck and processed. Once the strip was complete, tailings and washed coarse gravel were returned to the strip. Over time, the excess water drained away through the surrounding peat and gravel sands and the tailings consolidated. The topsoil was then replaced and monitored to ensure successful revegetation. The remaining washed coarse gravel was used to maintain the mine operation's roads and the nearby airstrip.

'Strip mining proved to be the most economic and practical method of winning the cassiterite-bearing coarse gravel sands.'

Processing

The processing plant used a gravity circuit to separate the cassiterite from the gravel sands and was designed and built entirely by Peter.

The gravel sands were tipped from the dump trucks through grizzly bars into a small rotary crusher. The rotary crusher broke down the gravel sands to football sized lumps (or smaller) and these were carried via conveyor belt to the trommel. As it rotated, water was introduced into the trommel, thereby 'washing' or separating out the coarse gravel leaving the fine gravel sands, cassiterite and water (the slurry).

Rabbling the charge.

The washed coarse gravel was transported via conveyor belt to the waste bin. The slurry then passed through a series of jigs that separate the fine gravel sands from the cassiterite. The fine gravel sands and water were pumped back into the strips as tailings. The cassiterite and water then passed over a ripple board to glean any gold and into a tank where the cassiterite settled out. Water from the tank was cycled back into the trommel. The settling tank was periodically emptied and the cassiterite concentrate shovelled into drums.

Initially the operation produced drums of cassiterite concentrate for sale to smelters in Sydney (Associated Tin Smelters) and Brisbane (Northern Smelters). Foreseeing the eventual closure of the tin smelters and because he was always looking for the next challenge, Peter began to work on smelting and refining the cassiterite concentrate on lease.

Strip mining and loading process.

Smelting

In 1992, Peter designed and built his first smelter, a blast furnace. The process of smelting cassiterite in a blast furnace requires extreme temperatures and a consistent quality of feed. Even so, it is notoriously difficult to control the smelter product. Due to the extreme heat, the blast furnace could only be operated in sleeting weather. This limitation combined with disappointing recoveries led Peter to abandon the blast furnace.

Peter started construction of the reverberatory furnace in 1997. Owing to its considerably more complex design, construction took the better part of a year. The smelting process inside the reverberatory furnace required cassiterite concentrate, diesel oil for fuel, coke for reductant and shell grit for flux. In combination with significant heat, these facilitated a chemical reaction that reduces cassiterite to tin. The shell grit, coke and diesel oil were transported into Melaleuca by boat during half-yearly provisioning trips to Hobart.

The smelting process began with warming up the furnace with a wood fire for 12 hours. At the end of this period, the charge was weighed out, tipped into the top of the furnace and distributed inside the furnace using a rabbling iron. The intake and exhaust fans were then turned on and the burner ignited. The furnace exhaust flue was designed in such a way that fumes from the smelter settled in the horizontal section of the flue releasing only hot air from the stack. More charges were tipped into the top of the furnace and distributed inside until it was at capacity and the correct temperature (1300°C) was reached. This was measured using cones that visibly deform at specific temperatures. The chemical ▶

Top Image: Erika Shankley , Bottom: Willson Family


Tapping the furnace to release the molten tin.

reaction took several hours to complete and reduced the charge to a molten pool of tin inside the furnace. At this point, the furnace was tapped through a small hole in the base. The molten tin ran out into 30 kg inverted pyramid moulds that sat on miniature rail tracks. Once solidified, these 30 kg pyramids were the smelter product.

Refining

The smelter product still contained some impurities. To improve the quality of the product, two separate refining processes were undertaken. Both refining processes were dependent on the low melting point of tin (230°C). The impurities (dross, slag and inclusions) generally have a higher melting point than tin, thus, heating the initial smelter product to approximately 230°C separated the tin from the impurities.

The primary refining processes took place while the furnace was still hot. A large inclined iron plate was placed on top of the furnace and heated during the smelting process. The 30 kg pyramids of smelter product were placed one at a time on the plate. As the pyramids slowly melted, the tin trickled down the plate into another mould leaving the impurities on the plate. The recovered tin cooled in the moulds before secondary refining.

Peter constructed a 'kettle' in which the secondary refining process took place. The kettle consisted of a deep steel tub with an inclined plate to one side and an outlet at the base. This sat on top of a wood-fuelled firebox and the whole apparatus rested on a wheeled base.

To start the secondary refining process, the firebox was lit and several 30 kg pyramids of recovered tin were placed in the kettle. Once the tin was molten inside the Kettle, a pipe was submerged, and compressed air was gently bubbled through the molten tin. Impurities were entrapped by the bubbles as they rose to the surface. The impurity-rich froth was then scraped off and placed on the inclined plate. Any remaining tin trickled back down into the Kettle leaving the impurities on the plate.

Once the secondary refining process was complete, the final 10 kg moulds were filled by refined molten tin from the kettle. The refined 10 kg bars were sold to foundries. The product was so pure that it was used as a direct input into the foundry processes. After the closure of the Sydney and Brisbane smelters, Peter and Barbara's smelter was the only remaining tin smelter in Australia. Consequently, Peter reduced mine production to ensure that the entire cassiterite concentrate could be smelted for sale.

Environment

The mine workings encompass a large part of the Melaleuca plain but only a small percentage is still visible from the ground or air due to diligent rehabilitation. Peter was careful during topsoil removal and replacement to ensure speedy revegetation. Historical workings on the Melaleuca plain were re-seeded with native seeds harvested from the area using traditional methods. Very little waste was produced from the household and mining operation; anything unable to biodegrade was stored and transported back to Hobart for disposal.

Peter and Barbara also played an important part in the preservation of the endangered Orange-Bellied Parrot by monitoring numbers, siting nesting boxes within the lease and providing accommodation and resources to researchers and scientists.

Legacy

Isolation, weather and the environment presented many challenges to living and working in Melaleuca. Surmounting these challenges to maintain a comfortable household and profitable mining operation required planning, resourcefulness and ingenuity.

In 2011, Peter and Barbara agreed to relinquish the majority of their mining leases to the Tasmanian Wilderness World Heritage Area. The mine plant and workshops, smelter, house and outbuildings that remain in Melaleuca today are a testament to a remarkable couple who built a life on the quiet edge of the world. ■


Stockpiling the smelted tin.

Images: Erika Shankley