Foundries and ancillary industries - overview

Growth in Cornwall and west Devon mining created a demand for ancillary industries to supply both the mines and its workforce, and to process its output. Amongst these industries (many newly imported to Cornwall) were: foundries; copper, tin and silver-lead smelters; rope-walks; ochre-works; arsenic works; chemical works; charcoal manufactories; candle factories; crucible works; brickworks; clothing factories; scientific instrument manufactories; gunpowder mills and explosives factories.

Engineering and foundries

'*The Engineer makes Engines for Raising of Water by Fire, either for supplying Reservoirs or draining Mines.*' (*The London Tradesman*, 1711)

An engineer, who operated and maintained steam engines, had become a specialist on Cornish mines as early as 1740. Initially parts for steam engines were made in foundries and forges outside Cornwall as the capability to cast and bore cylinders did not exist locally. The Darby firm of Coalbrookdale in Shropshire (established 1709) was one of the principal founders of iron cylinders and, together with others in the Midlands, supplied almost all the early engines in Cornwall.
It was not until the end of the eighteenth century that Cornwall began making her own engines.

The expiry of the Watt Patent in 1800 heralded a period of experimentation in Cornwall by engineers such as Sims, Woolf, Trevithick and Hornblower. From about 1820 virtually all the local mines bought 'Cornish' and by 1840 Cornish engines and engineers were the most distinguished in the world. Globally, as new mineral discoveries were made, so mine engines were despatched to South America, Australia, Ireland and South Africa; in fact wherever deep mining was to be found.

Three of the largest foundries were Harvey's Foundry (Hayle), Perran Foundry (Perran-ar-Worthal) and the Copperhouse Foundry (Hayle). Together they were responsible for the employment of upwards of 3,000 people during the nineteenth century.

Harvey's Foundry, Hayle (1779-1903)

Harvey's was indisputably the greatest of the Cornish foundries. It was established in 1779 by John Harvey and greatly expanded by his son Henry in collaboration with Arthur Woolf. It became the foremost engine foundry in the world, with an international market served through their port facilities at Foundry town, Hayle.

Perran Foundry, Perran-ar-Worthal (1791-1879)

Perran Foundry was the second largest iron foundry in Cornwall. It stood on a tidal inlet of the Fal estuary at Perran-ar-Worthal (near Falmouth) and was set up by seven

members of the Fox family in 1791. A year later, the same partners leased Neath Abbey Ironworks in South Wales and acquired nearby collieries, iron mines and blast furnaces to produce their own pig-iron – creating a vertically integrated operation. They were formulating a production chain of considerable commercial scale; an aim shared by their friends and co-partners in many mines and other ventures, the Williams family of Scorrier.

Copperhouse Foundry (1820-1869)

The Cornish Copper Company started a foundry in their former copper smelting complex in Hayle when smelting ceased there in the 1819. This traded as Sandys, Carne and Vivian and was one of the three great Cornish engine foundries. This works also manufactured what was to be the last Cornish pumping engine to work on a metal mine in Cornwall – the Robinson's Shaft 80 inch engine at South Wheal Crofty, Pool, which was 101 years old when decommissioned in 1955.

Other foundries

Cornwall and west Devon foundries and engineering works also specialised in the manufacture and supply of a wide range of mining equipment. There were foundries in Tavistock, Charlestown, St Just, Tuckingmill, Redruth, St Blazey and other mining districts. Holmans of Camborne was established as a boiler works at Pool in 1801. It developed into the principal employer in the district (over 3,000 employees) and expansion had a significant impact upon the urban development of Camborne. Holmans became synonymous world-wide with excellence in rock-drills and compressors.

Mechanical rock drills

Richard Trevithick (1771-1833) designed a high-pressure steam rock-boring engine, which also lifted and loaded the stone for transport, which was built by Henry Harvey at his foundry in Hayle. Mining rock drills however were not to be adopted in the region until the last quarter of the nineteenth century, well after Joseph Fowle of Boston, USA, invented them in 1851. Rock drills increased the rate of sinking shot holes dramatically. Their operation by compressed air also greatly improved ventilation and reduced working temperatures. But they did have a sinister downside.
The deadly sharp dust produced by early rock drills caused thousands of miners to die a painful death from miners' phthisis (silicosis); drills became known as 'widow-makers'. Cornish manufacturers subsequently pioneered dust suppression by delivering a water spray to the drill bit. Whilst the decline in Cornish mining removed much of the home market, trade in the Camborne engineering heartland soared with the opening up of huge markets overseas. One of the major exporters was Holman Brothers which, with James McCulloch, developed The Cornish Rock Drill. It was in use in South Wheal Crofty, Dolcoath, Tincroft, East Pool, Kit Hill, and in Wales by 1882.

In the late 1880s rock drills were sent to Australia, New Zealand and Spain. In 1889 Holmans began trading with South Africa and interests were concentrated on the Rand Goldfields in what became their greatest market for over half a century. By 1896 there were more than 1,000 Cornish rock drills in use on the Rand gold mines. Their impact upon the development of these deep mines was crucial and by the turn of the century their number had doubled. Both Holmans and Climax had experimental drill test sites, near Camborne and Carn Marth Quarry respectively.

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Copper and copper smelting

Native, or pure, copper would have easily been recognised as metallic masses commonly found at the surface on the Lizard peninsula or in the cliffs around St Just. In sea cliffs, such as those between St Agnes and Perranporth, copper salts create bright green staining that must have attracted attention from the earliest times. The near-surface oxidised zone of Cornish copper lodes produced colourful minerals rich in copper, such as the red oxide (cuprite) and the blue and green carbonates (azurite and malachite).

Copper smelting

The technical complexity of copper smelting meant that sites needed to be close to a plentiful and homogeneous mix of copper ores. In addition, large amounts of coal were needed for fuel and the reduction process; an economic supply of coal was therefore crucial. Copper smelting was carried out in Cornwall in several locations but principally by the Cornish Copper Company at Hayle (1758-1819). In time, however, the high fuel-to-ore ratio required produce a ton of copper metal (copper fine) rendered local smelting uneconomic; it made far better commercial sense to ship the ore to the coalfields.

Shipments were mostly of hand-picked, crushed (‘cobbed’) raw ore but later partly smelted regulus was sent too. At first the ores went to smelters in Bristol, but later the largest concentration of copper smelting works were to be located close to the south Wales seaboard around Swansea. The transport of millions of tons of copper ore accounts for the once extensive mule trade, the tramroads and railways, quays, industrial harbours and shipping fleets. The ‘Welsh Fleet’ brought coal for Cornwall’s steam engines as back-loads in the copper-ore schooners.

In the Swansea region, copper smelting (and indeed much of the tin-plate industry) was in the hands of Cornish industrialists. The Williams family bought the Morfa Copper Smelting Works in Swansea in 1831. Michael Williams (1784-1858) was vested with the responsibility of the Welsh business and became High Sheriff of Glamorgan in 1840. Henry Hussey Vivian (1821-1894) was responsible for the success of the family’s Hafod Works, Vivian & Sons, together with much of the enhancement of Swansea as a port and the creation of a railway to the Rhondda coalfield. He became the first chairman of Glamorgan County Council in 1889 and was made Lord Swansea in 1893. Grenfell & Sons (Copper Bank Works, 1803) was where Pascoe Grenfell partnered the great Anglesey mining dynasty of Williams. Ralph Allen Daniell also started the Llanelli Copper Works in 1805.

Some uses of copper

Defeating the shipworm

From the mid-eighteenth century copper was used to sheath the oak bottoms of ships to protect them from the burrowing teredo or shipworm. The hull of the frigate *Alarm* was sheathed with copper in 1761 which also improved her speed. The Admiralty subsequently had virtually the entire fleet sheathed. Large East Indiamen followed suit and copper was used almost exclusively until 1832 when it was replaced by a new patented brass.

Copper coinage

At a time of an acute shortage of copper coinage Matthew Boulton perfected a steam powered coining press that could produce coins of a standard size and weight. Between 1797 and 1806 4,200 tons of two-penny pieces, pennies, halfpennies and farthings were produced (equivalent to around one year's production of metal from the Cornish mines). Token money, only to be spent at the owners' shops, was issued in Cornwall, notably by the Basset and Williams families.

The sugar industry

The British-led West Indies sugar cane industry used copper to make boiling and refining equipment. It was also used to make brewing vats, distilling and dyeing vessels.

Electric cable

From the mid-nineteenth century the telegraph system required tens of thousands of miles of copper cable for land and submarine telegraphy. Copper was vital to this world-changing revolution in communications and Cornwall saw the first trans-Atlantic cable which came ashore at Porthcurno.

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Tin and tin smelting

The simple oxide ore of tin, cassiterite (SnO^2 – tin dioxide), accounts for virtually all the tin that has ever been recovered. It is noted for its high specific gravity (its heaviness - 7.29 gm/cc) approximately three times the weight of a comparably sized piece of the granite with which it is normally associated. Where tin lodes have reached the surface, weathering and erosion over millions of years have broken up the vein structure and released the cassiterite which is stable and durable and resists rapid breakdown. It tends to lie on the surface as coarse eluvial material, often mixed with quartz. When washed into valleys, it accumulates as concentrated alluvial deposits of dark coloured pebbles and gravel at trap sites within rivers and streams.

Tin smelting in Cornwall was, on the whole, a more capital-intensive and lucrative business than mining and was controlled by a 'ring' or cartel of a few families. Money was often advanced to mines or miners, to be re-paid in tin. For the Bolitho family of Penzance this practice led to them developing banking interests. Thomas and William Bolitho founded The Mounts Bay Commercial Bank in 1807 in the count-house of their Chyandour Smelting House. The Consolidated Bank of Cornwall was taken over by Barclays Bank in 1905. The principal Cornish families engaged in tin smelting were the Daubuz, the Williams, the Harveys and the Bolithos.

The ownership of smelting houses, and of the smelting companies themselves, changed frequently throughout the nineteenth century as industrial families changed their alliances and strategies. A landmark technical improvement in Cornish tin smelting came in 1702 with the introduction of the reverberatory furnace by Robert Lydall at Newham, near Truro. This used coal instead of charcoal and the charge of tin was no longer mixed with (and contaminated by) the fuel, but was reduced by the application of heat alone.

By the nineteenth century, most tin smelting was conducted in reverberatory furnaces, although the larger and more important blowing houses remained until the mid century. Tin smelters within the region were initially concentrated close to the Stannary Towns and navigable rivers or harbours. Those in Cornwall tended to migrate from east to west as production shifted from tin-streaming to deep lode-mining. Most of these early important tin smelters were concentrated in Penzance, Hayle, Truro and the St Austell area. Later, when rail transport had developed (and after Coinage had been abolished in 1838) Redruth became an important centre for tin smelting.

Some uses of tin

For centuries, Cornish tin production was destined for The Worshipful Company of London Pewterers and gave rise to important medieval ports such as Truro. Coins were also minted: tin halfpennies and farthings were introduced by King James II (reigned 1685-1688). In all £10,000 worth of tin was purchased, and £65,000 worth of coins issued. Bronze (an alloy of copper and tin), once used in the production of

cannon (before the development of large reliable iron castings), was also essential for precision instruments.

In 1789 a major new market was found for Cornish tin. The East India Company, which had a monopoly on all official ‘British’ trade with China, began to buy around two thousand tons a year. This was consumed as tinfoil in religious ceremonies and around half of this demand was met by Cornwall.

Tin-plated cans to preserve and transport food were invented by Peter Durand in 1810. During the early decades of the nineteenth century major growth in the tin-plate industry created a new and vibrant demand. Solder was an essential part of that industry and also became a vital requirement of the communications and electrical industries in the latter 1800s.

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Gunpowder

Gunpowder was very expensive during the nineteenth century, largely because of the monopoly on one of its constituents, saltpetre. Gunpowder, or blackpowder, was made by grinding a carefully controlled mixture of charcoal, sulphur and saltpetre together in 'incorporating mills'. The process was complex and extremely dangerous with the mixture being unstable during many stages of the production.

Gunpowder was imported into Cornwall until 1808 when the first Cornish gunpowder factory opened at Cosawes Wood, Perran-ar-Worthal, about 5 miles from Falmouth. The site at Cosawes, and at other works such as that at nearby Kennall Vale (1813), was chosen for its seclusion in a wooded river valley. This ensured both the availability of ample water power and provided some protection for nearby settlements through the natural shielding afforded by trees. The roofs of the factory buildings were also designed to blow off relatively harmlessly in the event of an explosion.

The introduction of gunpowder to Cornwall in 1689 represented a significant technological breakthrough. Rock could be broken with far greater efficiency, permitting easier access to productive lodes and increasing profits. By the nineteenth century gunpowder was being used in quantity and in 1836 alone, 30 tonnes of gunpowder were used in Cornish mines.

The first practical high-explosive ever fired in a mine was in the Restormel Iron Mine (managed by John Taylor) at Lostwithiel, in 1846. By the 1860s high explosives were being used far more efficiently and had become far more refined. In 1866, Alfred Nobel (1833-96) invented dynamite. This nitroglycerine-based explosive reached Britain the following year and Cornwall soon after. The principal Cornish gunpowder manufacturer - Shilson - set up the National Explosives Company at Hayle in 1888.

The first factory was built amidst the protective environment of Hayle Towans and soon became one of the leading manufactories in Britain. In 1889 the British & Colonial Explosives Company was formed and the site chosen for the new factory was a hectare of remote former mining ground at St George's Common, on the cliffs west of Perranporth. Extensive structures survive, both at Hayle and Perranporth.

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Safety fuse

Before the introduction of the safety fuse blasting in mines was extremely dangerous. Shot holes were drilled by hand, a charge of gunpowder and stemming inserted, tamped, and a fuse lit to fire the hole. Rudimentary powder-filled reed or goose-quill fuses burned unpredictably. There were countless accidents to miners involving blinding, loss of fingers, mutilation and death. In 1830, William Bickford, a currier (leather finisher and merchant) from Tuckingmill near Camborne, devised a way of introducing a stream of gunpowder into the core of twisted flax yarns after observing the actions of a local ropemaker. When bound with twine and sealed with a waterproofing varnish of tar, a robust and predictable fuse was produced. Initial designs burned at a consistent 30 seconds per foot and Bickford obtained his patent for the fuse in September 1831.

The production of the safety fuse in Cornwall increased dramatically as more mines adopted it when blasting underground. The Cornish fuse, made not only by the Bickfords but also by other manufacturers such as Bennetts of Roskear (1870) and Tangye's in Redruth (1886), was sent to mining fields throughout the world. Bickford's product predominated however, and they soon set up works in America (1837), Germany (1844) and a subsidiary company in Spain (1860). Production further spread with factories in Austria, Australia and Hungary. A century after its invention, the Company was manufacturing 100,000 miles (160,000 kilometres) of safety fuse per year.

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