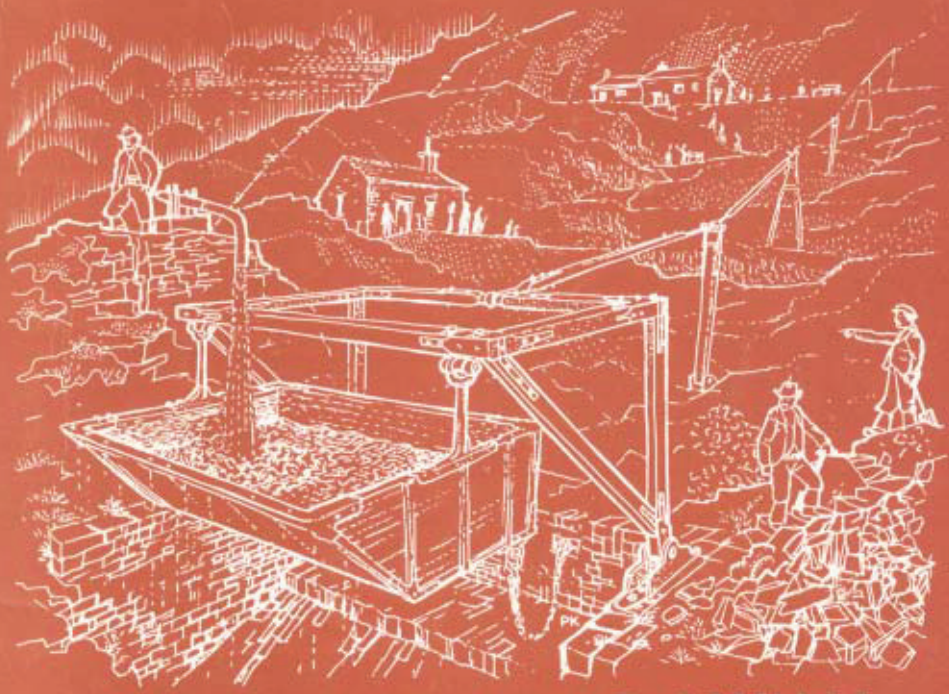
THE LLANDUDNO COPPER MINES

British Mining No. 9.



C.J.Williams.

Aerial view of the Great Orme's Head, 1964, showing waste dumps and try-holes in the area of the Old Mine. (Aerofilms)

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Geology

The Great Orme's Head, Llandudno, is an isolated promontory of the Carboniferous Limestone that outcrops along the coast of North Wales. It consists of over a thousand feet of limestone of Lower Carboniferous age, deformed into a gentle syncline, and traversed from north to south by at least four near-vertical parallel faults, with additional faults dipping south-eastwards at 45-80° and trending north-east to south-west and north north-west to south south-east.

To the east in Denbighshire and Flintshire the limestone bears extensive lead and zinc deposits, but at Llandudno the mineralisation is almost exclusively copper, although minor amounts of lead have also been mined0 Four main lodes were worked; the longest ran for about a mile northwards from near the tollgate on the West Shore to St. Tudno's church. The largest deposits were found at the intersection of two veins known as the 'Hanging Mawr' (Great Slide) and the 'Gyllath' or 'Cyllell' (Knife) veins.

Prehistoric and Roman Mining

The copper deposits at Llandudno were known to and worked by the Romans, and were probably mined in prehistoric times0 Although Roman coins were said to have been found in the Great Orme mines by miners in the nineteenth century, no visible remains of mining activity of this period survive. Evidence of Roman mining comes from the discovery of coin hoards at Llandudno and on the Little Orme, dated between AD 293 and 317. These consisted of large numbers of bronze coins of small denominations (5,000 in one hoard), probably intended for the payment of native miners.

Some ancient implements were discovered by miners in 1849. This find consisted of stone hammers weighing between one pound and fifty pounds, and a number of deer-bone chisels, found in a cavern about forty yards long. The absence of the iron-edged implements used by the Romans suggests that these tools were of prehistoric date, while the discovery of bones with them suggests that the miners lived in the workings. A further discovery of eight bone tools and two stone hammers was made about 80 feet below surface in the Old Mine in 1976.[1]

The Copper Industry

After the withdrawal of the Romans, there is no evidence of mining at Llandudno until the late seventeenth century. The Glorious Revolution of 1688 led to a favourable economic climate for the mining industry, and in the following year the first of several Acts which lifted the Crown monopoly on copper mining encouraged the private prospector. In the early 1690s there began the period of mining activity at Llandudno which ended almost two centuries later, and with which this publication is concerned.[2]

Llandudno was only one of the groups of Caernarvonshire copper mines - there were others in Snowdonia - but it was one of the most productive. At one of the Llandudno mines alone, the Old Mine, it was estimated in 1845 that some £200,000 worth of ore had been

worked[3] (about 30,000 tons at contemporary prices), while if the other two mines' production is taken into account, at least half as much again might be added to this estimate.

Such production figures, however, are dwarfed by those of the mines on Parys Mountain in Anglesey, where enormous quantities of low-grade ores were worked by opencast methods from the 1760s until the early years of the nineteenth century. The output of these mines was controlled by Thomas Williams of Llanidan, the 'Copper King', who was for years virtually to monopolize the industry, previously dominated by the Cornish mines. Ore from Parys Mountain, and Llandudno and the other Caernarvonshire mines, was taken by sea to the coalfields of Lancashire and South Wales for" smelting, until works were built at Amlwch.

Only in the early nineteenth century did the output of the Anglesey mines fall, and it was in this period, particularly from the 1830s to the 1850s, that the Llandudno mines enjoyed their heyday. Over a quarter of a million pounds worth of ore is said to have been raised at Llandudno in the years from 1835 to 1848. The latter year, however, saw the abolition of the duty on imported copper. This, combined with the opening up of reserves overseas - in Australia, North America, and Chile - which could be worked on a far larger scale than those in Britain, reduced her share of the world output of copper to a smaller and smaller proportion, and brought an end to the Welsh copper-mining industry.

CHAPTER I

MINING TECHNIQUES AND ORGANISATION

Mining Methods

Until the mid-nineteenth century, when the study of geology led to a better understanding of mineral deposits, the discovery of a mine was usually a matter of chance; the Ty Gwyn Mine at Llandudno was discovered in about 1835 when a cow displaced a turf showing traces of copper ore. The earliest workings of the copper deposits on the Orme were probably in the area of highest mineralisation - the hollow around Maes-y-facrell. Certainly the earliest documentary evidence we have of mining, a lease to Sir Thomas Mostyn in 1692, concerns mines in this area.[4] Once easily-accessible surface deposits have been worked, which may well have been done in Roman times, the veins must be followed by deeper workings, or other easier deposits located. The surface of the Great Orme shows evidence of attempts to find veins by digging through the subsoil, leaving dozens of characteristically shaped depressions rather like shell craters. Some of these may have been made during a feverish search for metal, inspired by the California gold rush of 1849.[5] Certainly they overlie the 'ridge and furrow' marks left by the plough on the fields of the medieval community on the Orme.

Early shafts were shallow and temporary affairs; once ore had been removed from the vein for a short distance they would be filled up. One early lease stipulates that this must be done 'so that man or beast be free from damage thereby', but a later lease made it a condition that one standing shaft be left well timbered in the forefield at the last working place.[6] Shafts had to be made secure for at least the first twenty feet through the subsoil, either by timbering or lining them with circular dry-stone wall 'ginging' supported on timbers.

The miners gained access to the workings by climbing down wooden or chain ladders or (in very narrow shafts) by foot-holes made in the sides. Ore and waste rock would be carried out by the men in bags until the depth of the workings made it worthwhile to introduce some method of winding. The simplest device was a hand windlass across the top of the shaft; these were also used underground - the remains of one have been found in workings in the Old Mine. By the late eighteenth century horse-powered whimseys or gins were used. Steam engines were not used until the nineteenth century, probably because the remoteness of Llandudno from a coalfield, and the resulting high transport costs, made it uneconomic until small, more efficient engines became available in the 1830s. The earliest engine known to be used at Llandudno, an 18 in pumping and winding engine built by the Cornish firm of Sandys, Carne and Vivian, was erected at the Old Mine in 1835.[7] At no time, however, were miners raised or lowered to their work, even though this meant a climb of four or five hundred feet at the beginning and end of each shift.

Water was not much of a hindrance to the miners until the workings neared sea-level, when mechanical pumping became necessary. As well as a steam-engine, the Old Mine also used a primitive water-

FIG.1 Llandudno at the end of the mining era: detail from plan in Parry's Llandudno: Its History and Natural History (1861), with some additional information (not to scale). The open common land on the Great Orme belonged to the Bishop of Bangor, as lord of the manor of Gogarth; the Old Mine was on this common. The enclosed lands were the property of the Mostyn family, and it was under these, particularly in the Pyllau area, that the New Mine worked. The telegraph near the site of the present hotel on the summit of the Great Orme was one of a chain of stations used for signalling from Holyhead to Liverpool, opened in 1827, it was replaced by an electric telegraph in 1860.

engine. This engine (sometimes referred to as the 'Tom and Jerry') was at Gogarth on the West Shore, and was fed by a spring still visible on the hillside above. Unfortunately no detailed description of this device is known, but it seems to have been a triangular frame, one angle of which was pivoted at ground level. Attached to another angle was a large tank which was filled with water through iron pipes from a reservoir below the spring. The third angle was attached to 1,300 yards of 'brammock rods' or flat rods supported on hinged pivots, and extending over the hill to the main pumping shaft, Vivian's Shaft (see fig.1). Another 250 yards of brammock rods ran to the bottom of the shaft. When the full tank reached the ground it emptied automatically, and the weight of the returning rods worked the pumps. The installation of the engine is credited to Thomas Jones of Newmarket, Flintshire, the agent of the New Mine from 1827.[8] Tom and Jerry, better known today as the cat and mouse characters in the M.G.M. cartoons, were riotous men-about-town in Pierce Egan's Life in London (1821).

Horizontal levels were also driven through barren rock to reach the workings. One shared by the Old and New Mines (possibly from near Pyllau Farm) was in use by the early 1780s. In the 1830s two long drainage levels or adits were driven from sea-level on the West Shore for the Old and New Mines, and the Ty Gwyn level from near the present pier. Such levels not only allowed ore to be trammed out in tubs on rails, but also made it easier for the workings to extend below sea-level. Water could be pumped up to the level and allowed to flow out down it, rather than be pumped the whole of the way up the shaft to the surface.

Until the early eighteenth century the mines would have been worked entirely by hand without the aid of explosives, by the use of hammers and wedges. Solid rock might be softened by 'fire-setting'; a fire was lit against the face to be worked, and when the rock became hot it was quenched by throwing water over it. This cracked and loosened the rock and allowed it to be picked out more easily. Gunpowder was probably first used for blasting at the Ecton copper mines in Staffordshire at some time prior to 1680,[9] but according to Lewis Morris blasting was not common until about 1700, and as late as 1730 many old miners in Flintshire were afraid of gunpowder and would not use it.[10]

Even using gunpowder, driving a level through solid rock was a slow and laborious process. Shotholes had to be driven by hand, one miner holding a drill and rotating it while another man struck it with a hammer. The holes were usually drilled at a slight angle downwards so that water could be poured in. This made the rock easier to work, but a pad had to be fitted around the drill to prevent too much splashing. Once the hole was driven about 18in deep it was cleaned out with a scraper and dried. A few inches of gunpowder were poured in from a powder horn and tamped down. Clay stemming was then added and rammed down with a round wooden stick. A pointed metal pricker was pushed through at one side of the hole into the powder, and more stemming added, so that when the pricker was withdrawn a hole was left for the fuse. Until the invention of safety-fuse in the 1830s, this was a straw filled with very fine gunpowder. It was fired by igniting a touchpaper or candle attached to the exposed end. All these tools

and the gunpowder were found by the miners themselves, or provided by the mine company and their cost deducted from the men's wages. Once a pattern of holes was driven in the working face and fired, the fumes would be allowed to disperse, and the rock cleared and taken out to the surface. Trimming shots might be necessary to make the level a regular shape and size. Some idea of the rate at which a level might be driven may be gained from the Penmorfa level, which was about 6½ ft high and 4 ft wide. Begun in 1834, it was driven 874 yards by twelve miners working alternatively, day and night, and was completed in 1842 - a rate of progress of about six feet a week.[11]

Ventilation had to be provided when explosives were used underground. Sacking screens could be hung from the roof of a level to direct the draught into the working area, and boards were sometimes placed across the roof, and sealed with clay, to make a return airway for the fumes. A natural draught would be created in the mine when it had several shafts and levels, but a short ventilation shaft about 250 ft from the entrance was made when driving the Penmorfa level. One visitor to the mines mentioned that air was supplied by a 'bwgan' or 'hobgoblin' - so called from the strange noise it made - but unfortunately no further details are given.[12]

The main lodes worked in the Old and New Mines were near-vertical, and ran roughly north-south. Levels from the main shafts were driven into the veins, and the ore removed, generally from below. As the miners worked upwards they erected working platforms on wooden stemples across the workings. The areas of the vein from which ore was removed were known as 'stopes' - sometimes twenty or thirty feet wide and over a hundred feet high in places. Art essential feature of a well-run mine was that exploratory shafts and levels should be sunk to open up new ground, so that the length and depth of the workings was always being increased.

The Miners

What sort of men were they who worked in the mines? The last of them must have died half a century ago, but we can gain some idea of their conditions from scattered references in surviving records, from what is known of other areas, and in a very few cases from the recollections of former miners at Llandudno, recorded in the early years of this century.

In their heyday the mines employed between three and four hundred men - and this in the period before the rise of the present town - so that their influence on the local economy must have been considerable. But for most of the men, mining was only a part-time occupation, combined either with fishing or with farming. Some lived in cottages nearby; the Old Mine had ten cottages on the common, which brought in a rent of £25 a year, and twelve cottages were built on the West Shore sand dunes in 1783.[13]

We have some details of one miner's life, for in 1911 the then agent of the Mostyn Estate, G.A. Humphreys, interviewed a former miner, John Williams of Maes-y-facrell, in an attempt to learn something of the mines in connection with their proposed re-opening.[14] John Williams was then aged seventy-four. His father, a native of Glan Conway,

Denbighshire, had worked in the Llandudno mines for sixty-five years. John started work in the mines with his father at the age of twelve. (Another miner began at the age of seven and a half).[15] He worked there for eight or nine years and then emigrated to America. (He came back to Llandudno after nearly twenty years, but by that time the mines had almost stopped work). Father and son stayed with relatives on the Great Orme during the week, but went home to near Glan Conway at the weekend.

Williams and his father worked for the Old Mine, near the foot of the main engine-shaft, Vivian's Shaft, or Copper Ddu as he called it. They climbed down fixed ladders in a footway shaft nearby for about three hundred feet, then walked along a level to the main shaft, and went down it (perhaps another hundred feet or so) on chain ladders. His father would not trust him to climb down the ladders - two men were badly hurt in a fall on them - so for about three years he walked up the Penmorfa level for about half a mile to get to the workings.

The miners worked in groups of between two and eight men, known by the name of the leader, for example 'Peter Jones and partners'. The leader made a bargain with the mine company to work a particular piece of ground. Thus one group might be employed to sink a shaft or drive a level at a certain price per yard, varying according to the difficulty of the work. Unproductive work of this nature was known as 'tutwork'. Similarly, men raising ore could be paid a certain price per ton. For this reason, each partnership got its ore to the foot of the shaft independently, and the ore was kept separate until it was wound to the surface by the company and weighed.

The men's wages could fluctuate wildly. On one bargain the work might be easy, and they would make good money; on another it might be so difficult that the money they had to spend on candles and tools might mean that they actually made a loss on it.

Another method of raising ore was that of tribute. Each partnership took out ore wherever they could find it. They took the greater part of the proceeds, and paid an agreed percentage, generally between a quarter and a half, to the company. This system tended to be used in mines which were running down. The looser control of the men meant that they often neglected essential non-productive work, and jeopardised the long-term prospects of the mine.

Only for one mine, the Old Mine at the time of its sale in 1846, do we have any accurate information on how much the men earned – between 11s (55p) and 17s (85p) a week. This would be for a six-hour shift; only in 1853, when John Taylor and Sons took over the mine, was an eight hour day insisted upon, whereupon the men went on strike. A few years later the prospect of earning 3s (15p) a day on building work in the town tempted men away from the mines.[16]

The miner wore a felt or leather hat, whose wide brim shielded him from water dropping from the roof. For light, he fixed a tallow candle' to the front of his hat with a lump of clay. He probably used candles as well to record the passage of time. Lewis Morris described how the Flintshire lead miners put a candle known as the 'watch candle' in a sheltered corner. Two and a half candles burned in eight hours.[17] A lantern with a birch-bark reflector has been found in the Old Mine.

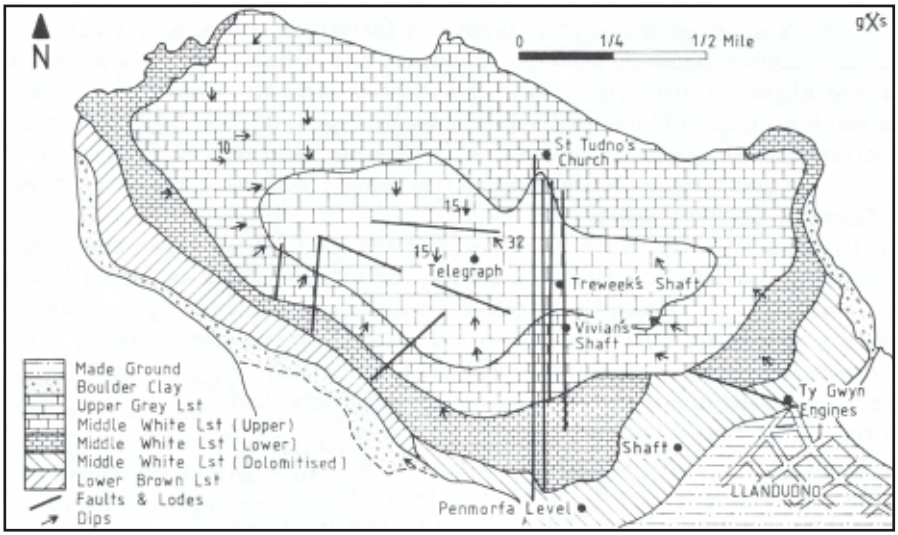

FIG.2 Geological map of the Great Orme, after G.H. Morton, 1898. The main veins worked by the miners were the four parallel ones running southwards from near St Tudna's church, and the one in the Ty Gwyn Mine.

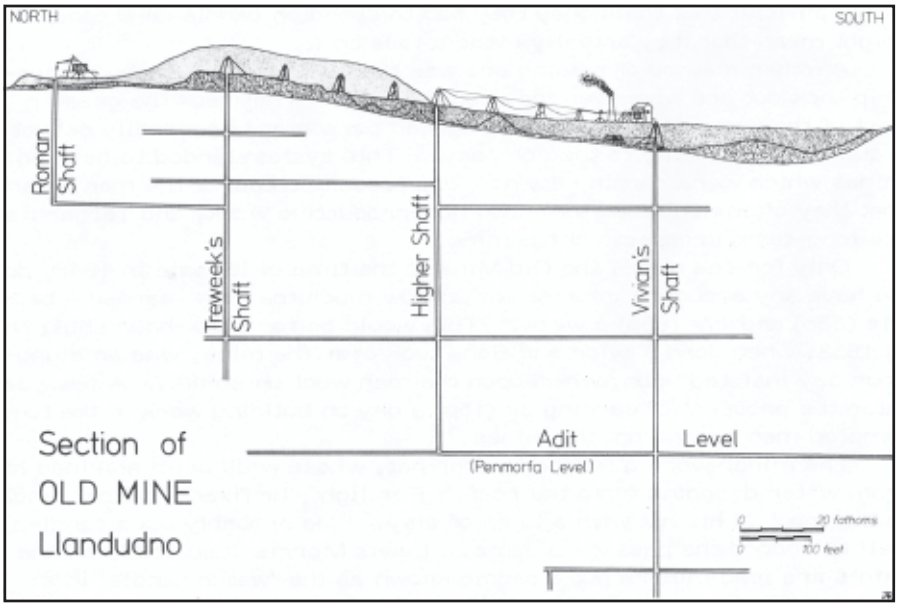

FIG.3 Section of the Old Mine, probably in the 1850s (Mining Record Office). This is the only plan or section of any of the Llandudno mines known to have survived, and it gives details only of the main shafts and levels. The engine in its house near Vivian's Shaft, with vertical winding drum, was adapted for winding both Vivian's and Higher Shafts, and rollers are shown in position to Treweek's. The capstan and headgear at Vivian's Shaft were for raising and lowering the pumping equipment during maintenance work, but no other details of the pitwork or brammock rods (probably abandoned by this date) are shown. There was a horse whim at one of the shallower shafts. A depth of about 210 feet below the Penmorfa level had been reached at this time.

The miners, judging from their names, were local Welsh men, while the mine captains and some skilled men tended to be English. The Cornish influence on mining in the nineteenth century is reflected in the names given to two of the shafts, Vivian's and Treweek's. Vivian's was probably named after Captain William Vivian, who had charge of the Old Mine in the 1850s. A local preacher in Cornwall, he helped to introduce English Methodism to North Wales in 1859, conducting English services in Bodlondeb Welsh Wesleyan Chapel. He left Llandudno in 1860, but a temporary English chapel was opened in the town in 1861.[18]

Mining had a folklore of its own. Most nineteenth-century guide books to Llandudno mention the belief in the 'knockers', mischievous spirits who lived in metal mines, particularly near running water. The sound of their hammers, it was claimed, guided the miners to a rich vein, but once the vein was worked the knockers were heard no more. 'Some venture to affirm that the knockers are nothing more than the rushing or dropping of water; certain it is, that miners are by no means terrified at their vicinity, feeling that they are fellow-workmen and good friends.[19]

At Llandudno and in other mines boots or clogs have been found in a corner, often near the end of a level being driven when the mine was abandoned. They were probably left by the men to bring them good luck in their work.

Mine Companies

The first step for anyone wishing to open up a mine was to come to an arrangement with the owners of the mineral rights on the land involved. The usual procedure was for the miner to take out a lease from the owner, mostly for the term of twenty-one years, The lease described the lands concerned, and stipulated a royalty. This was generally a fraction; a seventh of the ore raised was common, but this might be reduced later if the mining proved difficult and otherwise unprofitable. A proviso would be included that the mines must be worked continuously. A lease granted to Sir Roger Mostyn in 1783, for example, required that the mine should be worked for at least nine months of the year by six men.[20]

There was a formal procedure for signing and sealing the lease and taking possession of the mine. In one case - a lease from Elizabeth Williams of Ty'n-y-coed, Llandudno, to William Bridge of Amlwch, in 1783 - we have a detailed description of it, for a case was later brought in the court of Great Sessions, claiming that Bridge was ejected from the mine. A witness described how:

> ... He did on the twenty-ninth day of March last see Elizabeth Williams ... enter upon and take possession of the Mines and Premises mentioned in the indenture of lease … by going to one of the said Mine pits and putting his (sic) foot on the edge thereof and laying hold the windlass there being no other person at that time in or upon the mines and premises in question ... and then this deponent did then likewise see the said Elizabeth Williams after such her entry into and upon the edge of the said mine pit ... sign seal and deliver the said indenture of lease ... unto the said plaintiff William Bridge and ... immediately after such execution and delivery …

> he took possession of the mines and premises … by turning about the windlass of one of the said pits and afterwards holding the same in his hand …[21]

Even in the nineteenth century, when several hundred miners were employed, the permanent establishment of a mine company was small. The Old Mine in 1846 had fourteen (see chapter III). The miners who formed the bulk of the work- face could be laid off when their bargain came to an end, or taken on again, as required.

The usual method of working a mine of any size was the cost-book system, which had originated in Cornwall. The original working capital was provided by an issue of shares. Expenditure (or costs) were accounted for in the cost-book, made up every quarter. This was then offset against the income from the sale of ore, and any profit distributed among the shareholders. A loss, or expenditure on new equipment such as an engine, had to be met by calls on the shareholders. The disadvantage of the system was that no capital was put aside for contingencies, and once the mine made a series of losses the shareholders, not unnaturally, were reluctant to keep paying their calls. This resulted in delays and legal expenses until the reluctant shareholders were forced to pay up or forfeit their shares. The cost-book system was used from 1853 at the Old Mine, and also at the Ty Gwyn, where in a period of continuous losses it ended in the winding-up of the company.

Ore Dressing, Shipping and Smelting

The ore sent to the surface by the miners had to be cleaned and sorted before it could be sent to the smelter. Some lumps of very pure ore were found in the veins; John Williams remembered seeing some 'as big as three men could lift'. But generally the ore was still mixed with waste material, and the whole had to be broken up, washed and sorted. (The percentage of copper metal produced from the sorted ores varied from under 3% to 34%).[22] In early times natural hammerstones were used, weighing about 201bs. These were apparently brought to the site, and many are still to be seen on the waste dumps on the top of the Great Orme, and also underground. By the 1830s at least mechanical crushers were used. These worked on the principal of feeding the ore between two rollers held together, rather like the old-fashioned household mangle. The Old Mine had a crusher worked by the 18in engine, and the Ty Gwyn an 18in crusher worked by a 15ft waterwheel.[23]

The waste material from the Old Mine was collected as a slime in a big pool between the shafts and Maes-y-facrell. On at least one occasion this slime was found to contain enough copper to make it worthwhile to send it for smelting.[24]

John Williams described the dressing procedure when he was working on tribute in a period of decline:

> … The copper when brought up the shafts was still kept separate and placed in lots. The men then broke it up with hammers and got it as clean as we could and take (sic) out the stones and wash it in big tubs. water was scarce and we had to do a lot of the work with very little water. It was measured in a hand barrow which would

hold as much as two men could lift. It was divided into 3 lots - one for mine owner, one for royalty owner and one for the men who got the copper … After measuring the copper ore in the hand barrow and putting it down in the book, it was mixed together and carted down to the big yard in Tyisa Road … From the yard it was carted (in bags usually) to the ship in Llandudno Bay right before end of Lloyd St …

Ore from the Penmorfa level was trammed out to a yard near the entrance. Here it was hammered 'with big flat irons' (the heavy squared-shaped hammers with short handles, known as 'buckers '), and then sorted in the same way as on the top.

There was never a smelter at Llandudno, so the ore had to be carried to smelting-works in Lancashire, Amlwch or Swansea. (Swansea came to dominate the industry, for it was best placed to smelt the ores produced from the Cornish mines). Some ores from Llandudno were taken to Cheadle and Whiston in Staffordshire in the nineteenth century, and the small amounts of lead ore raised were sold to smelters in Chester and Flintshire.

The ore was taken out by sea. Another former miner, John Hughes, whose recollections were printed in the *Llandudno Advertiser* in 1917, has described how this was done. The ships employed varied in size from the *Sarah Lloyd* of 34 tons burthen (named after the wife of the lessee of the Old Mine in the 1860s) to the Ty Gwyn Mine's flat *Lady Champneys*, capable of carrying 90 tons. There was no landing stage, so the ships sailed in with the tide, and when it went out were left high and dry on the beach. The usual place was near the copper yard on what is now Glan-y-mor Terrace, but the West Shore was also used when the wind was favourable. The ore was carted out to the ship and loaded, and the vessel sailed out on the next tide. John Hughes named some other ships (mostly flats) engaged in ore-carrying: the *Barbara*, *John*, *Eleanor*, *Argyle*, *Lady Willoughby* (a schooner), *Lovely*, *Conwem*, *General Havelocke*, and the *Lady Augusta*.[25] The voyage to Swansea took two or three days, and whatever their destination, the vessels usually brought back coal to Llandudno for the steam engines at the mines.