The Monks Who Mined?

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Abstract: The area of Ceredigion around the Abbey of Strata Florida is presently marketed as an area of unspoilt, outstanding natural beauty. However; it is, in truth, a heavily industrialised landscape which has been exploited for its mineral resources as far back as the Bronze Age. It is now being increasingly recognised that unless the industrial aspect of this area is fully explored, then a full history of the lives of the people of Ceredigion cannot be produced. Recent research has been undertaken by the author on mining sites in this area, aimed at building a balanced chronology of mining spanning the entire period of metal extraction. During the research over 40 small mine sites were visited; hundreds of individual mining related features were located, surveyed and evaluated for their suitability for excavation and the recovery of information on pre 19th century mining. Following the survey a number of targeted excavations of features at the Abbey Consols mine, including spoil tips thought to relate to pre 19th century mining, were undertaken. This paper will outline the project and the results of these excavations and some of the researcher's other findings.

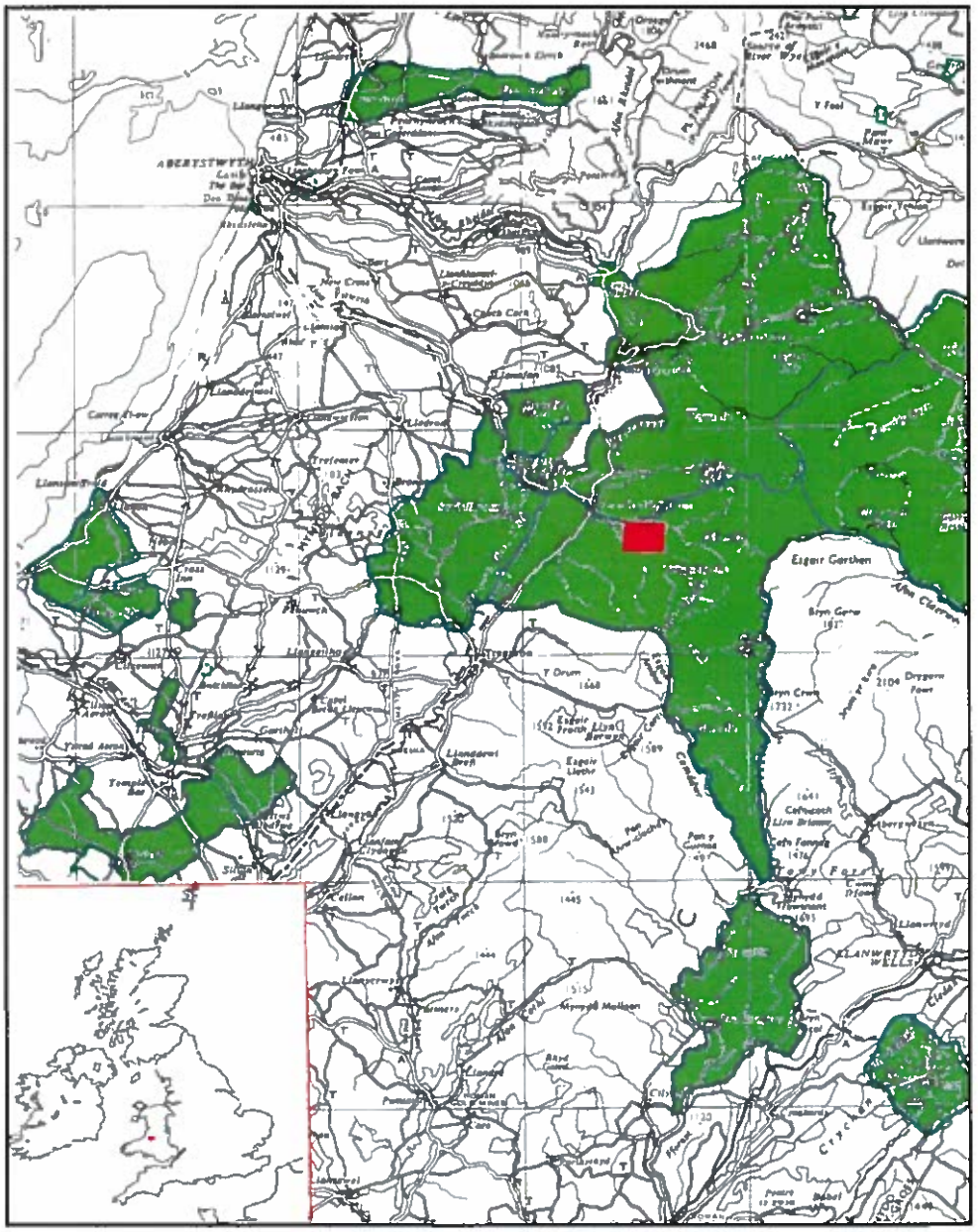


Figure 1: Strata Florida Abbey and its Land holdings (in green).

Introduction

This paper is an interim report on research being carried out on mining remains found on the lands of the former Cistercian Abbey of Strata Florida. Strata Florida Abbey is situated in mid Ceredigion 18 miles south of Aberystwyth and 40 miles north of Carmarthen, close to the present day village of Pontrhydfendigaid. The research project is aimed at investigating the possibility that mining may have taken place on the home grange of Strata Florida Abbey before the 18th century, and that some vestige of this mining may have survived in the modern landscape. The research includes a study of both historic documentation and a detailed archaeological survey.

The exploitation of mineral resources has been of vital importance to the economy of Wales for thousands of years, and even as late as the 1980s the production of coal, iron, steel, slate and non-ferrous metals accounted for up to 75% of its economic output (Turvey, 2002). While Ceredigion has no coal measures and few quality slate deposits, it does contain substantial lodes of non-ferrous metals. This natural abundance has been exploited for at least 4,000 years and developed into an industry, which at its zenith in the 1880s was the fourth largest lead producer in Britain. This industry provided employment in Ceredigion for an estimated 10,000 people (Lewis, 1967) out of a total population of 70,000 (Morgan, 2006). This number is even more impressive when one takes into account that the average mine employed fewer than 20 miners and that the typical working life

of a mine was 30 years (Jones, 1922). Most of these mines at best covered their costs or produced a modest return for their owners; occasionally, however, a mine would return extremely large profits. It was these latter mines, and the talking up of the potential of less profitable works, that generated much of the large amount of official and public interest in the industry from the 16th to the late 19th century. This led to many speculative, and in some cases, downright fraudulent mining schemes (Williams, 1977) and resulted in thousands of small mines and trials being opened up by people who sought to share in the riches on offer (Burt, 1984).

The Cistercians at Strata Florida

In order to understand the development of mining around Strata Florida it is important to recognize the role played by the Cistercian order. It was this group that constructed the majority of the great Abbeys of Britain and worked many of the mineral deposits of Wales, including those on the lands of Strata Florida for over 400 years.

The Cistercian monks were a Christian religious order which were formed in 1089AD. The monks of this order, in the medieval period, followed the rules set out by Saint Benedict but were heavily influenced by Saint Bernhard, who was at the time of the founding of the order Abbot of Clairvaux and one of the most influential people in Christendom (Burton & Kerr, 2011). The rules of Saint Benedict called for the monks to live a life away from the temptations of the secular world and to make use of all the fruits of the earth. While this was the stated aim of the order the truth was somewhat different and abbeys were situated across route ways and in areas which contained valuable assets such as virgin woodlands. Often these sites were situated in low lying ravines near to rivers or fast running water. These waters were harnessed by the Cistercians for use in transportation, sanitation and perhaps most importantly to drive machinery (Jamroziak, 2013). Strata Florida is typical of this kind of site lying as it does at the junction of three ancient route ways in an area which contains great mineral riches (Rees, 1968). Life in the Cistercian order proved very attractive to men, and later women, not only because of the piety of the people but also because the order offered protection from the violence and hunger that marked the era. Joining the Cistercians also gave men and women opportunities of advancement that were not available to lay people in the restrictive environment of feudal Europe (Bloch, 2002). This led to large numbers of people joining the Cistercians to live not only as monks but also as Conversi (unpaid workers) or as Mercenaries (wage earning labourers) (J. Burton *pers. comm.*). So successful was the order in recruiting members that by the end of the 12th century it had over 600 Abbeys spread across the known world from Finland in the north to Antioch in the near East. With this expansion came a spread of technology and new technical ideas as the Cistercians came into contact with different cultures. These ideas flowed freely across Europe through the Cistercians, who were given exemptions from tolls and taxes by monarchs and princes. The Cistercians were also allowed to trade without restriction across borders even, in some cases, during times of war between countries (Williams, 2001). During this period the order moved away from its ideals and became more involved in commercial activities, even to the extent that some houses owned slaves (Williams, 2001). While the Cistercians are perhaps best known to the public in Britain for producing wool, they were also heavily involved in many other industries, including mining

Figure 2: View of Strata Florida from the Abbey Consols mine

and metal production. This is reflected in subtle changes in the wording of later land grants to include not only the fruits of the land but also minerals such as coal and lead (Lewis, 1967). So successful were the Cistercians in acquiring mineral rights that some of their Abbeys were factories in all but name. For example Clairvaux in France was producing an estimated 1,000 tons of iron a year (Williams, 1991) while closer to Strata Florida, the Cistercian Abbey at Margam was mining coal and Tintern Abbey was producing iron (Birch De Gray, 1897). The Cistercians were perhaps the most important group promoting mining and industrial technologies in the period that has come to be called "The Medieval Industrial Revolution" (Gimple, 1988).

The continued expansion of the Cistercians was curtailed in the 14th century by the Hundred Years, war and the outbreak of the Black Death. The Hundred Years' war disrupted organisational and trade links within the order, which in turn weakened the central control and free flow of information between Abbeys (Williams, 1990). The outbreak of the Black Death also affected the order, not only by reducing the number of monks and nuns, but also by the weakening effect it had on the feudal system. The significant drop in population numbers caused by the Black Death in Britain led to opportunities outside the church for many people and initiated the rise of the yeoman farmer and minor gentry (Zigler, 2003). This lack of cohesion and control within the order, and the new opportunities now available, made the life of the Cistercians less attractive and the losses caused by the plague outbreaks could not be made up. These problems were compounded for the Cistercians in Wales by the disruption caused by the Normans incursions into Wales.

While the overall governance of Cistercian Abbeys was controlled by the General Chapter, they often took their political allegiance from the Crown of the country they were sited in (Williams, 1999). This proved particularly problematic in Wales due to the wars between the native Welsh Princes and the Norman invaders. The Abbeys situated in mid and north Wales owed their allegiance to the Welsh princes, this included Strata Florida, even though it had originally been founded by the Norman Baron Robert Fitz Stephen.

Strata Florida had received most of its lands by grant of Rhys ap Gruffydd, Prince of Deheubarth. Its links to the Welsh princes was sealed in 1238 AD when Llywellyn ap Iorwerth held his council at the Abbey during which he received the allegiance of the other Welsh Princes (Davies & Davies, 2012). These events led to the Abbey being seen as the spiritual home of the Welsh people and a counterbalance to the Norman cathedral at Saint David's, Pembrokeshire. This led to further grants and acquisitions from Welsh nobility until eventually its lands covered over 400 square kilometres, including much of the mid Ceredigion mineral deposits (Williams, 2001). However Strata Florida's support of the Welsh cause brought it into conflict with the English Crown and led to the Abbey being occupied by its forces on at least three occasions. Its allegiances also led to numerous disputes with neighbouring abbeys and led to its lands being subject to lawless bands (Leyland, 1539) and also subject to banditry (or partisan activity dependent on your view of the politics of the Welsh wars). This led to Strata Florida being an area where neither Welsh nor English law was fully implemented; a situation that was not resolved until the early modern period. After the dissolution of Strata Florida, its lands came into the ownership of local gentry who were freed from the constraints of disputes with Welsh princes, monastic and marcher lords. The gentry began to open up the mineral resources of mid Ceredigion including, in some cases, those that lay on Crown lands (Morris, 1754). Although they were charged with upholding the law and Crown rights the gentry, by the early 17th century, had begun a sustained and relentless policy of encroachment on tenant's holdings, common land and the Crown wastes. This encroachment came to a head in a court case over the mining rights at Esgair y Mwyn in 1756 (Bick, 1978, p32), during which the Crown proved ineffective in defending its rights. After this court case, freed from the fear of seizure of their mines, landowners and shareholders invested in mining and by the 18th century the area was one of the chief production sites for lead in the British Isles (Lewis, 1967).

Documentary evidence of mining at Strata Florida

Given the ethos of the Cistercians that they should make use of all the resources on their lands, and that the charter for the lands granted to Strata Florida included the words 'all the fatness of the earth below' these words could be taken to mean mineral resources (Green, 1927). There is good documentary evidence of mineral production from most other Cistercian Abbeys, both in Wales and in other countries, and therefore it would be unusual if the Cistercians at Strata Florida had not taken advantage of the silver rich lead deposits on their granges. However it was unclear at the beginning of this research how many mineral deposits were known or worked during the monastic period. This was because, while a large number of archives have survived from many Cistercian Abbeys, documentation pertaining to Strata Florida is very limited, consisting of less than two dozen documents. Further research into this indicates that it is the result, in part, of a concerted effort by some of the landowners of the late 16th and early 17th centuries to destroy any documents pertaining to tenants' rights. The documents that do survive relating to mining show that, in 1301AD, four miners were employed working lead deposits on the Welsh Comote of Genau'r-glyn. This mine is close to the modern day village of Llanabadarn, Aberystwyth on the former Strata Florida grange of Dawyarachen (Williams, 1999, p57). This document relates to a complaint concerning the difficulties of recruiting workers and that despite the returns being rich only four miners could be found to work the mine (Lewis, 1967, p28). The next records of mining-related events in the area show that two 'inspectors of silver' were being housed in Cardigan in 1340AD (Cal Close Rolls, 1339-41). It is unclear why these inspectors were in the area, however, it seems most likely that, Cardigan being the county town, they were there to inspect silver being mined locally. There is then a gap of over a hundred years until, in 1451AD, lead from the Strata Florida mines was recorded as being used to repair the roof on Cardigan Castle (Lewis, 1967). There is also secondary information in the form of a report that indicated that lead coffins were being regularly uncovered by farmers in the Abbey's old cemetery in the 18th and early 19th centurys (Carlisle, 1811) and that road building activities in the 1840s had cut through metal working furnaces which were thought to be medieval in origin. Williams writes that the Abbey fields were strewn with metal working dross which he attributed to the monks (Williams, 1889).

While documentary evidence relating to mining has been lost or never existed, archaeological remains of mining from the medieval and early modern periods are even less. It is, however, obvious from descriptions of the buildings that the monks at this Abbey had access to large amounts of lead (Williams, 2001). Archaeological excavations have indicated that a large amount of lead was used in the construction and maintenance of the Abbey and its substantial lead pipe water system (Williams, 1889). There was also enough lead available to enable the monks to clad the whole roof of the Abbey church after a disastrous fire in the 13th century. Away from the Abbey at Cwmystwyth, the archaeological remains of a small windblown furnace dating to this period have also been discovered, with samples taken from this site producing radiocarbon dates between 1060AD and 1300AD (Timberlake, 2003). It seems likely that this lead was sourced from the Abbey's own mineral resources, as no documents have been found that mention exports to Strata Florida from other mining areas.

The vast majority of mining remains discovered in the area to date have been attributed to the 19th century; this is also the period on which most of the archaeological and documentary research has been carried out. So overwhelming have been the resources invested in researching the 19th century industry, that it overshadows all the periods that went before; this has been to the detriment of the study of all other periods of mining in

Ceredigion. It is the aim of this research project to investigate earlier mining and in particular mining related to the monastic and early modern periods. It was hoped that this could be achieved by looking at not only known mines, but by also seeking out and identifying smaller, unrecorded mining sites. These would then be evaluated for their archaeological potential for providing information on pre 19th century mining.

In the past the discovery of archaeological evidence of mining from earlier periods has proved problematic due to the destructive nature of mining and the reliance of archaeology on stratigraphy for its results. The traditional way of undertaking a piece of archaeological research is to follow four logical steps. First written sources on the area are studied, secondly a full site survey is undertaken, and thirdly excavation of specific features of interest are examined. The fourth and final step is to carry out post excavation analysis and produce an interpretation of the site based on the findings.

Whilst this way of conducting research works well for most archaeological sites, it is problematic when applied to mining remains. Archaeology is based on stratigraphic processes where deposits are laid down in an ordered sequence. The problem encountered with mining is that it destroys most of this stratigraphy by taking away material from the site leaving only a hole in the ground and the remains of the last process, plus a substantially altered landscape. If the archaeology of earlier mining does survive it usually consists of the remnants of former working faces buried under the spoil of later mining. It has also proven to be fruitless to look for signs of earlier mining in the standing buildings such as wheel pits, crushing houses, or the homes of miners, as these almost always date to the 18th or 19th century. This is mainly because early buildings in mid Ceredigion were often flimsy affairs which have long since disappeared. This is especially true of the medieval period, for as Gerald of Wales commented; "*...Welsh housing was usually built in wood and only enough effort was put into them to survive a year*" (Davies, 1982). This, according to Leland's description of mid Wales, had changed little by the 16th century (Smith, 1906). Buildings such as these are also hard to date because they show a remarkable continuity of design. Not only have these buildings changed little over many centuries but after destruction they leave at best only ephemeral remains in the archaeological record (Peatre, 2002). The buildings that have survived from earlier periods (except in rare circumstances) are the more substantial, higher status buildings which are unlikely to be found on industrial sites (J. Grayson, *pers. comm.*). In contrast spoil heaps, even though they may have been reworked several times (as new technologies make the mineral within the spoil heaps workable), often retain an undisturbed core (providing a sealed context). Spoil heaps are also a convenient place to discard rubbish and therefore often contain broken tools such as hammer stones and anvils. These discarded tools can often give typographic clues to mining practices plus an idea of the date of workings (Davies, 1937). Consequently this research and the site surveys sought to identify older and undisturbed spoil heaps as potential sites for locating sealed contexts and secure datable evidence from pre 19th century periods.

As stated above studying primary documentation pertaining to mining on lands formerly owned by Strata Florida Abbey has been challenging. In addition, later documentation such as company records, journals and maps, while being extremely useful, had to be treated with caution. Much of the information contained within these documents was either fragmented or had been written from a particularly biased point of view. There was also the problem that a number of the mines were on what were formally Crown lands. Access to the records for these mines therefore proved problematic as they are held by the Crown Estates, and largely not in the public domain, being exempt from the Freedom of Information Act for commercial reasons. This lack of documentation also meant that secondary sources such as county histories could only give a partial overview. In later periods official reports and mining journals do cover the area in slightly more depth, however they are usually written from a biased stance as they were aimed at influencing shareholders of the time. The above statement also holds true to a certain extent for maps, which have been taken by many researchers as being authoritative and unbiased but they are not always so. Older maps were drawn using numerous different scales and often over emphasised features in order to impress the viewer, as in the case of estate maps. Even when examining the later Ordnance Survey maps of the 1840's and 1890's, it quickly became apparent that there had been omissions. For instance, when comparing the 1803 ordnance surveyor's sketches of Strata Florida with the finished map of 1841, numerous inaccuracies, changes and omissions were identified. Another example of an error was found on the 1900 Ordnance Survey map of the same area. This map showed a mine shaft near the centre of the village of Pontrhydfendigaid; the surveyor had, however, failed to record a second shaft 50 meters away. Both shafts would have been visible at the time of surveying, as they had been sunk as part of a late 19th century trial of veins between the Brynhope and Strata Florida lodes. This omission was probably due to the fact that the shafts were small, shallow and on opposite banks of the river Teifi. Mistakes like this are to be expected as the surveyors and mining researchers up to the late 20th century worked using only the most basic of equipment. However an accumulation of all these errors has led to many poorly recorded and in some cases incorrectly located mines.

Figure 3: Unrecorded trial shaft at the former Ty Maw farmstead, Pontrhydfendigaid

Given these inaccuracies and the size of the study area it was therefore decided that the most effective way to cover such a large area was to target the survey using remotely sourced survey data.

The evaluation of mine sites was combined with an examination of the literature on mining in Ceredigion, the Historic Environment Record (HER), satellite imagery, historic RAF aerial photography (M. Parry, *pers. comm.*) and ordnance survey maps (past and present) and has produced some interesting results. For instance, Hendra Felin mine, on the edge of Graig y Bwlch quarry (NGR SN74600 66371), was thought to have been largely destroyed; however when past aerial photography and historic mapping of the mine was compared with satellite imagery it showed that mining remains still existed and that

(Left) Figure 4: Wheel pit at Bendigaid mine

(Right) Figure 5: Tree growing out of side of a mine shaft

the site covered a much larger area than the HER indicated. This remote information was augmented by a field walking survey of sites and surrounding areas using a Global Positioning System receiver (GPS). The use of GPS enabled quick and accurate recording of feature locations, which were then overlaid onto other data sets. This data, however, was reliant on the quality of the equipment used and several different makes and types of GPS handsets were tried and tested during the research, ranging in price from a hundred pounds up to several thousand pounds. Each of the handsets displayed one common problem, in that they were all prone to increased inaccuracy during bad weather (because of this the weather conditions were noted on the record of site visits). As part of this process it was hoped that LIDAR data could also be used, unfortunately, however, as the only data available was to a 2m resolution, too low a resolution to be of any use. Despite the lack of LIDAR large numbers of unrecorded features were observed and it became evident that visiting and recording these would be a far larger task than originally envisaged.

Original research area

The unexpectedly large number of sites found, and the extra expenditure in time and money this would have caused, necessitated the area of the research to be scaled down. From the original area of land granted to the Abbey a new radius of three miles from the Abbey was chosen for the smaller research boundary. This was done working on the premise that, if the Cistercians were involved in mining activities at Cwmystwyth ,then it was also likely they would be exploiting deposits closer to the monastery. This new area, whilst reduced in size, still took in the most historically important mines, and offered the best chance of finding sites that met the excavation criteria.

The Surveying

The smaller size of the new research area allowed it to be examined in its entirety, enabling features which were of particular interest to be noted and their location recorded in preparation for visits during the field walking survey. In all there were forty main areas of mining that were identified and visited; from these forty mines the area most likely to contain pre-18th century remains were identified and surveyed in greater detail. The data gained in the initial survey was also used to identify areas which, while having no documentary evidence of mining, would be worthy of field walking. The importance of the site visits was confirmed early in the research when what had been identified through satellite imagery as a spoil heap, turned out to be a large pile of leached bark strips. One site that did produce evidence of undocumented mining was Troed y Rhiw, a deserted miner-farmer settlement two miles northeast of the Abbey. When this site was field walked a series of trials were located lying on a north south orientation across a minor mineral lode for almost a mile.

At each site visit particular attention was paid to mining methods, especially those used in driving levels and the removal of ore. Different technologies can, in general terms, be dated to specific time periods and, as each technology leaves a specific marker on the rock face, it is possible to build a typographical timeline for a site. For instance hushing leaves gullies which radiate out from a given point, fire setting leaves fractured rock coated with carbon deposits, and blasting technologies leave the remains of the bore holes. Each of these technologies give an indication of the date of mining; for instance gunpowder begins to replace fire setting in British mining in the 17th century. Early bore and fire workings can be identified because 17th and 18th century shot firing holes are generally smaller and have a rougher bore surface than modern ones. This is due to the poorer

quality steel cutting edge produced before the 19th century (R. Prothero Jones, *pers. comm.*). These dates are, however, only indicators of age and cannot be taken as proof of date, as the introduction of technologies was dependent on many things, including economic factors. For instance, because of the availability of large amounts of cheap firewood the ancient tunnelling technique of fire setting was still in use in Norway during the late 19th century (P. Claughton, *pers. comm.*).

During the field walking exercise soil samples were also gathered in order to identify any unusually high concentrations of heavy metals. It was surmised that finding raised levels of metallic pollution could indicate the position of possible ore extraction or processing areas. Therefore samples were taken from areas in which no mining was present in order to establish a background level of lead contamination which could be compared with samples from other areas. This technique, although effective in locating heavy metal contamination, proved to be extremely time consuming and expensive and was therefore unsuitable for surveying large areas of land due to the cost of processing the high number of samples in the laboratory. After examining over 400 samples it was decided to confine this technique to sites with proven mining archaeology, looking for particular features.

A dendrochronological survey of trees growing within and on mining features was also undertaken in order to determine the age of trees growing within leats and shafts. The idea being that the date a tree started to grow in or on a feature would give a definitive date by which that feature had been abandoned.

Despite using all the above survey techniques the identification of smaller features away from known mining sites was found to be still reliant on interpretation by the surveyor. This was because old metal mining trials and small stone trials are almost identical, (in some cases both stone and metals were mined on the same site) and therefore required human analysis of the material before a decision could be made (S. Hughes, *pers. comm.*).

Interim Results

To date over 40 different mining sites and in excess of 300 individual features have been recorded. The results of the survey and the study of historic documentation has indicated that many of the mines in this area were not sunk by 19th century miners. The mines appeared, in fact, to be a continuation of much earlier mining and that miners were actively seeking out older sites to re-exploit. Once a lode was found the area around it was subject to intensive trials looking for parallel veins, often to an extent that seems illogical today. Trials appear to fall into three groupings. The first group are around known deposits where one would expect lodes to be found. The second smaller group of trials were found near to lowland farms and smallholdings. The most logical explanation for these trials is that they were made by landowners and tenant farmers. Many pieces of mineral rich quartz were deposited in the area during the Ice Age; some of these may have been incorrectly identified by farmers and prospectors as indicators of a mineral vein being on their land. This happened in the area around Swyddffynnon after a large boulder of lead ore said to weigh almost 15 tons was found in the late 18th century (Davies, 1815). These trials probably belonged to the mining rushes of the 18th and 19th centuries. The third group of trials lay scattered across the remote areas of the Crown wastes and common land and are some distance away from both mines and the larger farms. Interestingly these are the very areas in which miner farmers and the dispossessed were forced to live, and it will not be a coincidence that many of the trials were near to the remains of squatter's settlements. Some trials could be a result of the policy of estate owners encouraging their tenants and shepherds to look for mineral deposits. For example, Lewis Morris wrote to Lord Powis in May 1763 advising him to pay shepherds and the local people to search out possible ore lodes in the wastes (Owen, 1949). As such, some of these trials, if they were undertaken on this basis, could be classed as official mining sites. There is, however, a strong possibility that many of these trials were illegal and made without the Crown's or land owner's knowledge. It is well documented, in ethnographic studies of emerging industrial societies (Perlman, 2010) and in historical documents covering the industrial revolution (Roberts, 1990), that the poor will exploit every means available to survive. The social conditions of the times would have enhanced the miner's sense of independence; and in times of dearth, self-sufficiency would have been forced on them by the parish's reluctance and inability to adequately support the destitute (Davis, 2005). Therefore it seems likely that miners, driven by poverty, would have sought to use their mining skills to make ends meet by finding out new ore deposits. The wastes would have offered the chance of discovering new ore deposits or reworking abandoned mines. The returns may have been scant but to those receiving poor relief it would have been worthwhile.

Research into local mining lore in Ceredigion has shown that it is full of tales of men who found valuable mineral lodes by accident; were some of these illegal trials which proved too hard or too valuable to hide? If the unexplained trials were the result of illegal prospecting then was this low scale production being tacitly allowed by the land owners? It would have been in the interest of landowners to keep these skilled people in the locality even during the leaner times, as one of the factors that hampered mine owners in better economic times was a lack of labour. There are a number of examples where miners were encouraged to stay in their local areas by being allowed to rework spoil heaps specifically in order to keep skills preserved within the locality (Lewis, 1967). Two rare references to this process are when Hooson (1747) remarks on poor people gleaning ore from tips and Spargo (1870) who recorded that local miners were working as tributers at several mines in Ceredigion which are recorded as 'standing idle' in the official records.

Many of the trials that were found seemed, at first, to be placed in illogical positions in the landscape; however prospecting for new sites in the past would have been based on the miner's experience and not on the science used today. Prospecting would have been based on time honoured signs of ore-bearing land such as changes to soil colour or the types of plants growing on the site (Hoover & Hoover, 1950). Exploring every rocky outcrop for mineral veins might seem, to those who have some knowledge of the geology of metal deposits, as foolish, however one must take into account that even the trained geologists of the early 20th century could not predict where a mineral vein lay with certainty (Vernon, 2009). It must also be appreciated that searching for minerals was not the sole preserve of the miner, but that other members of society would have been, and still are, involved in prospecting. The fact that there was involvement from the wider community would go some way to explaining why trials have been identified in places where the finding of lodes seems, at first, unlikely; that being said, the majority of the trials lie across known, or close to presumed, mineral lodes.

As well as locating many previously unknown trials, this research also found several unrecorded shafts, adits and a complete leat system on the former Pantyfedwen farm (SN752 649). The mine at Pantyfedwen was interesting as, although two shafts and two adits were already known, it was not known by whom or when these were worked. A full survey of the site conducted along with Louise Barker (*pers. comm.*) of the Royal Commission on Ancient and Historical Monuments showed that the workings were much more extensive than had been thought. During a survey of the mine and the surrounding area a further shaft, two adits, a quarry system and a leat system were also identified. The leat was particularly interesting as it tapped several water sources along its length and because it served both the Pantyfedwen mine and the mine workings at the Bryn Hope some two miles away. Documentary research indicates that this leat and some of the shafts and adits at Pantyfedwen were undertaken as part of the work of the West Florida Silver Lead and Blend Mining Company. This company is recorded as raising £20,000 for mining projects around Strata Florida in the late 19th century (Webb, 2012). This amount however, must have proved insufficient as none of their projects proceeded beyond the development stage.

Possible multi-period sites for excavation

As mentioned above the survey was set up with the aim of identifying sites that offered good prospects of finding evidence of mining from several periods. Five such sites were identified; of these only the Abbey Consols mine (SN745 663) has, so far, been subject to excavation. This mine was identified due to the amount of survey work that had already been undertaken on the site by the University of Wales Trinity Saint Davids (UWTSD) and the good relationship which had been developed with the land owner. The mine had already been subjected to a series of small excavations in 2004 by Jones (*pers. comm.*) who had also examined a 19th century water wheel and adit tailings at the mine for the Strata Florida project.

The Esgair Mwyn mine (SN754 269) was the second choice as a site for excavation. This site had the strongest documentary evidence, having a recorded history dating back as far as the 17th century at which time it was described as an ancient mine. It was at this mine that Lewis Morris (1774) described finding items which he thought dated to the Elizabethan period. Esgair Mwyn mine had been worked almost continuously from its reopening by Morris in 1746 until the 1970s when George Hall (*pers. comm.*) attempted to rework the 19th century spoil heaps. The mine, however, had been more heavily disturbed by later works than any of the other mines and as a result any excavation would have been extremely complex. That being said the site offered good prospects and would probably produce good evidence with a well-targeted and financed excavation.

The survey had also located three other sites that had a topography that indicated old mining and which did not appear to have been overly disturbed by miners in the 19th century. These were:

Llwyn Llwyd mine (grid ref SN746 685) - this mine's history dates back to the 1770s when it was noted as being worked by miners from Derbyshire (Bick, 1978). This site had some interesting topographical features and there were indications that the lode had been worked before the 18th century. Access to this site was problematic and therefore it was not suitable for the survey.

Pantyfedwen mine (grid ref SN752 649) - this was a site which, whilst its documented history only dates back to the early 19th century, it had aspects that indicated there was much earlier mining on the site. Another advantage with this site was the good relationship between the Strata Florida Project and the landowner and the fact that the site has already been surveyed.

Broncaradoc mine (grid ref SN690 693) - this mine had a known history dating back to the mid-19th century but had some very interesting small workings in the valley around it. One of the workings had some aspects that indicated it may have been a very old trial (S. Hughes, *pers. comm.*). This site however had various land access issues including problems with land slips which ruled out any excavations even if permission could be gained.

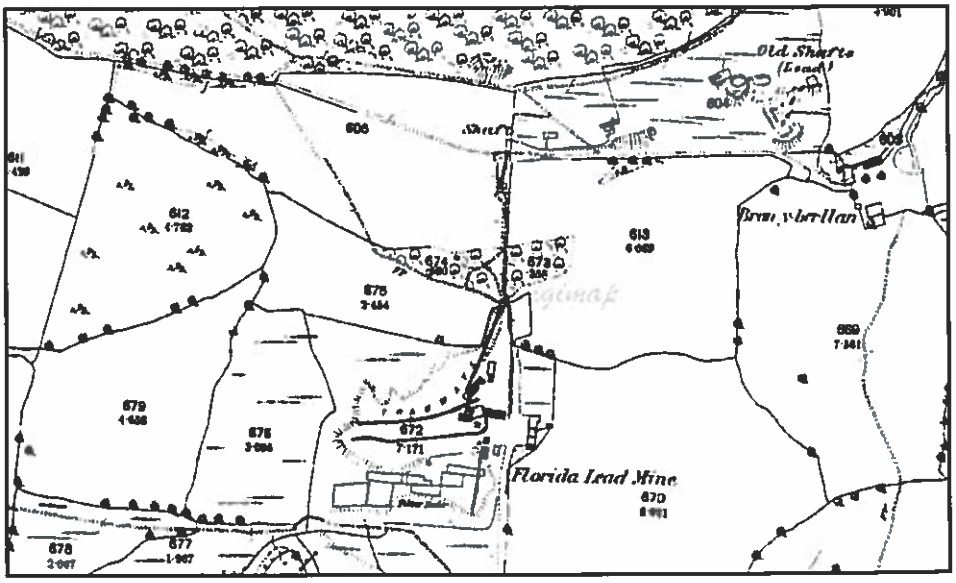
Abbey Consols Excavations

A series of archaeological explorations, which were jointly funded by Metal Links and the Strata Florida Project, were undertaken at the Abbey Consols Mine over a four week period between May and June 2013. Seven features were excavated with two aims; looking for dating evidence, and recording features that were in danger of being destroyed by farming and commercial activities on the site.

The first location to be excavated was a section of a turbine leat, which was in the process of being converted into a mountain bike track. The passage of cycles along its length has resulted in the destruction of large parts of what only two years ago was a pristine leat. This was the third leat to be severely damaged on the site due to such activities and it was decided therefore to record a section of the leat in order to record its method of construction.

The second location was the site of possible washing tables. During the survey of the mine a leat was identified running from a small turf-walled reservoir down to a series of three terraces. These terraces were interpreted as the possible site of washing tables which served the mine in the early 19th century. The lowest of these terraces was being irreparably damaged by tractors driving across it and it was therefore decided to record the feature before it was totally destroyed. During the excavation two corner pad stones and a central water worn gully were uncovered; however only one piece of galena was found. The shape of the feature, the pad stones and central gully supported the initial interpretation, however it was expected that washed galena would have been found in quantity. The lack of mineral was unexpected, especially as the surrounding area was covered in mining spoil. It may have been that the valuable galena had been removed during the washing process, which would explain its near total lack of presence. If correct, the interpretation of washing tables will enhance our understanding of the processing of ores in the early stages of this mine as no dressing floors had been found on this part of the site before. If washing tables had been used in conjunction with the sorting of ore underground and at the shaft lip, then this would go some way to explain the lack of these features because relatively pure metallic ore was being removed perhaps using anvil stones on the heap. This, however, is a hypothesis and it was decided that more investigation was needed before any positive conclusion could be reached.

Figure 6: 1880 Ordnance Survey map of Abbey Consols mine (copyright Edina Digimap)



The third location explored was a small cairn. The cairn was made up of sub-rounded rocks which had an average size of 7cm by 4cm and was unlike any other found on the rest of the site. The cairn was also unlike its surroundings in that it was not covered by soil or grass apart from one small section which had been overlaid with spoil from a previous excavation. The cairn was surrounded on all sides by mineral spoil which meant that it was unlikely to have been the result of field clearance. The stones was also not mining related as they were of a

sedimentary rock type which fractured easily and therefore the cairn was not the remains of a stock of grind or hammer stones. Because there was no logical explanation for its positioning the decision was taken to section this feature. The cairn was excavated to a depth of 30cm. At a depth of 6 cm, a layer of oak leaves in remarkably good condition was found. Immediately below this layer a spread of spoil was encountered. As there are no trees on the site it appears that the leaves had blown on to the site from oaks in the woodlands above the site. It therefore seems likely that these stones had been brought in during an autumn. This must have taken place before May of 2004 because spoil from an excavation which took place at that time overlays a quadrant of the cairn.

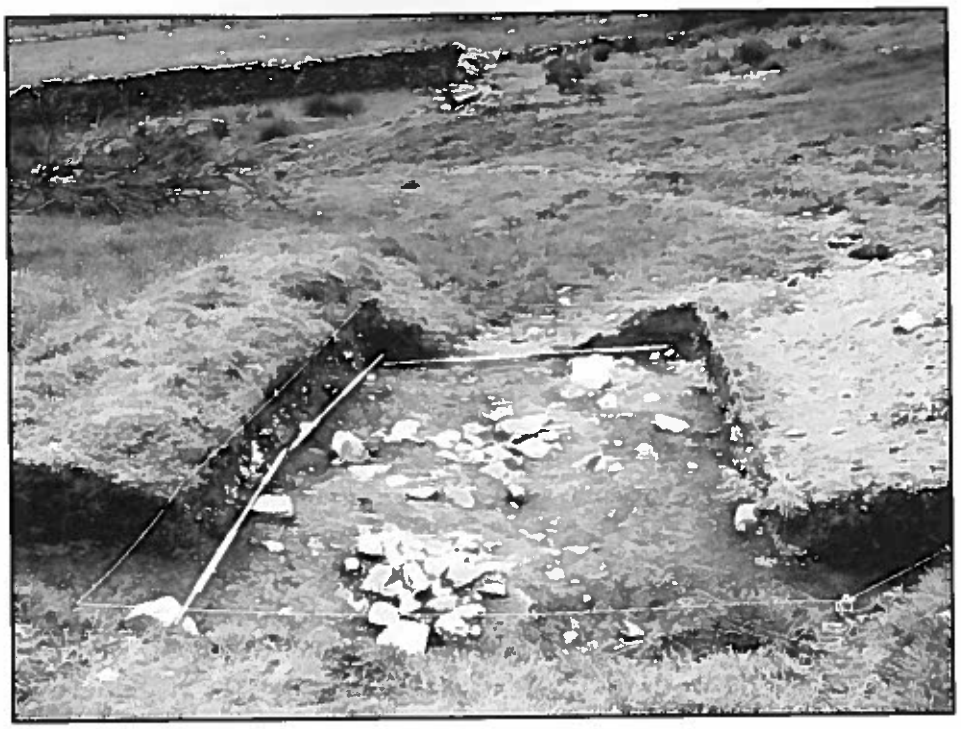


Figure 7: Possible dressing table site.

The fourth location to be examined was an area of parched grass on the southern slope above the main shafts. Unusually, the parched area was in the form of an L shape with the main body 7m x 1.5m and the foot 0.5m x 3m. Running downhill from the foot of this feature were three smaller and less distinct marks of 0.2m x 0.16m. This part of the site is subject to winds traveling down the valley from both the east and west, and because of this it had been identified early in the research as a possible position of a bole or bale furnace, a windblown hearth. Due to its position and the shape of the parch mark (which was what would be expected in the area of a former bole furnace) (Kiernan & Van de Noort, 1992), it was decided to undertake an excavation of this feature. When the turf and thin layer of topsoil was removed, underground development spoil was found directly underneath it. Two sections of this spoil were removed showing that the layer was an average depth of 4cm to 5cm and that the spoil was laid directly onto a natural surface. No charcoal or burnt rock was found in the layers and therefore the most likely explanation was that the feature was the remnants of a larger spoil heap that has been levelled.

The fifth feature to be excavated and recorded was a small flagstone footbridge. This footbridge spanned a leat which had been constructed in 1856 (Bick, 1978) and ran from the Teifi pools to a water wheel set to the west of the earliest part of the mine. The leat appears to have fallen out of use in the 1880s and was partly destroyed by the building of a track around the same time. The bridge, however, had survived in relatively good condition until a recent storm had brought down a tree close to it. The fallen tree had blocked the leat and caused a build-up of water, which was undermining the foundations of the bridge. In order to record it, the water was drained away and the bridge and the area around it were cleared of bushes, grass, silt and mud. The bridge was found to be made up of 4 large flagstones which were very similar to some of the larger stones found in the boundary walls near to the former Abbey gate house which was being excavated at the time by the UWTSD (Q. Drew, *pers. comm.*). It may well be that the bridge flagstones were once part of the internal flooring of the Abbey building. As well as the larger stones, a small roughly cobbled area leading to and from the bridge was also uncovered and recorded. The dimensions of the bridge indicated that it was intended for pedestrian or pack animal use from the shafts on the eastern hillside, and by travellers using the footpath marked on maps from the 1880s. While the footpath first appears on maps in the late 19th century the bridge was most likely to have been built in 1856 at the same time as the construction of the leat (Bick, 1978).

The sixth location investigated was a spoil heap that was associated with a small quarry and a short dead-ended level. The quarry appeared to have been opened to work a deposit of high grade building stone, however, sometime before the 1900s a 15m long adit was driven into the north face. The quarry adit was one of a parallel line of five such features which varied in depth and which had been driven into the hillside at various levels. Of these, only the lowest two had progressed beyond the trial stage. No date has been found for any of these adits but Spargo (1870) states that the mine was being worked to a depth of 10 fathoms under the adit in 1870, so it is safe to assume that at least one of these had reached the lode by that time. The quarry must, however, have been dug before 1880 because this is when spoil in the area of the quarry was first marked on maps of the site. The adit can therefore be tentatively dated by this method by its first appearance on the 1900 map as an old level indicating that it was a disused feature. Using this premise it can be assumed that the quarry adit was driven and abandoned sometime between 1880 and 1900.

The adit had been driven along the full length of a 15m fault in the strata, mainly by hand, and with blasting techniques being used in the areas of the hardest rock. At no part of this, or in any of the other adits on the hill above it, were there any indications of mineral veins, however the alignment of the features indicated that miners who had been developing the adits had been seeking areas of ore lodes rather than stone. This hypothesis is strengthened by the general alignment of all the adits, with the deep-drainage adit at the base of the hill, and what appears to be, a back filled shaft sunk into the top of the hill. In an attempt to see if datable evidence could be found a 3m x 1m sondage was excavated at an intersection of two areas of spoil; one of which was from the quarry and the other from what was thought to be related to the adit. This, it was hoped, would establish if the quarry and adit had been created at the same time or if the adit had been driven into an existing feature. While no datable evidence was recovered, the excavation established that the hillside around the quarry had been stripped back to bare rock prior to the spoil being laid down. The deposition pattern of the waste indicated that the spoil on this part of the site occurred as a single event. However further investigation is needed before any conclusions can be reached as to the chronological relationship of the adit and quarry.

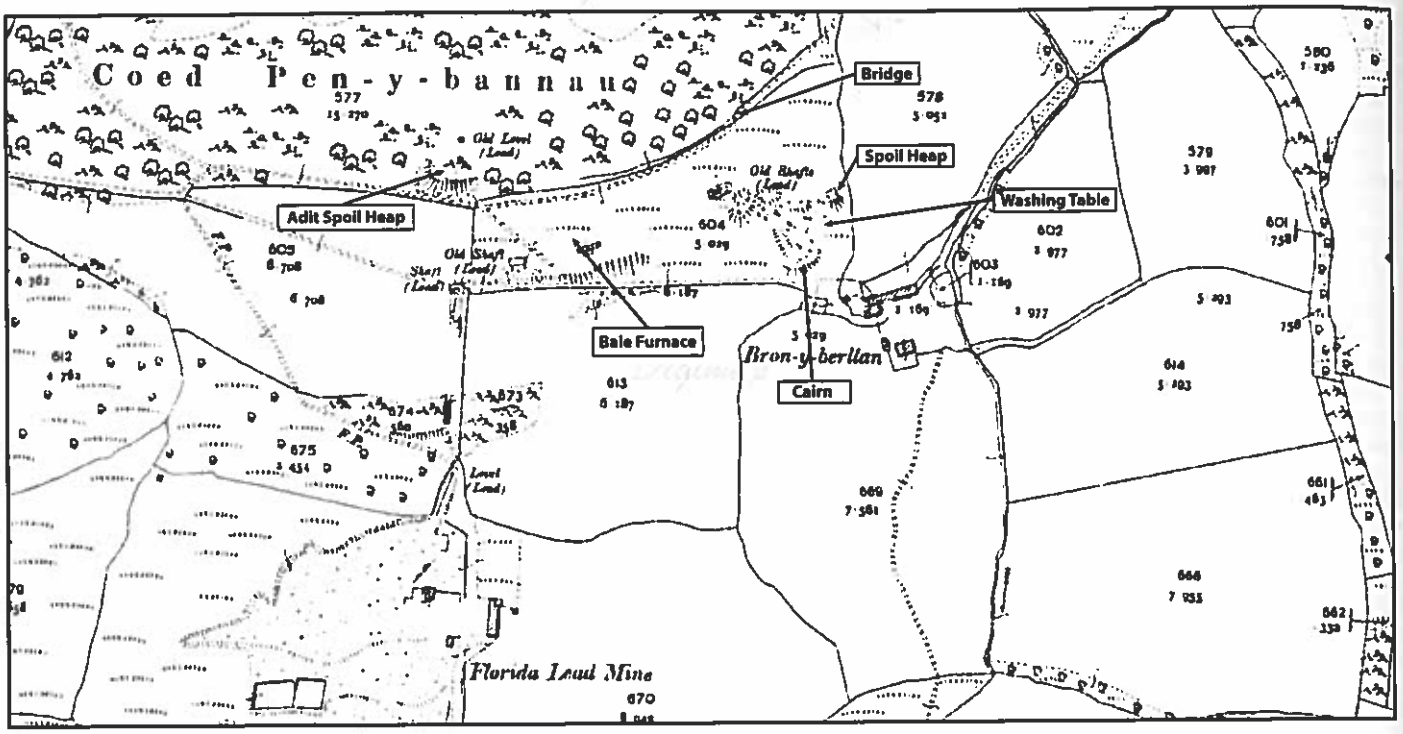


Figure 8: 1900 Ordnance Survey map (Edina Digimap) showing the adit in the woodlands and the sites of the various investigations referred to in the text

The final area to be excavated was a small spoil heap (NGR SN74600 66371) of approximately 4m x 6m x 10m. This spoil heap had been chosen first because of its undisturbed topography and position on the eastern end of the site, an area in which documentary and map evidence indicated that the earliest mining had taken place (later mining migrated to the western end of the site). Secondly it was chosen because analysis of samples taken from it had indicated that the feature contained large amounts of discarded zinc in comparison to other spoil deposits. The discarding of this zinc was taken as an indication that the shaft had been worked at a time when it was uneconomic to mine this mineral, which in this part of Wales would place the construction of the shaft before the 1850s (G. Hall, *pers. comm.*).

The excavation began by removing a thin covering of stunted grass and topsoil from the spoil heap, after which a 3m wide slot was cut into the centre of the spoil to a depth of 1.3m. The topmost layer of the stratigraphy was made up of a discrete deposit of grey, machine crushed material which covered the dome of the spoil heap. This layer was obviously from a later mechanised stage of the mines working life and, as such, was an unexpected find, as the spoil heap was thought to have dated from the pre-mechanised period of the mine. The layer immediately beneath the machine waste was larger and typical of waste that had been hand sorted. This layer was made up of larger pieces (on average 4cm x 5cm) of local rock with the occasional piece of lead/zinc gangue material and degraded iron pyrite. The mineralised layers continued to a depth of 0.8m at which depth a deposit of underground development waste was encountered. The stratigraphy in this part of spoil contained substantial amounts of heat fractured and fire reddened stone and a number of larger soot stained stones (the largest recovered was 24cm x 18cm). Pieces of charcoal and partially burnt wood in an excellent state of preservation were also found intermingled with the burnt stone in this deposit. Together, the size and fracture patterns of the fire reddened rocks, the soot staining on the larger stones and the burnt wood and charcoal indicated that this part of the stratigraphy contained the remains of the hard rock breaking technology of fire setting. The size of the wood remains which were between 3cm and 4cm long and 1.5cm and 2cm wide, indicated that bundles of fagots, possibly made from brush or coppiced wood, had been used for the fire setting process rather than the more substantial pieces of wood illustrated in Agricola's De Re Metallica (Hoover & Hoover, 1950) (the wood illustrated in De Re Metallica may, however, represent a heat guard rather than fuel).

The use of wood bundles in fire setting was mentioned by Tonkin (Hunt, 1887) who recorded that miners in Cornwall in the early 18th century used furze and faggots when fire setting. Faggots made up of pieces of small wood were also used in the Harz mines because of its bright quick flame (G. Hall, pers. comm.). The use of small brush wood would make sense in mid-Ceredigion as wood was a scarce and valued commodity because of the poor woodland management, and deforestation of the area that took place under the monks in the medieval period (Smith, 1906) and its procurement for use in mining had been problematic from the medieval period onwards (Rees, 1968). Lack of wood was, on at least one occasion, blamed for the cessation of mining in an area, as remarked by Leland in his journal from the 1530s (Smith, 1906). The soot covered rocks had carbon deposits on one face only, indicating that the other faces had been protected from the effects of the smoke. This, and their angular shape, indicated that they may have been dressing waste from the roof or upper walls of the workings.

As said earlier, this area of the excavation was undertaken in two parts; this was necessary because as the excavation proceeded it had become apparent that the spoil heap was much deeper than originally thought. In order to ascertain the depth of the spoil a sondage was driven to depth of 1m (the maximum allowed without shoring). However the sondage failed to reach the natural land surface and it appeared that the spoil, rather than being laid over a natural slope, was in fact filling a depression in the hillside, and as such contained more waste than had originally been thought. Given the restricted financial resources and time constraints, it became obvious that a full cross section of the feature could not be achieved by means of a trench through the centre of the feature without the use of digging machinery. It was decided therefore to cut a vertical section from within the backfilled shaft to the front of the spoil which would then connect with the sondage and the main area of excavation. The section was cut far enough into the shaft to reveal the shaft edge and the bottom of the spoil heap and far enough forward into the spoil to allow a full cross section to be planned.

Cutting a section from inside of the shaft, as well as revealing a full cross section of the deposits, also showed that the waste was laid on top of the remains of the spoil from an earlier phase of mining. This earlier spoil had been levelled to create a stable platform on which to deposit the later spoil. The upper spoil deposit was found to be constructed in a conical shape, with a lower section that was bolstered by a revetment of glacial boulders. The boulders which made up the revetment appeared to have been removed from the shaft after they were washed into it following an earlier abandonment. This conclusion was reached after examining the placement pattern of similar boulders which lay embedded in the banks surrounding the shaft entrance. The most likely reason for the construction of the revetment was to prevent the spoil heap from collapsing back into the shaft mouth. The lower part of the spoil heap consisted of mineral-free material which appeared to be a natural back-fill from the shaft (interestingly when the site was visited in 2014 following a very wet winter similar material was found to have been washed into the shaft). The upper layers showed a marked increase in the amount and change of material to the development rock and waste from the working of a mineral lode. The deposition pattern indicated that the lower spoil had been laid down in small lodes and that initially the valuable ore had been separated from the waste underground. The upper layers were less well sorted and there was a marked increase in the amount of zinc and lead minerals found in the upper part of the stratigraphy. The increase in mineral found in the upper stratigraphy was indicative of spoil from a site worked at a time when zinc had little commercial value. The way in which the spoil was deposited also indicated that hand picking had been undertaken, either underground at the working face or as the material was deposited on the dump. The discarding of so much mineral could also indicate that the lode had been very rich in galena when this part of the lode was worked. This would validate Spargo's (1870) assertion that the surface workings at the Abbey Consols had been very rich when the mine was worked in the 1840's. The discarding of valuable galena is not without precedence in the area and was remarked on by Lewis Morris (1775) who had noted the large amounts of valuable lead ore that had been discarded in spoil heaps at the near-by Esgair Mwyn mine. The stratigraphy within this upper spoil heap showed no signs of having been reworked after the initial deposition or disturbed by later investigatory activity. This is interesting as the mine was reopened in the 1880s when zinc was being produced on the site and one would have thought that the old waste tips would be the first place new miners would look for zinc mineral. Perhaps the smallness of the spoil heaps made this unprofitable.

The older, levelled spoil lying under the later spoil heap was quite distinct, in that it consists of a fine material mixed in a glade clay-like deposit. This deposit, which continued from the lip of the shaft to under the upper spoil heap, was cored to a depth of 0.6m, at which level the remains of the turf was encountered. The turf was interpreted as the original land surface and the glade material as mixed mud and spoils which had been washed into the shaft after its abandonment following an earlier phase of mining. This earlier material had subsequently been levelled in order to allow the deposition of further spoil from the last phase of the working at this shaft. The limit of this spread of spoil from the original opening of the shaft was not located, but probably lies buried beneath the later spoil heap.

The shaft itself was back filled with fine machine-produced waste which abutted the glade deposit, with the interface between these two materials showing a sharp and extremely well defined edge. The spoil which was used to fill the shaft was identical to the machine worked spoil found further downhill, near to some derelict buildings. The back filling of the shafts in this area of the mine was carried out in the 1970's by the present landowner Mr Jones (*pers. comm.*) who remembered filling the shaft with his father, using mineral from other areas of the mine. The use of this material to back fill the shafts on this part of the site explains the top layer of machine crushed material which seemed so out of place with the rest of the spoil.

Figure 9: Stone with soot deposits, recovered during the excavation

The excavation of the spoil heap and an examination of the topography of the site enabled a chronology of the working life of this shaft to be estimated. The shaft is multi-period, although what time periods were covered, or how many, cannot be said. What can be said is that the lode in this area was first worked as a surface outcrop by means of a shallow quarry. At some later date a shaft was sunk into the workings which followed the lode underground. This part of the workings and the shaft then

Figure 10: Section of spoil heap showing stone revetment within the spoil heap, photographed from shaft centre

the results from this survey may represent the buried remains of a cupellation furnace of medieval date, and that the monks were refining silver from argentiferous lead sourced from mines on their lands. That the monks possessed the necessary metal working skills to produce such a feature can be seen in the 1539 record that one of the Abbey's monks was in prison for forging silver coins (Williams, 2001). It is hoped to further investigate these themes and carry out an investigation into the area of disturbed ground with the farmer's permission in 2015.

A social history of mining communities in the parish of Gwnnus (Strata Florida)

As well as studying the archaeology this research also looked into the history of miners who lived in Gwnnus, which is the parish in which most of the mines were situated.

An on-going examination of this area is being undertaken looking at the land grants, rental rolls, parish records and census returns in an attempt to add a human element to the work by teasing out some of the details of the miners and their families' lives. Using these resources so far it has been possible to match people working as miners to the local houses as far back as the 17th century; however it has proved impossible, except in a few well documented cases, to connect miners to any mines. One rare example is Llwyn farm where Lewis Morris, in the mid-18th century, records that its owner worked at Esgair Mwyn mine. Extraordinarily, when I visited the same farm almost 250 years later, the farmer told me his grandfather had worked at the same mine. A picture of a close knit society is emerging where people looked after their own in time of need, as can be seen by the number of children and the elderly recorded in the census returns living with close relatives such as grandparents and siblings.

In the 1850's the records show that this was a community in which the range of trades increased, and the people experienced an improvement in living standards. These seem to be associated with a substantial increase in mining activities in the area at that time. The mining booms (and the enclosure of common lands) were marked by an influx of people into the parish. However, contrary to popular belief that the area saw a mass immigration of Cornish miners, most of the incomers were from the surrounding parishes. It was a society which valued the miners and in which the miner-farmer settlements were well integrated. Those settlements themselves are far more complex than have been portrayed in the past. Rather than simply being miner-farmers, the people living in these communities were undertaking many forms of subsistent employment including miner-quarryman, miner-stocking knitter and miner–pauper.

These were communities where, by the 1840s, an unwritten consensus had been achieved between the land owners and the miners. The consensus allowed the miners to build squatter settlements in the area in order to maintain a skilled industrial workforce and a pool of farm labourers to serve an area where farming and mining were the mainstays of the economy. This consensus and continuity of living style was maintained until the industry's almost total collapse at the turn of the 20th century.

Figure 12: Litharge found in a loose stone wall near a possible smelting site

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Figure 13: Ruins of a squatters cottage at Claer Ddu mine

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