

GREAT ORME EXPLORATION SOCIETY **NEWSLETTER**



MINING HISTORY

ARCHAEOLOGY

AUTUMN 1989



EDITORIAL

Many members will now know that outline planning permission for the tourist mine has now been granted, common sense prevailing over an earlier Council decision to commission a study into the impact of road traffic on the Orme. Had this decision stood it would have delayed matters for some time but now the road to further progress is so to speak, open.

As reported else where in this Newsletter the recent AGM resolved to create the new class of Associate membership and thus provide an opportunity for persons to follow in detail, developments through these Newsletters. Although the idea is to cater for passive interest in the Society any associate member wishing to contribute articles or other items will be most welcome to do so.

An attempt will be made to produce a Newsletter around Christmas but as ever is subject to people producing articles and other items.

A late item is the possibility of a day trip to a slate mine whose name escapes me. Tom Parry is I believe arranging something and if its half as good as last years trip to Rhosydd will be a good day out made better if Bob Smith goes in his summer wellies.

Thanks to all the contributors to this edition and good grovelling

DES



THE TELEGRAPH STATION. LLANDUDNO.

Published by Catherall & Pritchard Chester.

News & Notes

We do seem to be managing newsletters on a regular basis now in fact this is the 3rd this year. If we continue to produce these and hopefully to improve the presentation, there are a few points. Please take them on board.

Newsletters are produced for the society because of the good offices (literally and metaphorically) of Tony Hammond. If the true cost of photo copying were applied then it would be at least £2.00 per copy. It would be wise to bear this in mind when considering associate fee levels, due to be considered at the next general meeting.

I can think of many improvements in presentation, but a lot of these are constrained by the time and much of the material received for publication arrives pre-typed. It would assist if typed scripts had 1" margins at the sides and 1" from the top.

We shall only be able to produce newsletters as long as people contribute material. Within our membership we have a tremendous range of knowledge and expertise. Please let's have articles for publication and any interesting pictures etc. There are many comedians in our ranks surely there's someone who can draw as well. A regular cartoon spot would go down well, any volunteers?

To a certain extent the newsletter is a record of the progress surrounding the exploration and evaluation of a nationally important site. If the development of the tourist mine proceeds I feel sure that back copies of these newsletters could become a source of revenue to the society.

* * * * *

During exploration of the older workings Andy Lewis reports finding small flakes of what was thought to be native copper. Analysis of these at Bangor (Courtesy of Dave Jenkins) has shown these to be an arsenical bronze. This poses the question of where does the arsenic come from and what do the metal flakes represent. Andy considers the most likely explanation is that they are fragments of tools lost during working. If this is so then surely it opens the possibility of an intact tool being found.

As to the source of arsenic there are arsenic mines in Snowdonia and perhaps trace element analysis could confirm them as a source.

The fire setting experiment carried out on 21st & 22nd October was a great success in showing just how well the technique works. An earth shattering success. Full details in the next newsletter.

The summer 1989 journal of the Shropshire Caving and Mining club carried an article on the Orme Copper mines inspired by their visit to the mines last spring. Andy was guest speaker at the club's annual dinner held on the 30th September.

Annual General Meeting Report

There comes a time in the life of any organisation when it steps back and critically considers itself. GOES did that at the Annual general meeting held on the 11th August 1989 at the Wedgewood Hotel,. The following matters were considered.

Position Of Honourary President. The period of office of the present post holder, Mr Tom Hannon had now ended and Edric stated that he had written inviting him to become the societies first Associate Life Member. This would be subject to the meeting approving the creation of an associate class of membership. No reply had been received and the meeting resolved that the post should be retained but kept vacant.

In the absence of nominations and the willingness of the present officer to continue, all were confirmed in office until the next AGM which is to be held on the 19th January 1990.

The motion to create a new class of Associate Membership resulted in a vigorous debate both on the wisdom of such a step and how much such members should pay. Inevitably the question of full members subscriptions came into the discussion and a motion was passed that subscriptions will be raised to £6 per annum and that a new class of associate membership be created with a subscription rate of £5. Associate members will be entitled to receive by mail copies of Newsletters and all social functions will be open to them. Associate members will not carry the insurance cover provided for full members hence will not be able to go under ground.

An equally lively discussion surrounded the question of communications between members for information on trips. In the end the present system was reaffirmed ie Andy Lewis and Richard Burton usually know what is going on so they are the contacts.

A resolution was made that Aberconwy Council be approached with a suitable drawing of a plaque and a proposal that this be erected by the Society near to the Ty Gwyn Entrance. The plaque would give information on the mine and would commemorate its rediscovery by GOES.

The subject of the societies intentions towards further work in the Ty Gwyn was raised. There seems to be a diversity of opinion on what the societies role should be in terms of exploring blocked passages in the adit or should we be trying to locate other workings in Happy Valley. It was pointed out that the society is not in any position to under take developement of a tourist mine. However the meeting was advised that a twelve month lease had been granted to a local concern to evaluate the tourist potential and it was expected that society members would play a part in underground work if required. For the time being access to the Ty Gwyn is assured and the meeting accepted the idea that a regular digging evening be designated each week. It was also confirmed that permission to break down the cellar wall opposite to the Grand Hotel had been granted by the council and work has been scheduled for a weekend in 1990.

In order to recognise outstanding services to the Society by members it was resolved that two trophies be awarded annually. The first is to be called The Silver Rock Bolt Trophy awarded for outstanding services to the Society and second, The Ty Gwyn Award for the member who has created the most mirth during the preceding year (guess who'll win that).

It was also resolved that a series of information leaflets on the Orme Mines be prepared. Such leaflets would be a source of revenue to the Society since they could be sold for 15-20p each. Dave Smith is to be the coordinator for members wishing to make an input. (please see note else where in this Newsletter).

A note from Don Smith now redeparted for Canada after a brief visit drew attention to the need to protect the copy right of photographs when these are used by the press. Don also asked that if material is used by the press to ensure that it is reproduced the right way round.

Would all smoking members please note that the practice is banned underground and in order to help resist temptation are requested to leave fags cigars pipes or any thing else smoked above ground during trips. It has been pointed out that this is not the first time that a smoking ban has been imposed. Apparently John Taylor banned it in the 1850s.

The proceedings of the meeting having taken up an unprecedented three hours were closed and members were shown the latest series of pictures take by Don on his visit followed by a selection of Chis Jowetts slides.

INFORMATION SHEETS

As resolved at the general meeting work is to start on the preparation of a series of information sheets. The financial reasons for doing this are the same as the newsletter, they form an increasing source of revenue to the society and are an advertisement for its work. In view of the anticipated rush of volunteers for producing sheets may I suggest the following subject headlines and persons who feel they can contribute can get in touch with me (Dave Smith C.B 516572)

Suggested subject areas

History of the Ty Gwyn mine.
Geology of the Orme.
Smelting of ore
Mineralisation on Great Ormes Head.
Mine Machinery.
Mining Method 2000 BC to 1870 AD.
Bronze Age Mining Technology.
Mining Folk Lore.

FIRESETTING

Introduction

The discoveries made at the Great Orme during the past two years indicate that the site was a major copper producing mine during the Bronze Age period (radiocarbon dates 1700-1000 BC.) . The technologies associated with the immense scale of mining evident here, are only now beginning to be realised. One obvious line of enquiry is how these early miners were able to extract copper ores from such great depths, often to 100 feet below surface and for at least 500 feet laterally. The only methods available in order to attain these depths would have been the process of firesetting coupled with the use of stone and bone tools and to a lesser extent bronze tools.

Firesetting

The process of firesetting is recognised as being one of the earliest methods of fracturing rock in order to render it more workable for either mining or quarrying. In fact the process was known to Neolithic man over 5000 years ago, and even continues to be used today in particular mines such as those in parts of South America.

The actual method simply entails lighting a fire against the rock surface required to be broken (i.e. a mineralised area of ground). The heat from the fire affected the rock in a number of ways, firstly it would cause expansion causing tension with resulting fracturing. Secondly by vaporising any water within existing fractures creating further cracking. Sometimes the heated rock surfaces were doused with water, the resulting contraction causing intense fracturing in certain rock types.

After the fire had subsided and the fumes cleared a combination of stone, bone and antler tools were employed to break away the now heavily fractured and weakened part of the mineral vein.

As firesetting technologies improved it became more efficient to direct the flames and heated air from the fire onto specific areas of the mineral vein. Underground this would have been achieved by a system of ducting using wood and material to produce box type sections which would either conduct the fumes away from the fire or assist in drawing fresh air to the point of combustion. As the mine increased in extent further passages would become available, when linked together they would improve ventilation to a greater degree.

The normal fuel used in firesetting would be dry timber, typically indigenous trees to the area. On the Great Orme the charcoal identified amongst the mine spoil from firesetting is oak and alder. One peculiarity about charcoal from the Great Orme when compared to other recognised sites is its small fragmentary size (normally less than 10mm across) and its poor distribution through the mine waste. A suggestion that charcoal rather than timber may have been used as a fuel on the Orme has been put forward, perhaps this would then explain the above observations, as charcoal tends to burn out almost completely whereas timber usually leaves some residual deposit. Could it be that Bronze Age miner on the Great Orme had perfected firesetting to such an extent that the characteristic charcoal remains are almost absent?

Conclusion

To date little research into experimental firesetting has been completed, an article by Timberlake and Picken (1988) gives some insight to the process and poses many questions, some of which will only be answered by continued firesetting trials. References in De Re Metallica and Tin In Antiquity also supply further but limited information.

Any firesetting experiment no matter how limited, would eventually assist in producing an overall picture of how ancient man was able to achieve the scale of mining, which recent study is only now beginning to realise. It is the aim of the Great Orme Exploration Society and Early Mines Research Group to advance research in these fields.

References

Agricola G. (1556) De Re Metallica Translation by H.C.Hoover and L.H.Hoover

Penhallurick R.D. (1986) Tin in Antiquity Institute of Metals

Timberlake S. & Picken J. (1988) Stone hammers and firesetting Bull. Peak District Mines Hist. Soc.



A—KINDLED LOGS. B—STICKS SHAVED DOWN FAN-SHAPED. C—TUNNEL.

CA.L Sept 1989

AN EXCURSION INTO THE PENMORFA

On a Sunday morning in August this year a group assembled at the Penmorfa, Phil, Bob and Alma Smith, Richard Burton, Dave Jenkins, Geoff David, Bill Oliver and myself. A trip into the adit had been long overdue, and there was a distinct air of enthusiasm among the party. Soon we were lifting the unlocked gate off its lugs, noting the vegetation was now quite thick and was obscuring the portal. Once inside all those memories came back, the shock of the cold water, the damp, the oozing mud and that finely constructed dry stone lining. We noted the bulging masonry that coincides with the driveway to Glan-y-don cottage had deteriorated further, many commented that something should be done soon.

Ahead lay the notorious mudslide, no different to normal, perhaps one day it will be cleared. Beyond, the tunnel lining appeared to have narrowed, probably as a result of the pressure of mud that flows from between the beds of limestone here. Then started the long haul though waist deep water along the perfectly cut straight passage, I could not but help marvel how each six foot of passage represented one weeks around the clock work, the complete tunnel taking eight years and eight months to complete between 1834 to 1842.

On one of the walls half way along our route I noticed many initials of explorers of the 1970's, they included two very notable people of the time "Billy Davies" and "Huw Tudno Williams" dated 1977.

We finally reached the point where the level had broken into the workings, here we took the right hand fork passing the two flooded shafts, which Chris Jowett one day intends to dive, this year he says! At the base of Vivians shaft we stopped to look at the blockage and wonder how far it continued, and to what height the column of trapped water extended. A quick on site calculation estimated a mass of water at least 100 foot high lay above us.

From Vivians the party headed north to where Higher shaft had once connected but was now blocked. The passage continued to where it had been intended to connect with Treweeks shaft but was never completed. The walls of this passage had become coated in calcite flow stone ranging in colour from yellow to red from iron oxides and from green to blue due to secondary copper mineralisation.

The party then returned to the "Y" junction, this time taking the left fork, there we spent a quarter of an hour investigating some of the ways off the cross cut at the second vein, these were the first workings I had explored when I was introduced to the Penmorfa in February 1975. In those days wetsuits were unheard of and you were doing well to have a carbide lamp! This place will also be remembered by Billy Davies and those who were with him on the day he decided to take a very quick route down one of the shafts he was attempting to climb. As always Bill survived to climb again another day.

Finally the group set off to the higher workings from the main junction, stopping to view the most eastern of the veins in this area, which clearly displayed the hanging wall and foot wall of the lode indicating a dip to the west. A stop for food and drink was made before we headed off over the "ice bridge", here we were within one of larger stoped veins, could this have been what the old miners referred to as the "cyllell" or knife.

Before long we were climbing a series of small rising walk-ways that ended at the large flat roofed chamber, this was certainly the largest chamber that has so far been discovered, being roughly 60 by 80 foot across and at least 50 foot high. From here a number of passages radiated, these were explored into places which I or others in the party had not visited before, once more showing that there are always new areas to be found in these seemingly endless workings.

In one place here Dave Jenkins and myself observed a rock cut feature about four inches wide that extended around the walls and roof of a passage, suggesting some sort of sealed doorway, possibly to control ventilation. This was as far as we were to go, and so we returned to the "Y" junction, one half of the party returning via the "ice bridge" while I followed the remainder through the more sporty route down the lower waterfall pitch. We were all glad to cool off as we waded back through the water in the main level towards the entrance

Back at surface we were greeted by Les and Martin Smith who had thoughtfully brought along a supply of hot tea and whiskey or should I say whiskey and hot tea, this completed a most enjoyable though long awaited excursion to the Penmorfa.

One note I would like to make is that Bill Oliver probably our oldest member completed the tour as well as any man, if not better than some I have seen, and he is 72! (sorry Bill if I have the age wrong, blame Edric). The above described excursion was made on sunday 13th August 1989.

C.A.Lewis, 7th September 1989



THE CAMBRIANS AT LLANDUDNO

The Cambrian archaeological association has been in existence since 1846. During this time it has developed an annual general meeting conducted in North and South Wales in alternate years. This enables its members to study different areas under the guidance of experts in different fields. This year it was the turn of Llandudno to host the 90 odd members of the society who came. Total membership is about 850. This year several areas were visited but I shall only talk about one day that was spent viewing sites on the Orme, Wednesday August 16th.

Most of the members stayed at the Tynedale Hotel on the Promenade. Here we were met at 9.00 am by two members of the Llandudno Historical society, Bill Oliver and Elan rivers who took us on a walkabout on Llandudno prom explaining the history of the area and giving many anecdotes. We finally ended up near the pier, at the entrance to the Ty Gwyn Mine. This walk took about an hour and we were at the tram station by just after ten o'clock. Here we had a set back. The telephone system had broken down they wouldn't run the tram up the Orme without it being repaired.

Crosville had charge of our transport and laid a green dragon bus to shuttle members up the Orme. However many of us walked, straight up from the station. The older members 80 and over went up on the bus. Our oldest member is 92.

At the halfway station we were met by Danny Dutton and Richard Burton. Danny gave us an admirable exposition about his excavations at the mine which was appreciated by all. In addition we were shown a selection of the objects that had been found.

Frances Lynch from bangor university gave a talk about the chambered tomb, Llettyr Ffiliast.

By this time the bus had come up with our lunch and we proceeded up to the car park on the top to eat it. During lunch a very sharp shower of rain sent us running for shelter, however it didn't last long, and was the only rain of the day.

After lunch we assembled outside the Nature centre to hear an address of welcome from the warden, in the centre Frances Lynch gave us a resume of the prehistoric sites, with the aid of maps, that we were to see during the afternoon.

The more hale and hearty members of the society followed Frances on a tour of the long huts, hut circles and lynchets to be seen to the north of the summit. Here we were shown what appeared to be settlement sites, both of round and rectangular hits and fields that showed strips and lynchets. Some of these could well have been medieval, others were no doubt prehistoric.

Peter Smith, the secretary of the Royal Commission on Ancient Monuments was with us. In 1950 he and I did a chain survey of the Hwylfar Ceirw, which we have always looked upon as being a stone alignment of Bronze Age late. Frances Lynch thinks it is nothing more than a ploughed out field bank!

We then returned to the summit where the green dragon awaited us and we were taken down to the west shore to meet the other buses.

From here we proceeded to Deganwy Castle for the final site of the day. One of the members of the Gwynedd Archaeological Trust gave us a lecture on it embodying some new ideas about Maelgwyn Gwynedd.

We then returned to the Tynedale Hotel where I had dinner with the Smiths. After dinner Peter and I visited two old friends, both over 80, at Llandudno Junction. In 1950 Peter, David Paterson, and I had hired a rowing boat and rowed around the Orme to the Llech cave where we made a plan for the inventory of ancient monument for east Caernarvonshire.

Finally Peter ran me home in his Land Rover. In the dark we missed the way and ended up going back through Pydew.

The end of a perfect day ; out with the Cambrians.

Frank Jowett.

BRONZE AGE ICE AND VOLCANOES

As future work on the Great Orme mining continues it is likely that attention will turn to a search for settlements where the early miners lived.

There are several candidate sites for investigation and if these are the Bronze Age settlements it will be interesting to see if evidence is found of the sudden and dramatic change in climate that occurred in 1150 BC.

The change is recorded in the growth rings of ancient trees found in bogs in North Western Europe and North America. Further evidence comes from ice cores in the North Greenland ice cap where by studying the ratios of oxygen isotopes $^{16}\text{O}/^{18}\text{O}$ in the ice it is possible to infer past climates. Within the ice cap layers are a fine deposit of volcanic dust coincident with the 1150 BC horizon. This has been geochemically analysed and is known to be the result of an eruption of the Icelandic volcano Hekla. The fall out from this eruption has been found in many sites in North America and North West Europe and its geochemical signature confirm it to be that of the 1150 BC eruption known as Hekla III. Find a layer of Hekla III dust and you have an accurate date of 1150 BC. It has been found at Bronze Age sites coincident with other evidence of a sudden change in living pattern best explained by a deterioration in the weather ie a volcanic winter.

All of these ideas and the evidence were put forward in the BBC television HORIZON program entitled 'Time Of Darkness' and broadcast on the 26th June 1989. Those readers who saw this excellent program will know the evidence presented to explain the effects of volcanic eruption on the weather. It links the prospects of global warming due to mans activities to that of cooling due to volcanic effects. There is substantial evidence to suggest that certain types of volcanic eruption inject large quantities of sulphur dioxide in to the stratosphere which reacts with water vapour to form an aerosol of sulphuric acid. Reflection of the suns energy by the aerosol is thought to produce a cooling effect and precipitate a very sudden change of climate. The theoretical model fits the known facts and its predictive ability has been tested by the eruption, in 1982, of the Mexican volcano El Chichon. Large quantities of sulphur dioxide were injected into the stratosphere and when the data was fed into a computer simulation of the weather patterns it predicted severe winters in 1984 and 1985. As we all remember we got them.

So to go full circle maybe we shall be seeing evidence of the 1150 BC volcanic winter and perhaps even the dust will be detected although I don't think its been found this far south as Yet.

Recollections.

It happened during one of the early Vivian trips, a big one as I remember. The object was to collect charcoal for carbon dating and several eminent visitors, armed with small plastic bags and tweezers had joined the party. Had I not bumped my knee on the abseil down I would probably just have tagged along and striven to look intelligent, the darkness would help.

As it was I felt anxious about negotiating the caving ladder and decided to take things a little easy. I've always, or should I say I always used to, enjoy grovelling on my own away from the main party dousing my light and having a little 'natter with the knockers' in the total darkness. At the start of a rather long and tight crawl I excused myself and said I'd stay where I was, and "do a little research". I don't suppose they were impressed in the least but the natural courtesey of the mine explorer prevented them expressing their thoughts ! I watched the last light disappear into the tunnel sat on a ledge in the large stope and extinguished my lamp.

It is always difficult in retrospect to accurately recall a sequence of events. I distinctly remember, 'looking into the darkness' and thinking of how it must have been in the old days.

My awareness of the light was a gradual process and it seemed a long time before I realised that it came from two candles, small fat tallow candles. Both were attached to the bowler like felt hats of two miners, who apparently oblivious of my presence, appeared to be discussing the area beyond the tunnel. Try as I will I cannot recall any actual conversation between them, but somehow I knew they were discussing those who had once laboured in the 'old workings'.

The older miner held his hands up at face level and then brought them down in a hammering motion. Was he demonstrating the use of a stone maul ? The younger man smiled and shook his head, almost extinguishing his candle in the process, raised the short handled sledge hammer he was carrying and patted it's iron face. They then moved off through the stope and the darkness enveloped me. I now not how long I sat there in some sort of timeless limbo.

I sensed rather than heard the party coming back along the narrow crawl. By time the first one emerged into the stope my lamp was alight and I was eager to get out. It is said that I ascended the caving ladder, "like a rat up a drain pipe".

Tom Parry. August 89.

More Subterranean Animals.

In 1869 John Price, a gloriously eccentric cleric, naturalist and historian published a guide book entitled, "Llandudno and how to enjoy it".

He briefly mentions the copper mines,

" Further up the hill, the refuse of the disused (query used up ?) mines will reward the mineral collector with specimens of lead and copper sulphides, and occasionally coarse malachite. It used to be an amusement to pass two or three hours under ground with John Roberts of the Cefn Meiriadog "venture" for guide, climbing ladders with far-fetched steps, by the light of your own candle stuck into a potatoe or clay ball, to see the ores and spars in situ, amid shafts and galleries said to be commenced by, "gwaith yr hen Romans", and a horse or two, sleek and well favoured in that uniform temperature, and forbidden to see the light of day, unless by medical advice, till you emerged at last, delighted with the subterranean treat, though mud-besmeared, half suffocated, greasy, purblind, and looking like a boiled Owl from Oxford."

Unfortunately he is vague as to the location of this pioneer of tourist mines. The reference, "further up the hill, the refuse of disused mines . . .", could apply equally to either the Ty Gwyn or the Pyllau workings. It would appear that the mines were entered by descending a laddered shaft. Sadly he omits to mention the depth but it is highly unlikely that Victorian tourists would have been prepared to ladder into very great depths, is it not ? Shafts and galleries would have been common to all the local workings and the reference to, "gwaith yr hen Romans", is to this day a somewhat contentious issue !

It would appear that, 'Old Price', as he was commonly known also pioneered the practice of writing, subterranean animal articles ! References to horses in metalliferous mines are rare and their use was certainly uncommon. Local mine exploration has never revealed any evidence of the use of pit ponies, and yet he positively affirms the presence of, "a horse or two, sleek and well favoured . . .". He states that these animals never left the mine which seems to suggest that they were employed at the foot of a shaft rather than in dragging tubs along an open level which could have been the case in either Penmorfa or Ty Gwyn. Where then could he have seen them ?

Is it possible that these stories of strange animals in underground workings could occasionally be true ?

Tom Parry. August 89.

THE VIVIAN'S

While reading through a history of the smelting industry in the Swansea area published in 1881, I found a number of references to the Vivian family, and their endeavours, which I hope will be of interest. The first mention refers to a Richard Vyvyan of Trenouitthe, Cornwall, in 1582. This is during the period when the Mines Royal Society was being formed and incorporated, and smelting in Swansea was just beginning. He had been at Neath with his ship while it was undergoing repair. It seems likely he was transporting copper ore as a mineralogist, Mr Carnsewe, Sir Walter Raleigh's Quartermaster, had written to Sir Edward Stradling, the then High Sheriff of Glamorgan, asking for help as Richard Vyvyan was having administrative problems too.

Nearly 200 years later, in 1755, John Vivian (capitalist and mine owner), Sampson Swaine (Smelter of South Wales), Matthew Boulton (Partner of James Watt), and probably others formed the Cornish Copper Company with a capital of £500,000 to fight the Swansea and Anglesey strangle hold on the price of copper (the ticketing process) and the smelting industry. They built furnaces at Hayle (Copperhouse), near Cambourne where they smelted about 4-6,000 tons pa. They were opposed by the Swansea and Anglesey industries and were not widely accepted by their Cornish brothers in the industry. Stocks of ore built up as a result of the market manipulations, prices fell, mines closed and men were thrown out of work. In addition, supplying coal suitable for smelting in adequate quantity proved to be expensive. They ceased smelting and the Cornish Copper Company came to an end but the investors were able to salvage their investment.

John Henry Vivian, John Vivian's second son, was born in Truro in 1779 and came to South Wales when his father moved his smelting operation to the Swansea area. In 1800, John Vivian built his first copper works in Penclawdd which was managed by Mr W Rees who later moved to the Amlwch works where he died.

Ten years later, in 1810, John Vivian obtained a lease to build the Hafod works at Swansea from the Duke of Beaufort and Earl of Jersey in the name of his two sons, Richard Hussey Vivian and John Henry Vivian. Their business prospered and in 1831 the Williamses (W Williams of Cornwall) and Vivians obtained the lease on the 'Birmingham' works which later passed to the Vivians alone who converted the works to handle zinc.

Germany was the source of the mining and smelting technologists in the 16th century and was still a leader in the field during this period. It was therefore to Germany that John Vivian sent his son, John Henry, to learn the very latest and best smelting technology. On his return he was instrumental in employing a German chemist (Mr G B Herrmann) at Hafod who remained with the family firm after his death, working for his son Henry Hussey Vivian.



J H Vivian
MP FRS FGS

John Henry Vivian was an expert in his field and having contributed academic articles on smelting and geology was elected to Fellowship of the Royal Society and the Geological Society. He was also MP for Swansea for six successive Parliaments from 1832 until his death in 1855. He was among the first to realise the appalling effect copper smoke was having on the local population and the environment. He used several new patented methods to reduce this and put up prize money of £1,000 for men such as Professor Faraday to come up with a solution but without success.

His elder brother, Richard Hussey Vivian, didn't stay with the business but joined the Army. He was appointed Baronet, with the title 'Lord Vivian of Glyn', in recognition of his

services during the Peninsula War.

In 1839 Messrs Vivian obtained the run down works at Taibach which they revived and enlarged. The managing partner in this enterprise was Mr A Pendarvis Vivian, MP for Cornwall West, but I have no idea what his relationship was to the family; perhaps he was a cousin.

In 1853 the Williamses, owners of the Morfa works, and their neighbours at Hafod, the Vivians, bought the White Rocks works close by. The works took its name from the barren appearance of the rock produced by the sulphurous fallout from the smelting industry. The Vivian's portion was later converted to work silver lead. Five years later the Vivians again teamed up with Williams and Sons to buy the Spitty works.



R H Vivian,
Lord Vivian
of Glyn



H H Vivian MP JP FGS

Henry Hussey Vivian maintained contact with German industry, not only by Mr G B Herrmann, but by bringing across from Germany 30 men to work the Forest copper works (under German management; Mr Daehme) which he had bought in 1867 and had converted to work zinc. Like his father (JHV), he became an MP and he worked at reducing the noxious fallout from the furnaces. Pembrey works had been compelled to build tall chimneys up to 250' high in 1847 and Cwm Afon works had a flue ducting the smoke up hill to a chimney at the summit; a total of 1200' from furnace to chimney top. This only served to deliver the fallout somewhere else and wasn't the solution. [Sounds familiar...acid rain]

His chemist, Mr G B Herrmann, brought his attention to a process known as the Gerstenhofer system which was tried out on several furnaces and found to be effective. Although expensive to install, once working it was economical as it produced a useful by product, sulphuric acid. It involved turning the furnaces from a horizontal axis to a vertical axis and feeding them from

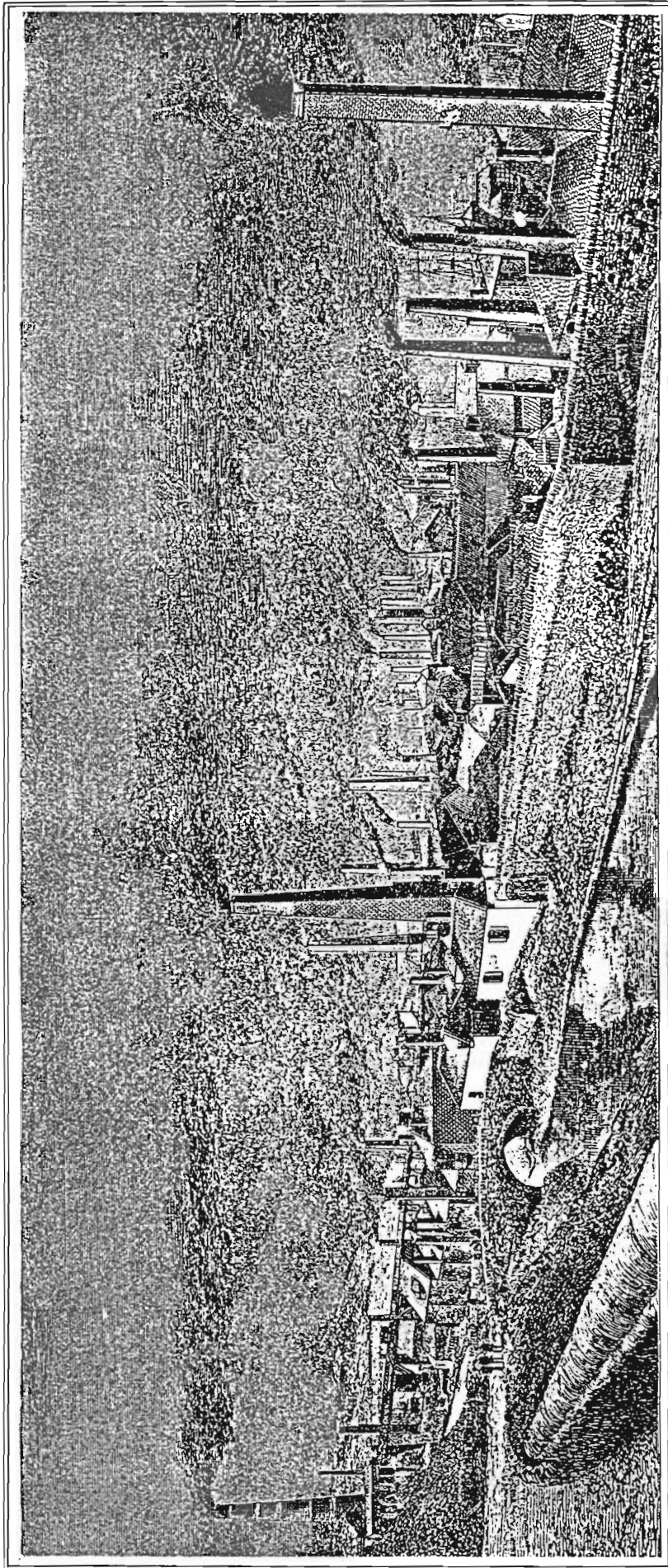
the top. The ore fell in over a series of triangular bars. The ore below was roasted and gave off sulphurous fumes which condensed on the bars and then burned off in an exothermic reaction which helped to heat the incoming ore.

The fumes were collected and passed into large condensing chambers where it either bubbled through water or passed through a water spray, to form sulphuric acid. The final effluent may not have been acceptable by present day standards, but it was a considerable improvement on their previous practice. H H Vivian then systematically converted all his furnaces which was clearly expensive but economically worth while. His neighbours however, were not as ready to modify their process and continued to belch forth copper smoke for some time.

The sulphuric acid was then used at the alkali works and to make super phosphate fertilizer very close by; both works were owned by the Vivians. They developed a very lucrative chemical business from their main enterprise and it is therefore little wonder that the Hafod complex was incorporated into ICI in about 1920.

Ref: The Smelting of Copper in The Swansea District of South Wales; by Col. George Grant Francis FSA, published in 1881.

Don Smith, London, Ont, May 1989



VIEW OF THE HAFOD COPPER WORKS.

ON THE SWANSEA RIVER, TAWÉ.

CONSTRUCTED BY MESSRS VIVIAN & SONS.

A.D. 1810.

DOWN BELOW

It's amazing what you find, down below,
Tools of every kind, down below,
There are skeletons as well,
But they no longer smell,
It's amazing what you find, down below.

As you're grovelling around, down below,
Where Knockers did abound, down below,
If they're throwing stuff at you,
It's to stop them feeling blue,
Be kind to fairy folk, down below.

As you navigate the mine, down below,
Keep where you tread in mind, down below,
If the floor begins to shake,
Then another route you'll take,
It's an awfully long way down, down below.

When you find an artefact, down below,
Leave the find intact, down below,
Record the things you find,
Leave only prints behind,
There's data to collect, down below.

When you find the N-W Passage, down below,
Be sure to tell Huw Sage, down below,
There's a few ahead of you,
Colonel Mostyn went there too,
You'll have to form a queue, down below.

They say the Roman's mined, down below,
They kept their miners chained, down below,
If rattles you do hear,
You do not need to fear,
They're turning in the ground, down below.

There are many ways to go, down below,
To abseil's quick to go, down below,
But coming up's the trick,
Like a monkey up a stick,
Be sure you're rigged to go, down below.

When digging in the strata, down below,
Who's history you're a parta, down below,
Please excavate with care,
You're not the first ones there,
You'll find the originat'r, down below.

In the limestone you will find, down below,
Dripstone of every kind, down below,
Malachite and pyrite,
Galena and dolomite,
But most of it's been mined, down below.

When wading down the adit, down below,
You think your tiny's had it, down below,
It could have been far worse,
And volubly you curse,
Outside it's 10 below, below below

You're waiting for your fellow, down below,
Upon his rope you'll follow, down below,
Drop nothing on his head,
No matter what he's said,
But shout Below! Below!, down below.

Oh it isn't hard to tell, down below,
Where Billy Davies fell, down below,
The mark is on the ground,
And the echo's still around,
Oh HELLLLLLLLLLLLLLLLL(p), down below.

Now it isn't far away, down below,
The glow of light of day, down below,
From out the hole one crawls,
And out of overalls,
Then Andy's place for Tay, down below

Don Smith, London, Ont, May 1989.

To the tune of the London Drain Inspectors
song, 'Down Below'.

GREAT ORME COPPER MINES, Llandudno (SH 771 831) :

During late 1987 an underground survey requirement as part of a proposed car park and shaft capping scheme allowed entry to be gained to three 19th century shafts at the copper mines in the Pyllau are of the Great Orme. These shafts had remained sealed since the closure of the mines in the 1870's. The survey allowed access to a complex system of workings some of which appeared to be of early origin. Throughout investigations carried out during 1988 it has been possible to recognise four distinct areas where evidence in the form of stone implements, charcoal from firesetting, significant calcite deposits, numerous bones, rock fracture patterns and spoil stratigraphy suggests a phase of mining of considerable age. It would appear that these indicators are in line with similar findings beneath Bryniau Poethion, some 80m away, from which a radio carbon date of 2940 +/- 80 BP was obtained (James 1988).

Three sites clearly display early mined out stopes which had been purposely backfilled or infilled with surface derived spoil. These have in certain areas become cemented by the deposition of calcite from percolating ground waters. Calcite flowstone up to 0.09m thick exists at one location, clearly capping a fireset produced deposit containing fragmented charcoal. Complete sequences of this early spoil infill are now exposed. This is as a result of the 18th and 19th century miners having prospected by driving headings and sometimes removing the complete volume of the material, revealing the extent and depth to which the early miners had reached. From the layout of these workings and considering geological factors, it would appear that some of these stopes may have been operated as trench mines, linking with deeper sections as the veins were following under rising ground to north.

Spoil landscaping operations for the car park construction at the site during summer 1988 were monitored by Gwynedd Archaeological Trust and the Great Orme Exploration Society. Surface finds included occasional 19th century iron tools and at least fifty complete or fragmentary stone implements of varying size and form. The total number of stone artefacts from the site, including those in situ underground and those removed by earlier researchers, must now be in excess of one hundred.

Four individual stone type forms have been recognised:

Type A. Hammerstones of rounded form, unrilled, depressed ovoid in shape and 4 to 13kg in weight, with particular examples up to 0.30m in length. The size of these stones would suggest a two handed use even if some form of hafting was provided. An alternative could have been some type of rope cradle where the cord was swung from a supported position on to the required rock working surface. However the occurrence of certain of these larger stones within a particularly confined early area would imply their simple use as a two handed implement.

Type B. Hammerstones of rounded form, unrilled 1 to 4kg in weight with shapes ranging from ovoid to elongate. These are likely to have been single handed implements, with elongated forms used in conjunction with a type C stone as a pestle type tool. Types A and B have been located both underground and from surface spoil.

Type C. These can only be described as mortar stones, generally being of a more flattened character around 0.25m in diameter with an obvious concave feature describing wear on both the upper and lower surfaces. Used with Type B stones, they would have provided a suitable arrangement for fine processing of material, notably the ores. All stones of this type have been discovered exclusively from excavations within the surface spoil tips. None has been located below ground.

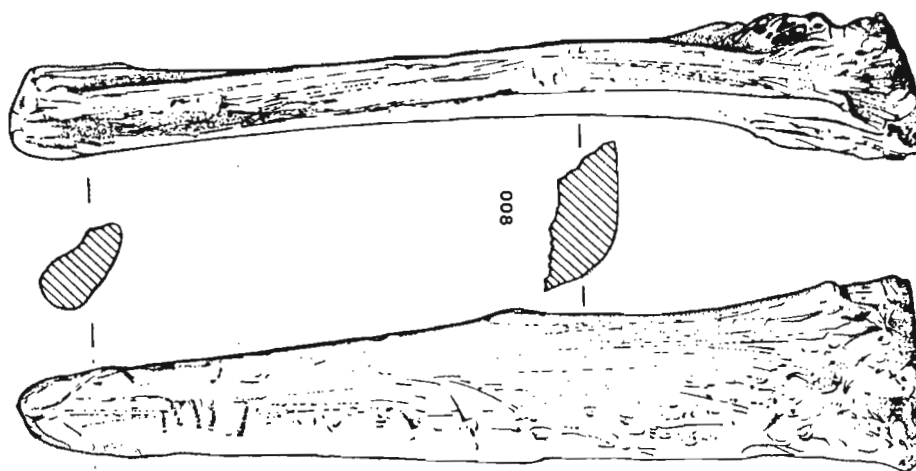
Type D. Referred to as dressing stones, these are of greater dimensions, normally around 0.50m in diameter and up to 0.30m in sectional height. The upper and lower surfaces are slightly concave, consistent with wear of a heavier grade of material processing. Several stones of this variety have been found, all from surface locations and often incorporated within 19th century masonry surrounding the shaft collars.

Nearly all stone types are of igneous rock. Many were microdiorite, typical of beach stones derived from Penmaenmawr headland, others were of a basaltic to doleritic character. The remainder consisted of a hard brown silty mudstone.

For the Great Orme Exploration Society.

Editors note: This article by Andy Lewis was published in archaeology in Wales vol 28 which also contained papers by Simon Timberlake and John Picken. Simons paper describes excavation of ancient mine sites at Parys Mountain and Nantyreira. Evidence of early mining is described for both sites including stone mauls and fire setting.

Johns paper reviews the occurrence of various types of stone mining hammers found in several ancient mining sites in Wales.



Bone Chisel from Vivians Shaft x1

STEAM POWER IN THE LLANDUDNO MINES

To our knowledge, there were four beam engines operating at the mines during the last century, one at the Old Mine and three at the Ty Gwyn Mine. There are a few facts of which we may be certain, but because of established Cornish engineering practice we may infer other data from them. The best source of data in this respect is 'The Cornish Beam Engine' by D.B. Barton.

The first engine installed was manufactured by Sandys Carne and Vivian in Cornwall, probably at the Hayle foundry. With a cylinder of 18" diameter this was a small engine and if worked with steam at 40 PSI would generate approximately 11-12 HP, not much compared to the monsters operating in deep Cornish mines¹.

This power output would have been achieved running at maximum strokes per minute, eg 15, with the steam valve wide open. It was not at all efficient as the steam had little chance to expand fully. To get maximum economy, engines were often run at around three strokes per minutes, or less, with the steam valve open for just a fraction of the stroke which allowed it to expand effectively. It was unusual to run an engine any higher than 10 strokes per minute.

As this engine was adapted to operate on two shafts for winding and also to pump and crush it was probably a rotative design. The engine probably also used a condenser to increase power and producing hot water which could be used for the boiler, thus saving on coal. This would have required some 16,000 gallons of clean cold water per day². Because of the limited water catchment on the mine site, the condensing water probably came from the mine.

Fortunately this is a limestone area with alkaline water so there would have been little copper salt dissolved in the water to corrode the condensing gear. On the other hand, dissolved calcium carbonate could cause problems with scale and may have been the cause of the boiler explosion in 1856 at the Old Mine. In Cornwall, if there was no surface water for cooling and mine pump water was used, it was often necessary to install brass condensing gear to overcome this problem.

The portable 22" engine installed at the Ty Gwyn Mine was reported to be 40 HP, which suggests it was working steam at about 80 PSI rather than the usual 40 PSI which would have generated about 17 HP. The 50" Cornish engine (ex Halkyn Mine) had a reported HP of 90 at 15 spm, and therefore probably worked steam at 40 PSI though I suspect rarely operated at 15 spm.

The Sims compound engine was the largest engine of its type in the area and one of 55, of various sizes from 60"/100" to 7"/12", erected throughout the United Kingdom. This powerful 200 HP engine was probably working steam in the 50" high pressure cylinder at about 40 PSI, and in the 90" low pressure

¹ Calculated HP at 40 PSI: $\{ \text{cylinder radius}^2 \times 3.142 \} / 22.25$

² Condensing requirements: 1,400 gallons/per HP/per day.

cylinder at about 20 PSI, giving a calculated HP slightly over 200 HP. This engine was designed for efficiency and fuel/steam economy, by allowing steam to expand as much as possible through two cylinders rather, than power. To carry this objective to its logical conclusion a condensing phase would have been used, in the 90" cylinder, and the cylinders heavily lagged.

The best of the design seems to have been the prototype, the 50/90 engine at Carn Brea which gave the Taylor engine a good run for its money in the duty races³. In 1840 this engine was rating between 90M and 95M compared to the Taylor 85" engine at 98M. Usually the duty fell after some 12 months operation, but the Taylor engine, the best of its day, was still putting out 70M in 1851.

All engines needed to be repacked every 6-8 weeks with oakum/hemp and tallow. This was a simple task with most designs, but with the Sims compound design access was gained to the lower cylinder via a man hole in the top of the upper cylinder. Not only would this have been awkward and time consuming, but it would have also been very warm work as the cylinders would still be hot, so much so that cool air often had to be blown in with bellows while the man worked.

Working steam as expansively as this was costly, not only in capital terms of erecting the engine, but the engine could wreck itself very easily and with it the pitwork which was prone to heavy wear and tear anyway. Even the small engine at the Old Mine had major problems at one stage in 1856 when the main shaft failed (?main pump rod, ie pitwork).

After about 1850 the large engines, even if more efficient bushel for bushel, went out of fashion, as did the great duty races, in favour of greater numbers of smaller cheaper engines. Although we have some data from the Old Mine regarding coal imports, there is insufficient to even guess at the duty of the Sandys engine, and non at all for the Ty Gwyn engines.

Condensing requirements for these three engine, totalling 330 HP, would have been large, approximately 462,000 gallons per day, sufficient for a decent sized swimming pool, 22yd x 22yd x 6yd. The reservoir, Llyn Mawr at Ty Coch, would have had insufficient capacity for a whole day without replenishment, hence the need for supply from anywhere that it was available, such as the Old Mine and springs in the town.

What a shame we don't have a single surviving engine or engine-house to show for ourselves.

Don Smith, London, Ontario, 20/09/89

³ Duty, foot pounds in millions (M): The number of pounds of water raised one foot by one bushel of coal. Pre 1850 a bushel was taken as ~93 lb (depending on the coal type), post 1850 as 1 cwt.

UNDERGROUND ODDITIES AROUND BRYN EURYN

For several years I had been hearing vague rumours about shafts and adits in the general area of Bryn Euryn, and last April Frank Jowett and I spent a productive afternoon doing a tour of all the holes that he could remember. The results are shown on the sketch map attached to this article.

Site No.1 is an underground passage - most likely part of a mine - in the area of Llys Euryn. It extends from a point just West of the Eastern end of Cowlyd Close to a point a few metres East of Tan-y-Bryn Road, near the head of the cul-de-sac called Craig Wen. We did not actually find it on our tour, as the whole area is now thickly built over, and we suspected that the present occupants of the houses might have objected to our digging little holes all over their beautifully manicured lawns. But Frank remembers seeing the passage briefly some years ago when workmen broke into it while digging the foundations for one of the new houses. Frank also remembers that there used to be a light railway (used as a mineral line) running alongside Rhos Road from a small jetty near the modern slipway, up to the area of Llys Euryn. He thought it was for a mine, rather than the quarry.

Site No.2 was a burial - presumably prehistoric - of a human skeleton, accompanied by two "bun-shaped" cakes of copper, found somewhere just to the North of the corner between Tan-y-Bryn Road and the cul-de-sac South of Llys Euryn. We could not locate the place exactly as it was hidden in primary jungle in someone's garden, but a fairly detailed report of the finds (with photographs of the copper "cakes") is contained in an article by Willoughby Gardner published in "Archaeologia Cambrensis" for 1958 (37 years after the finds were made).

Site No.3 is a shaft (or a well ?) found while building one of the new houses just East of Llandrillo Parish Church. Frank considers it more likely to be a shaft, rather than a well, as he remembers that the top was ringed with large boulders rather than bricks. Unfortunately it has now been built over, so it is inaccessible, short of digging underneath all the houses in that area - which might be unpopular with some of the occupants.

Site No.4 is an Adit - probably a Trial Adit - in the garden of a house called "Woodlands" (No.88, Dinerth Road) just opposite the junction with Craig View. This Adit is at the foot of a low cliff (about 5 metres high) of reddish-brown limestone, and goes in for at least 10 metres. About 3 metres in from the entrance a cross-passage goes off to the right (South), and about 1 metre further in another cross-passage goes off to the left. The main passage terminates in solid rock (marked with some drill holes). Just to the South of the entrance there is a vertical vein of Calcite, about 2 cms. thick. The red colour in the Limestone suggested to us the possible presence of Haematite, but Andy tells me that it could just as well be Dolomite.

Site No.5 we failed to find, but Frank is fairly sure of it. He remembers it as an Adit (or possible a shaft) just to the East of Dinerth Road at its junction with Bron-y-Nant Road.

In addition to the above, there is also of course the small mine just South of the Expressway, on the South side of Conway Road, just East of its junction with Dinerth Road. I had a look at it, some years ago, with a party of Troggs from St. David's, and Chris went there a few months ago and dived the shaft.../P.T.O.

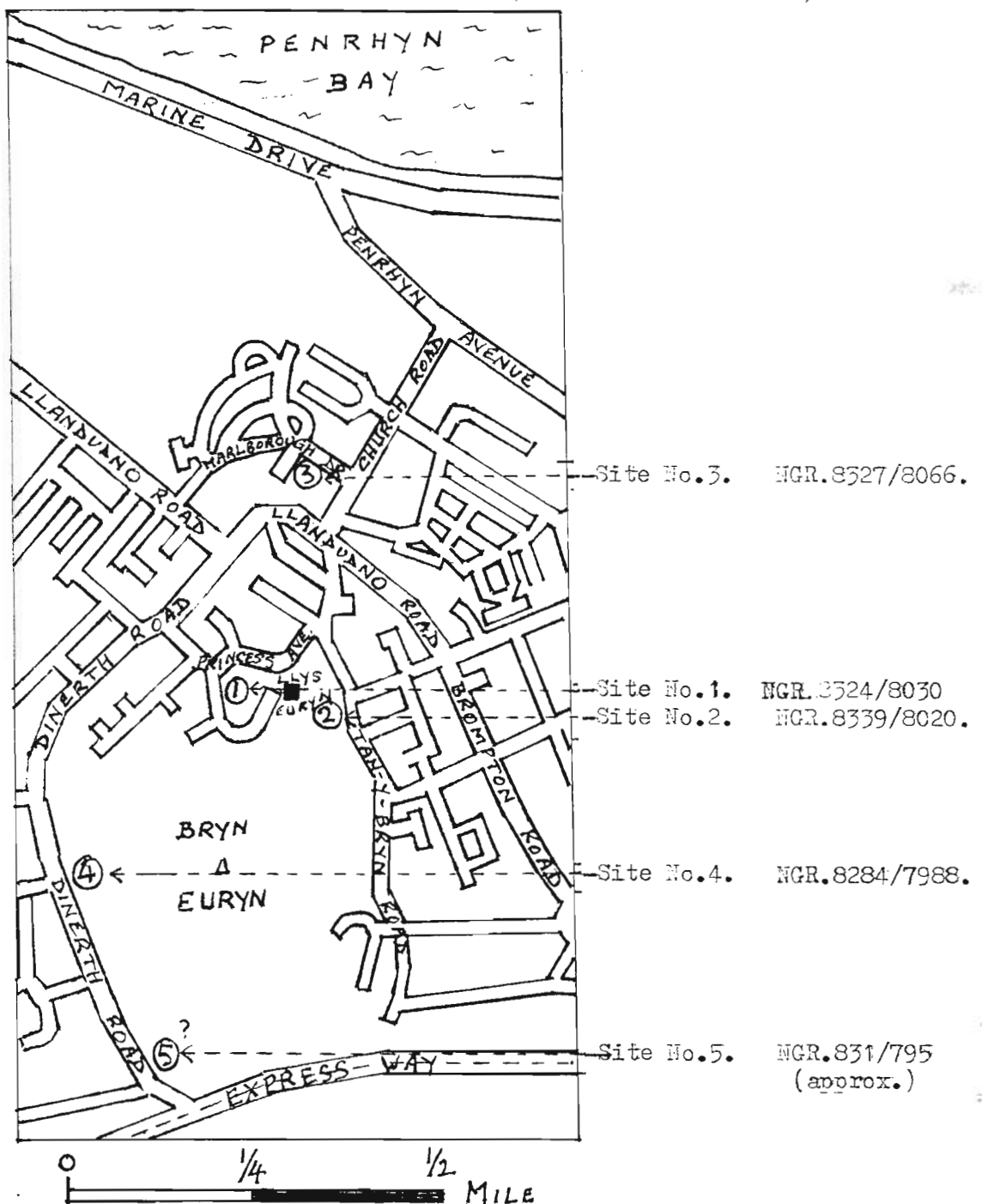
shaft therein. This was 35 feet deep, he tells me, and there were no continuations and no side passages.

As to what minerals were being exploited in this area, Andy Lewis suggests that the most likely one would be Lead (by analogy with the Llandulas mines about 5 miles to the East). Judging by the size of the workings, they cannot have been very extensive, and the probability is that most - if not all - of them were simply "Trials".

Comments by others, especially those actually living in the area, would be welcomed.

GCD.
27/8/89

SKETCH MAP TO SHOW AREA AROUND BRYN EURYN (see Article attached)



UNEARTHING ROMAN COINS BY HUW TUDNO WILLIAMS

Many interesting and historical finds have been made in Llandudno and neighbourhood over the years and indeed are still being unearthed at present. The panoramic hills, valleys and caves almost reluctantly yield their secrets from time to time confirming the long gone presence of prehistoric animals, humans and other strangers who either invaded or visited our shores.

In the late nineteenth century and the early part of the twentieth, two important finds of Roman coins were made in the area of the Little Ormes head which at the time were amongst the four most important discoveries ever recorded in any part of the world. The largest of the two however was not recorded until thirty years on as will be explained later. The other opposite the stable entrance of Simdda Hir past the once huge Graigside Hydro Hotel (now demolished and built upon) situated at Craigsidde on the road to Penrhyn bay, comprised of approximately 550 coins found in a bank not far from the highway. At the time the Mostyn Broadway was being constructed and at finishing time on a dark evening two cartloads of soil and material had been transported and dumped about halfway between St Pauls church and the former Grand Theatre, the date being the 19th January 1907, so it was not until the following morning that the exciting discovery came to light. In a report by W.B Lowe M.A it was stated that the coins were covered with a black earthy matter which was distinct from the neighbouring soil and were found about two and a half feet below the surface of the ground. Some corroded pieces of bronze plate with rivets through them and hammered down on both sides were eventually picked up which suggested that the hoard had been enclosed in either a metal or wood and metal box. Four distinct coins were found with a long strip of thin copper folded around them and were first brass specimens of an earlier age than the rest of the find. The centre of one coin and a part of the copper strip had been soldered probably together.

When news of the find spread throughout the town the Broadway area was invaded by treasure hunters who eagerly pocketed specimens as they dug them out of the rubble. It was thought that at least a hundred and probably more were picked up in this manner. Acting on orders from the treasury the local police managed to gain possession of most of them, but some had been disposed of to visitors and other sources.

Most of the hoard were eventually acquired by Mr Frederick Holland a local antique dealer who had his galleries at the Prince of Wales Hotel St Georges Crescent, those being sold to Mr Willoughby Gardener who wrote an interesting book on these finds.

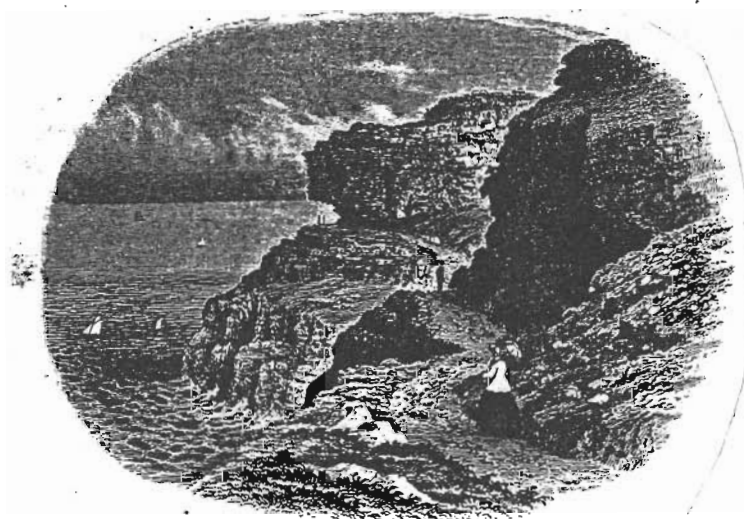
After all the fuss and excitement it was discovered that the coins were not, with the exception of the four previously mentioned, gold or silver and therefore not "Treasure trove". The majority were third brass and it was found that most - in fact about 97% proved to be British struck money with the effigy of the emperor Carausius 287-293 A.D. the remainder were of earlier emperors. Coins of Carausius are not infrequently met with wrote Willoughby Gardener, in small numbers mixed with others, especially in the south west and west of England. Only two large finds have previously been recorded. The first was a discovery of 545 examples of Carausius in the biggest ever unearthing of 29,802 coins at Woolmer Hants in 1873. The second was of 210 excavated near Rouen. Many of the coins marked M.L were minted in London and some marked C in Colchester, the majority had no mint numbers upon them.

The other find was made about half a mile away by the old tollgate crossing Penrhyn Bay (not from from the present entrance to the Rhos golf course) it was then a field belonging to a farm sited on the Little Orme. This discovery contained 5000 bronze Roman coins which had been cemented together by a type of green oxide into a solid mass and were held in a one handed earthenware jar, red in colour, 15 inches high by 8 inches wide. This find was made by a Llandudno farmer when an alteration to the road was being made during 1873- he kept this a dark secret for 34 years until his death but

following the fuss after 1907 find a relative reported the hidden hoard of his uncle and stated that the urn had been enclosed in some kind of stone walling. The coins after special treatment were also identified as "third brass" with some "second brass" and all were described as being in magnificent condition - 3000 were of British mint and 2000 of Gaulish. The London mint coins were marked with the letters: PLOV, PLN, MLN and MLL. Others with the following letters: RP, RS, RT, RQ probably were struck at Richborough, though there is a possibility say the experts that they were minted in Rome. The Gaulish coins had the following mint letters: (TREVES) PTR, (ARIES) PARL, SARL, TARL and QUARL (LYONS) PLG. There were various effigies on the coins but almost two thirds of them bore that of Constantine the Great (A.D 306-337) in different forms and the other third had the effigy of L?*&'%\$ (A.D 307-324). A few of Maximinius Daza (A.D 305-313), Maximianus Hercules (A.D 286-305), Constantine Chlorus (A.D 292-306) two of Allectus (A.D 293-296) and one of Carausius (A.D 287-293). It is therefore deduced that the collection was of the time that Constantine was emperor in the west with Lianius I. in the east. At this period the emperors stamped the effigies of their colleagues alternately with their own on the coins they minted.

Several Roman coins have been found on the Great Orme and Llandudno district but these have been isolated and scattered finds. During 1891 near Rhos on Sea while converting two small fields into one large one a vase half full of Roman coins was found in the base of a hedge, the colour of the vase was brick red with a grey lip, a photograph of the vase taken by Mr J.B Hall of Llanrwst appeared in a volume of the Llandudno, Colwyn Bay & District Field Club proceedings of 1923-4. During 1888 Thomas Kendrick working below his cave on Ty Gwyn Road unearthed an ancient fire place and found embeded in clay 17 coins of the period of Carausius. A box of coins was discovered in a small lake in a garden in Penrhyn Bay in 1924. During 1906 at Llandrillo-yn-Rhos, while quarrying at Llys Euryr an urn full of bronze coins containing some third brass of Constantine the Great came to light at Rhos Fynach, buried in an arch in the abbey garden and wrapped in sheet lead coins of Constantine the Great of all brasses were discovered. Several brass and one third brass of the Constantine period were found south of Gogarth Abbey marked "Soli invids comiti", on reverse figure of sun. One coin of Constantine was found in the Great Orme workings during 1977.

Although there is no direct evidence of Roman mining in the Great Orme copper mines such as iron edged impliments etc the discovery of the large hoards of coins in the Little Orme area and Roman traditions of utilising any profitable amenity in areas throughout the world surely should leave little doubt that they used local labour to work the Orme mines and that the small denomination coins were used for payment of the workforce.



CLIFF WALK LLANDUDNO.

Published by Cadogan & Frederick, Chester

GOING DOWN THE MINE?

If you have never explored a disused mine before, remember that it can be **EXCITING** if done properly, but **LETHAL** if you do not know what you are doing.

Here are 12 basic rules for your survival.

1. JOIN A MINING HISTORY GROUP.

There are 20 principal groups, which cover the whole of the country. Unless you are attending a special course, consider joining one of these, and they will teach you how to be safe underground.

2. GET THE BASIC GEAR.

The basic things that you need are:

Warm clothing and boiler suit.
Strong boots or wellingtons.
Helmet.
Lamp.

For simple mines, a torch is OK, but the best is a miners' electric headlamp. ALWAYS carry spare lighting, and REMEMBER a change of clothes.



3. ALWAYS GET PERMISSION.

Always ask the mine owner for permission to enter. If you don't know the owner, ask the local mining history group. Never break in, or trespass, if permission is refused. Always leave mines safe by replacing gates or lids before you leave.

4. TELL SOMEONE WHERE YOU ARE GOING.

If you have an accident, you want people to know where to locate you! Leave a message with a responsible person, giving the following details:

1. Name and location of the mine.
2. Anticipated time down the mine.
3. Anticipated time out of the mine.
4. Time due back to the person you have told.
5. Details of how to get the rescue service, if needed.

5. NEVER GO UNDERGROUND ALONE OR INCAPABLE.

FOUR is the MINIMUM safe number underground, so that, in case of an accident, 1 can stay with the victim, and 2 can go for help.

NEVER take alcohol or drugs before or during a trip, as this will reduce concentration, with potentially lethal results.



6. DO NOT EXCEED YOUR CAPABILITY.

Choose easy trips at first, and leave the more difficult techniques until you are used to moving underground. Ladder climbing, for instance, can be very strenuous at times, and it is always harder climbing out!

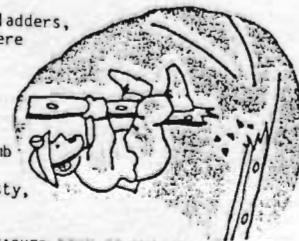
If in doubt, turning back is better than having to be rescued.

7. DO NOT GET LOST.

Some mines are like mazes, and it is very easy to get lost. If there is a plan of the mine (your local mining history group can advise you) take a copy with you. One good idea is to cut small arrows from a bright coloured polythene bag and, whenever you come to a junction, leave one of them pointing towards the entrance. ALWAYS pick them up on the way out.

8. NEVER CLIMB ON LADDERS AND MACHINERY

You may come across ladders, timbers etc. which were used by the miners. NEVER use these, as they are of uncertain age, and probably rotten. Similarly, don't climb on old machinery, as it is probably rusty, and may collapse.



9. NEVER CLIMB ON STACKED ROCK OR WALLS.

For their convenience, the miners often left waste rock in the mine. It was stacked up, and supported by timbers, which have since rotted away, leaving the rock precariously balanced. DON'T TOUCH, or climb on, these features, or you may bring down tons of rock onto yourself and others.



10. NEVER FOOL AROUND WHEN UNDERGROUND.

People in groups sometimes do silly things, but, with the dangers underground, practical jokes can have tragic endings. Be a steadying influence on your friends. They may laugh when you say better safe than sorry, but this is a small price to pay for your life and theirs.



11. DO NOT RUIN THE MINE ENVIRONMENT

This is what you have come to see, so leave it in a good condition for others.

Don't: hammer minerals in an indiscriminate manner, destroy or remove artefacts or other archaeological features, interfere with any plant or animal life.

Never leave any litter, as this can destroy the mine life without your realising. Don't leave graffiti.



TAKE only photographs. LEAVE only footprints.

12. KNOW WHAT TO DO IN AN EMERGENCY.

Mines are dangerous places, and accidents can happen to even the most experienced people. If, however, you don't panic, then the victim stands a good chance of surviving. Learn about simple First Aid, so that you can make them comfortable. Exposure is one of the most dangerous things - learn about its symptoms and treatment. Always leave someone with the victim, and send at least two people for help. The Area Cave Rescue Organisations are very efficient, and can be called out by dialling 999 and asking for the Police. Tell them what has happened, the location of the mine, and the nature of the victim's injuries.

These 12 rules are the most basic knowledge that you need, but it will take a few years before you are anything like experienced. THE BEST WAY TO GAIN THIS EXPERIENCE IS TO JOIN A RECOGNISED MINING HISTORY GROUP, AND TO GO UNDERGROUND WITH EXPERIENCED PEOPLE. A list of such groups is obtainable from the address below, on receipt of a stamped addressed envelope. The Association's membership provides a national coverage, and, if you indicate which area you are interested in, it will advise you of the appropriate one(s) to approach.

Once you have gained experience, you may wish to take others underground. Remember, that as a leader of a party, you take on extra responsibilities. The Association has drawn up a leaflet giving advice to leaders of such groups, in which are listed all the most likely potential dangers to be met with in a mine. If you should wish to obtain a copy of this leaflet, send a stamped addressed envelope to the address below.

NATIONAL ASSOCIATION OF MINING HISTORY
ORGANISATIONS
c/o Peak District Mining Museum,
The Pavilion,
MATLOCK BATH,
Derbyshire,
DE4 3NR