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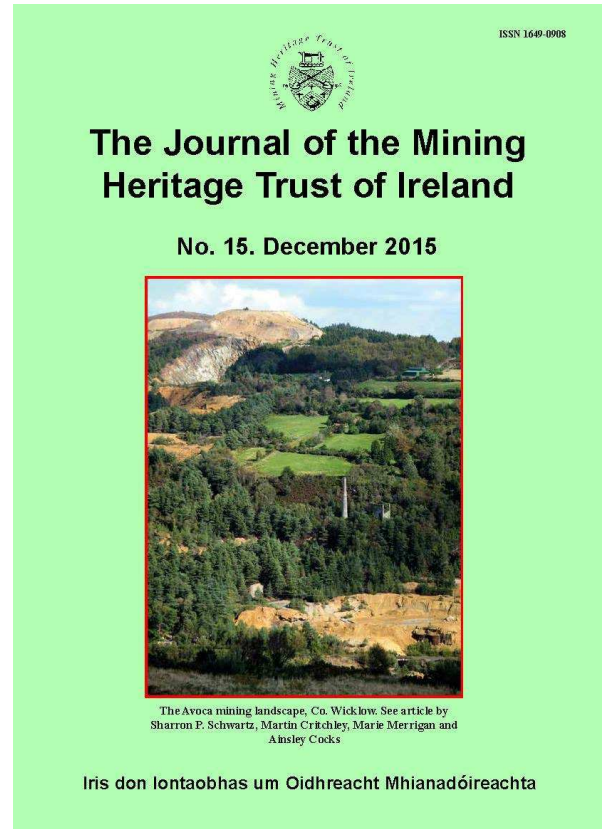
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‘CONTESTED SPACES’: IMAGININGS OF POST-INDUSTRIAL MINING LANDSCAPES, THE CASE OF AVOCA, COUNTY WICKLOW

Sharron P. Schwartz, Martin Critchley,
Marie Merrigan and Ainsley Cocks

Abstract: The polymetallic mines of Tigroney, Cronebane, Connary, Ballymurtagh and Ballygahan in the Avoca Valley, County Wicklow, were the most important group of metalliferous mines in Ireland, the exploitation of which resulted in rural industrialisation on a scale not common here. Now closed, these mines form one of the most impressive historic mining landscapes in Britain and Ireland, with a panoply of industrial features unusual in an Irish context. However, this remarkable landscape is threatened by ongoing and impending remediation works undertaken by the state under the aegis of compliance with health and safety legislation. Drawing on experiences in the remediation of such landscapes in Cornwall and Wales, this paper argues that historic mining landscapes are ‘contested spaces’. Far from being merely contaminated and derelict sites to be remediated and reclaimed, historic mining landscapes also embody powerful and important cultural meanings. They can be imagined quite differently by individuals or groups who actively construct and signify their values and beliefs which may be encoded in, and intertwined with, the physical features of a landscape. By looking at the processes and issues involved in the treatment of historic mining landscapes in Cornwall and Wales, specifically the Parys Mountain Mine, Anglesey, some of the key factors problematising the remediation, preservation and protection of the relict mining landscape of the Avoca Valley will be explored. *Journal of the Mining Heritage Trust of Ireland* 15, 2015, 55-90.

POST-INDUSTRIAL LANDSCAPES: PERCEPTIONS AND PROBLEMS

Almost two decades ago, a seminal work jointly published by Cornwall Archaeological Unit and the Institute of Cornish Studies, University of Exeter, clearly set out the multi-faceted conservation value of Cornwall’s metalliferous mine sites (Johnson *et al.* 1996). This important document came at a time when the historic mining landscapes of Cornwall, once at the forefront of British industrialisation, stood at the threshold of great change. Few back then would have dared believe it possible that exactly a decade later these would be inscribed onto the prestigious UNESCO World Heritage Site (WHS) list. In the early-90s, Cornwall had the highest acreage of ‘derelict land’ arising from industrialisation in England, but had not been particularly successful in drawing down funding to regenerate brownfield sites for re-development.

However, the increased availability of grants in the early 1990s to recover such land for economic regeneration prompted concern about how remediation and reclamation works might impact on the fabric and authenticity of Cornwall’s post-industrial landscapes. Heated debate arose between planners and archaeologists in particular about what value should be placed on certain aspects of these landscapes.

This debate was also being echoed in former mining regions elsewhere, such as Wales. Like Cornwall, these too were trapped between the tell-tale signs of their industrial past and the realities of their post-industrial future (Schwartz and Lorenc 2011, 261).

The waste generated from mining proved to be particularly contentious, with soils impregnated with heavy metals (perceived to be a threat to health and safety) proven to be nurturing rare or unusual biota (Purvis 1993; Spalding 1995; Spalding and Haes 1995; Spalding *et al.* 1996). It was also argued that spoil heaps were important from a mineralogical and archaeological viewpoint (Bristow and Sparrow 1996; Sharpe 2005), providing important contextual evidence of past mining activity and therefore worthy of preservation in their own right. This point was well made by Quivik, when writing about attempts to remediate the post-industrial landscape of the copper mines and smelter sites around Butte, Montana, in the United States. He observed that attention usually focuses on the most iconic and visible features such as headframes, hoist houses, mills, smelters, mine offices and workers’ housing, often at the expense of ancillary features such as mine spoil heaps and tailings dams. Yet, he argues, ‘wastes from the mining industry are more than just visual, physical, or chemical presences on the landscape; they embody powerful

and important cultural meanings as well' (Quivik 2007, 35).

Creating new uses and identities for post-industrial landscapes is often highly politicised, fraught with problems and its success varies across different regions. For although post-mining landscapes are encountered globally and demand best practice, there is no universal strategy for post-mining landscape transformation, and this was especially apparent in the 1980s and early 1990s. Moreover, the concepts of industrial archaeology and heritage were not only new, novel and challenging arrivals in the heritage sector, but also in academia (Palmer 2000). If industrial heritage was deemed to be of consequence, the question that needed to be asked, according to Sir Neil Cossons, was 'why and to whom?' (Cossons 2012).

As Cossons further elucidated: 'the techniques of preservation and conservation built up over many years in the wider heritage sector do not necessarily meet the demands of industrial heritage' (Cossons, 2012, 8). He proffered that the 'one size fits all' approach was unlikely to succeed. It soon became apparent that there were two recurring themes. The first was the transformation of former industrial landscapes into cultural ones, creating landscapes that celebrate the local population and their heritage, even though at the same time that population may be promoting preservation of the landscapes through new usage. The second was the re-imagining of post-industrial landscapes as a result of their transformation into diverse, sustainable and green eco-zones through remediation to revitalise local economies through heritage and eco-tourism. However, it also became apparent that the two approaches did not always make easy bedfellows and at times seemed to be diametrically opposed. This was particularly evident when the views of local stakeholders were marginalised or ignored, as the post-mining landscape often holds significant value to them as a visual representation of their combined heritage. To quote from Cossons (2012, 9):

The industrial heritage is of wider social and cultural significance as part of the record of people's lives, and as such provides an important sense of history and identity. That may relate to an industry, a specific company, an industrial community, or a particular trade or skill. Or, the industrial heritage may have technological and scientific value in the history of manufacturing, design or planning. These values are intrinsic to the site itself, its fabric, components, machinery and setting in the industrial landscape, in written documentation, and also in the intangible records of industry contained in human memories, traditions and customs. Industrial heritage may offer identity for a community or provide the signature for a place, recognised externally.

As Baeten (2009) noted, 'successful remediation plans require open dialogue between planners and stakeholders, and transparency with regard to objectives, emphasis on sustainability and the environment, and above all, engagement with, and the involvement of, local communities'. What had become increasingly evident, was that balancing the requirements of land reclamation and remediation (amelioration

of soils and water courses impregnated by heavy metal and other contaminants, and the making safe and cleaning up of brownfield sites for re-development and regeneration), while also seeking to protect rare biota and biodiversity, important geological legacies and significant industrial monuments that underpinned the very *raison d'être* of many former mining communities, was often highly contentious and emotive.

Ireland has a long history of widely-spaced mining ventures, but, according to Walsh (1978, 114), the majority of these historic mines 'were of little significance' economically. This viewpoint was no doubt strengthened by the all pervading perception in the mid-twentieth century that there were no mines in Ireland, which stemmed from a placid acceptance that Ireland was a land naturally impoverished, a bucolic haven which possessed no minerals of any worth. 'For over four generations this myth was "severely and effectively schooled" into the nation's youth' according to Kearns (1976, 251), and, 'apart from quarrying, modest extraction of poor quality coal and the cutting of peat in bogs, there was, in fact, little evidence to contradict this notion'. This view of Ireland was finally challenged by the discovery and development of some of Europe's largest lead-zinc deposits during the 1960s.

Traditionally, the term Industrial Revolution is used to describe a period of massive industrial change from 1750 onwards, involving a sharp break with the past. The principal characteristics of this phenomenon were large-scale production, economic specialisation, the use of steam power and machinery, employment of large numbers of waged workers in factories, market expansion, urbanisation and population growth. Colin Rynne has argued that nineteenth century Ireland never became industrialised in either a British or European sense (Rynne 2006, 2). According to him, truly large-scale industrialisation only took root in some of the largest towns and cities of Ulster, underscored by economic specialisation and a move away from proto-industry to full scale factory production of linen.

However, shifts in spatial focus have uncovered combined and uneven patterns of industrialisation in Britain, highlighting the fact that the process of industrialisation was not always one of 'revolution' but rather of 'evolution' (Pollard 1981; Hudson 1992; Richards 1993). Indeed, there were significant differences in the speed of large-scale industrialisation, with change and continuity co-existing in some regions. Although Ireland, outside of Ulster, experienced only in patchy form the industrial-scale production usually associated with the quintessential view of the 'Industrial Revolution', some sites are nevertheless noteworthy both in their extent and output. For example, the Ballincollig Gunpowder Mills, a preserved site in County Cork, is the largest industrial site in Ireland and the second largest of its type ever to have been constructed in Europe. Moreover, this works enjoyed a global market for its product (Rynne 2006, 290-295). Can the same be said of Ireland's mine sites?

As Michael Dillon (1968, 79) noted almost 50 years ago in his study of Coalisland, a town in County Tyrone sited on Ulster's 'only substantial coalfield' (Stewart 2002), little attention has been paid to the evolution of Irish industrial landscapes



Fig. 1: The rural industrial mining landscape of East Avoca around the turn of the twentieth century, showing extensive spoil heaps and three Cornish-type engine houses on the Tigroney Mine, including the one that accommodated the largest engine ever erected in Ireland (top right). By kind permission of the National Library of Ireland

specifically connected to mineral extraction. At Coalisland (which manifested a multifaceted industrialism that included textile manufacture) he argues that coal and fire clay extraction created a landscape containing evidence of almost every element which characterised the ‘Industrial Revolution’ in the Midlands or north of England. Indeed, he notes how one English geographer commented, ‘When I reached Coalisland I sat bolt upright and wondered if I was still in Ireland’ (Dillon 1968, 81). However, he also concedes that Coalisland was possibly unique, for most of the areas in Ireland associated with former mining do not contain the full panoply of features characteristic of industrialisation: canals, railways, rows of workers’ housing, chimney stacks, shaft-head infrastructure, adits, shafts, spoil heaps and deep opencasts; the majority are small scale indeed. But that is not to downplay their importance.

The Avoca Valley in County Wicklow has experienced over 300 years of mining activity and is undoubtedly Ireland’s most important metalliferous mining area, as elucidated in the following quotation:

There is, perhaps, no tract in the British islands which exhibits, even to the eye of the uninitiated, an appearance so strongly stamped with the characteristics of the presence of metallic minerals. For a considerable distance on both sides of the deeply-cut valley of the Avoca the face of nature appears changed, and instead

of the grassy or wooded slopes, or the gray rocks which beautify the rest of its course, we see a broken surface of chasms, ridges, and hillocks, glowing with tints of bright red and brown, or assuming shades of yellow and livid green, which the boldest artist would scarcely dare to transfer to his canvas. Here and there from among the ruins peers the white stack and house of a steam-engine; or water-wheels stand boldly projected against the hill-side, - some still and neglected, others whirling round in full activity; long iron pump rods ascend the acclivities to do their work at distant shafts, and as long as daylight lasts, the rattle of the chains for raising the ore, and the clink of the separating hammers attest the vigour of the operations (Smyth 1853, 371).

These are the mid-nineteenth century words of eminent Victorian geologist, Sir Warington W. Smyth F.R.S. of the Geological Survey of Great Britain and Ireland, and he depicts a rural-industrial landscape in an area that arguably manifested some aspects of regional specialisation on a scale unusual in Ireland. As many as 17 steam engines were installed in the Avoca Valley at various times during the 1800s, most manufactured in Cornwall, including the largest engine (Williams’ 60-inch) ever set to work on an Irish mine. By the early decades of the nineteenth century, Avoca was locked into a global mining economy, its copper mines providing contract employment for more than 2,000 waged labourers (Inglis



Map 1: The location of the main mining areas discussed in this article. Cornwall, Anglesey and Wicklow, the ‘Celtic Copper Triangle’ have collaborated on a number of transnational mining heritage projects over the past two decades

1835). Avoca’s internationally known ‘sulphur’ mines supplied the bulk of Britain’s pyrite needs in the mid-nineteenth century (Smyth 1853), and the valley saw significant opencast activity up to the 1970s and 80s. By the late nineteenth century, the Avoca mines had fostered the creation of chemical and explosives factories in Wicklow Town and Arklow.

Today, Avoca has the largest concentration of extant remains of Cornish-type engine houses in Ireland, as well as a wide range of other industrial monuments and features, including open pits, tailings impoundments, spoil heaps, ochre pits, adits, shafts, leat channels, mineral railway tracks and bridges, miners’ housing (albeit not the rows of terraced houses so characteristic of industrial landscapes in Britain)¹ and places of worship. The Avoca mines have left a rich landscape legacy, but also an historic problem in the form of metal enriched soils which allegedly pose a health and safety hazard, and one of the most polluted watercourses in Ireland (Yau and Gray 2005). Under the terms of the Water Framework Directive (set out in 2000), the most significant piece of water quality legislation to be developed by the EU for at least twenty years,

¹ The Avoca mineworkers constructed crude one roomed botháns on the roadsides, or wasteland on, or close to, the mineral setts. Inglis notes 274 such dwellings clustered on the Tigrooney-Connary Hill in East Avoca and a further 63 on the opposite side of the valley in West Avoca (Cowman, 1994, 776). The majority of these buildings have long since melted back into the landscape.

the Avoca River, from source to sea, requires attention.

However, there is currently no specific legislation in Ireland dealing with the remediation of orphaned or abandoned mine sites. The main focus has therefore been on environmental remediation and overall, very little has been done to conserve and protect industrial monuments and associated landscapes which are the most visible extant reminders of Ireland’s historic mining industry. As Matthew Parkes highlighted back in 1999 at a workshop convened in Dublin to address the ecology of old mine sites, the prevailing opinion was that old mines and quarries were, by and large, viewed as ‘eyesores’ and ‘problems to be dealt with’ (Parkes 1999, 75).

This has been especially so since the introduction of EU legislation including the Water Framework Directive (2000), the Extractive Waste Directive (2006) and will likely gain further traction following legislation such as the Seventh Environment Action Programme. This entered into force on 17 January 2014, and prescribes/directs that by 2020 land be managed sustainably in the Union, soil be adequately protected, and the remediation of contaminated sites be well underway. It also commits the EU and its Member States to increasing efforts to reduce soil erosion and increase soil organic matter and to remediate contaminated sites. This of course begs the question, what level of remediation is necessary to be compliant with EU legislation? Moreover, is it even feasible, or desirable, for certain former mining landscapes which are deemed to be very heavily contaminated to ever be able to satisfy such strict environmental criteria on soil and water quality?

The Mining Heritage Trust of Ireland (MHTI) has been in the vanguard of progressing more positive ways of viewing historic mining landscapes. The MHTI sees them as assets worthy of protection, and as potential catalysts both to enhance a sense of pride of place for local inhabitants and to stimulate sustainable tourism initiatives. Working with local groups and government agencies, the MHTI has availed itself of local, national and international funding, achieving several notable successes with regard to the conservation of visible and iconic nineteenth century surface mining monuments. Cornish-type engine houses at Allihies, County Cork (Morris 2002, 2003) and Bunmahon, County Waterford (Critchley and Morris 2005), have been consolidated, while a larger multi-million euro landscape remediation project at a former lead mine near Silvermines in County Tipperary has made safe a twentieth century toxic tailings dam, within the scope of which a group of important nineteenth century mine buildings were also conserved (Morris 2011).

However, other significant mining landscapes languish in a state of benign neglect. These include the lead mines of Newtownards in County Down near Belfast, Northern Ireland (Schwartz and Critchley 2013, Moles *et al.* this journal), and more particularly Avoca, which has experienced only a limited degree of consolidation works to some of its extant Cornish-type engine houses (see below). Moreover, the curtilage around individual mining monuments that includes features such as shafts, spoil heaps and tailings dumps, is often not afforded any protection and is therefore at risk of degradation



Fig. 2: The West Avoca mines of Ballygahan and Ballymurtagh around the turn of the twentieth century. Note the large open pit (centre), extensive spoil heaps and industrial buildings, including three engine houses. The open pit, expanded in the mid twentieth century, has since been used as an unlined landfill (see Fig. 22) and the majority of the surface landscaped and grassed over. The loss of the remaining spoil (top right), would further seriously degrade what remains of this historic mining landscape. By kind permission of the National Library of Ireland

or obliteration.

The recent commencement of remediation works on the Avoca mining landscape in County Wicklow, undoubtedly the jewel in the crown of Ireland's historic mining centres, has raised significant disquiet echoing concerns similar to those expressed in Cornwall and Wales in past years. This article aims to explore how historic mining landscapes are 'contested spaces', imagined in myriad ways by different people. By looking at the processes and issues involved in the remediation and conservation of such landscapes elsewhere, particularly Cornwall and Wales, we isolate the key problematising factors which place the Avoca mining landscape under threat.

IMAGININGS OF POST-INDUSTRIAL MINING LANDSCAPES: THE CORNISH AND WELSH EXPERIENCE

Central to the issue of remediation is that of the landscape itself, a collectively perceived array of attributes, a suite of material, social, historical, and physical elements that have been manipulated and exploited by man and are the result of human social activity. Landscapes are comprised of consciously or unconsciously placed things and are altered environments and arranged spaces. As Cassell and Myron (2005) note: 'they occur within the context of the historical circumstances surrounding human presence at a particular place at a particular time. Landscapes are thus cumulative and represent

a palimpsest of developed and developing ideas. They are simultaneously snapshots in time and ever-changing aggregations of ideas and experiences and things. They represent notions of the way things are and also the way things ought to be or have been or will be. They are archaeological sites writ large'.

Landscape then, is the stage for all human action: it reflects past activities but it also encodes the cultural backcloth against which people's views of the world are formed. However, when considering the interpretation of historic landscapes it is important to avoid falling into the trap of simply acknowledging the visible, material landscape and the study of form and space. We must seek to explore issues of symbolism and meaning, human perception and the experience of landscape and the interactions of individuals, culture and society with it (Yamin and Metheny 1996, xv). And, with this must come an acknowledgement that the landscape may be envisaged differently by individuals who actively construct and signify their values and beliefs which may be encoded in, and intertwined with, its physical features. Indeed, as Harner (2001) notes, 'landscape is both representation and reality, both symbol and form, both image and actual lived conditions'. Competing groups continually contest the dominant morphology and symbolism, thereby reshaping the social and physical space. Landscapes become the materialised discourse of different social interests (Schein 1997), so they are always a compromise, a continual process and product of struggle to

provide meaning in the world (Mitchell 1996).

Coining the phrase ‘multilocal’, anthropologist, Margaret Rodman, argues that ‘place’ – the meaning of a landscape – is socially constructed at many levels by many individuals and groups so that a single place might be experienced quite differently’ [by different people] (1992, 647) and have many meanings and identities which are often contradictory and competing. It follows, therefore, that historic mining landscapes are imagined and reimagined in a variety of ways by individuals and/or groups and carry multiple meanings for different users. Crucially, Harner argues that a coherent form of place identity can only develop when landscape reality and representation are in apparent equilibrium, and this only arises when the shared beliefs and perceptions about place meaning for the majority match the ideological beliefs of those in power. We argue that the contested meanings ascribed to historic mining landscapes in Britain and here in Ireland revolves, to a great degree, around a struggle for political and cultural hegemony which has greatly impacted how they are viewed and consequently treated.

Cornwall

Indeed, this struggle is very apparent in the seminal document authored by Johnson *et al.* (1996). On the one hand, Cornwall’s mining landscapes could be seen as a reminder of a triumphal past, a powerful symbol of Cornishness, ‘a memorial to the proud days when Cornwall dominated the international world of deep-mining and steam engineering’. On the other hand, the experience of two of this paper’s authors (Schwartz and Cocks), growing up in highly deprived former mining areas of 1960s and 70s Cornwall – Redruth and St Austell – suggest that this narrative was largely crowded out by the indifference of many people. They saw the historic mining landscape as a symbol of failure and dereliction, of dramatic and catastrophic decline, of English exploitation, signifying dispersal, unemployment, poverty and defeat. Taken to its utmost bent, this narrative determined that Cornwall’s mines had created a poisonous and dangerous landscape legacy whose soils and watercourses were contaminated with asbestos, arsenic and heavy metals, and which cried out for remediation on health and safety grounds.

It was found that Cornwall had the highest acreage of ‘derelict land’ in England in the early 1980s (12,000 acres or 11 % of the total), most of it the direct result of mining activity; what to do with this ‘derelict land’ rapidly became something of a contentious issue between those who saw its value as a cultural landscape worthy of preservation and those who believed former industrial land would better serve local communities by being remediated and landscaped for retail purposes and housing.² Indeed, the dichotomy of interpretation seemed to be magnified as the crumbling engine houses and mounds of unsightly spoil of the ‘English industrial revolution’ sat uneasily alongside competing narratives of place: romantic imaginings of the ‘Cornish Riviera’ with its palm fringed holiday beaches of golden sand, or the ancient high crosses,

holy wells and dolmens of the twentieth century Revivalists’ Celtic Cornwall (Chapman 1992; Westland 1997).

For Schwartz and Cocks, an attitude of indifference and even disinterest in Cornwall’s mining legacy seemed to prevail well into their teenage years. This was reinforced by a resounding silence in their school history textbooks about Cornwall’s role in the British Industrial Revolution. Meanwhile, the ivy clad ‘ruins’ studding these ‘derelict wastelands’, which were nonetheless their childhood playgrounds, gradually fell victim to the elements, while some were helped on their way to oblivion by stone robbing, vandalism and deliberate demolition. The very word ‘derelict’ widely used back in the 1970s and 80s, is shot through with cultural and economic presumptions and is a pejorative term with connotations of ‘neglect, abandonment, uselessness, ugliness, even danger and contamination’ (Payton 1996, 9). And the end of life white goods, decomposing mattresses, abandoned cars and heaps of domestic refuse littering the overgrown burrows and choking the shafts of the old mines, only served to enforce this viewpoint. It is no coincidence that Cornwall’s largest landfill was sited at the once famous and extensive United Mines at Gwennap.

The very idea that such ‘derelict’ landscapes might be of intrinsic aesthetic or cultural value to individual or group identities, and worthy of financial investment to preserve them and/or to transform them into amenities with socio-economic benefits to local communities, was not an easy concept to grasp. As Nicholas Johnson, the then County Archaeologist and vociferous campaigner for the preservation of Cornwall’s mining landscapes recounts, ‘... it was difficult to convince councillors and the tourist industry to put money into a “dead industry” to revitalise the Cornish economy’ (Schwartz 2008, 8).

Complicating the issue was the fact that some people who perceived Cornwall’s post-industrial landscape to be a powerful cultural icon, were resentful of ‘up country’ interpretations, based on increasingly romantic imaginings of it, by in-migrants and holiday-makers. The message that Cornwall had been an important mining area was beamed into every home in the UK with a TV set via the hugely popular and captivating 1970s *Poldark* period drama, which undoubtedly piqued interest in Cornish mining history and drew thousands of new tourists annually to Cornwall in the years that followed, stimulating the tourism industry.³ Yet, critics pointed to the fact that cream teas served by people dressed up as miners or bal maidens (female mine surface workers) only served to romanticise, and even trivialise, what life had really been like for those who worked in Cornwall’s mining industry.

Indeed, the growing popularity of cultural or heritage tourism on the back of this period TV drama brought into sharp focus the conflict between the support for mining landscapes as potential leisure amenities that employed local people (albeit

² This attitude was particularly prevalent among Cornwall’s planners and enjoyed a degree of support from leading politicians.

³ A well-received reboot of the series featuring Irish actor, Aidan Turner, was screened in 2015 with a further series planned.



Fig. 3: Consolidated engine houses along the Great Flat Lode at Wheal and West Wheal Basset near Redruth, Cornwall, seen here during the Smoking Chimneys Celebration organised by the Mineral Tramways Heritage Project in 2008. The mine spoil surrounding these monuments was removed when the area was remediated in the 1990s. The works included landscaping, grass seeding and the installation of zig-zag aggregate pathways and picnic tables which did not meet with universal approval. Image, Ainsley Cocks, 2008

often on a low paid, seasonal basis), and the reality of ‘derelict’ land reclamation schemes. The tourism industry was, on the one hand, willing to recognise the activities of organisations like The National Trust that had acquired and consolidated the Wheal Prosper engine house at Rinsey Head in Breage (Laws 1978, 29-30) in the early 1970s (and which later featured in the blockbuster *Poldark* TV series), and the transformation of Geevor Tin Mine (which closed in 1990) into a museum. On the other hand, it also appeared to tacitly condone so-called ‘environmental remediation and improvement’. This often encompassed the large-scale removal or re-profiling of mine spoil, re-vegetation (epitomised by highly controversial reclamation projects along the Great Flat Lode near Redruth), and even afforestation (Brown and Acton 1994, 7). Such projects were increasingly frowned upon: ‘The environment of an industrial monument is equally integral to its existence and therefore important in understanding its significance’ (Editorial 1989). Indeed, for some observers, the sight of engine houses marooned amid grassy swathes (Fig. 3) with picnic tables, marked the ‘sanitisation’ and ‘prettification’ of the historic mining landscape, transforming it into something ‘totally alien’, what one critic disparagingly termed ‘Surrey with engine houses’ (French 1994). Other detractors pointed the finger of blame at the EU:

Onerous standards set by Brussels are resulting in topsoil tipping which in time will drastically alter the types of vegetation growth which have for long been

associated with mined areas. All this is happening despite opposition from naturalists, environmentalists, mining historians and even Cornwall County Council’s own archaeologists (Brown and Acton 1994).

During the 1990s, in parallel with the increase in mine site remediation which was taking place in what was ‘...probably the most important mining district in the world...’ (Burt *et al.* 2014, 21), there was a growing awareness that the mining landscapes of Cornwall were worthy, not only of protection and wider recognition, but also acclaim. During this decade, the concept of World Heritage Site (WHS) status for mine sites in Cornwall gradually gained traction through initiatives undertaken by Cornwall County Council’s Historic Environment Service (HES) headed by archaeologist, Nicholas Johnson, which developed the idea of promoting a series of discrete mining landscapes across Cornwall and west Devon. Taken together, these would tell the story of how Cornish mining came to dominate the international metalliferous mining sector during the 1800s.

A political milestone was achieved when the ‘Cornish Mining Industry’ was included in the UK Government’s WHS Tentative List document of 1999 (DCMS 1999, 22-24). The timing of this was fortunate in that it coincided with the availability of European Regional Development Fund grant aid under the Objective One programme for Cornwall. Spurred on by the successful WHS inscription of the Blaenavon Industrial Landscape in 2000 (see below), capital funding was



Fig. 4: The extensive spoil heaps of the West Caradon Mines on Bodmin Moor are designated a SSSI. Spoil heaps are but one element making up the historic mining landscape which should always be viewed in an holistic manner. The Cornish Mining WHS Management Plan specifically cautions against the removal, burial or disturbance of mine waste. Image, Sharron Schwartz, 2015

duly secured from this source by the HES the following year. A nomination bid team was assembled in the spring of 2001, which received financial and government officer support from the partner local authorities in Cornwall, as well as West Devon Borough Council and Devon County Council.

In order to maximise public involvement and support for the emerging nomination, a WHS Bid Partnership (such as was convened during the Blaenavon WHS bid), was set up. All those organisations (government and non-government) and individuals with a stake or interest in mining heritage and history, were invited to play an active role. At the time of the nomination submission to UNESCO in February 2005, the Bid Partnership had grown to include 70 organisations and some 140 individual participants, and was seen to be functioning as a fully inclusive and democratic forum for discussion.

Garnering the level of support achieved through the WHS Partnership Board was to prove an effective tool in demonstrating to UNESCO the degree of cross board commitment which existed towards the nomination. This fact, coupled with the considerable conservation work that had been undertaken at mine sites in the years prior to the nomination, was highlighted for praise at the World Heritage Committee Session in Vilnius in 2006, when the Cornwall and west Devon Mining Landscape was inscribed onto the World

Heritage List.⁴ The shared beliefs and perceptions about place meaning for a majority of people living in the former mining regions of Cornwall (and west Devon) had converged sufficiently with the ideological beliefs of those in power, hence the successful outcome.

From the widespread perception of Cornish mining sites as dangerous, derelict, contaminated areas of little intrinsic value, to a cultural landscape of Outstanding Universal Value (OUV), was a barely believable turn around. Cornwall's engine houses are now revered as 'cathedrals to industrialisation' and equal in significance to monuments such as Stonehenge and the Taj Mahal. The silhouette of the engine house has become a recurrent visual theme throughout Cornwall, ever since the introduction by Cornwall County Council Trading Standards Office in 1991 of the 'Made in Cornwall' scheme which adopted the symbol of the engine house as a logo on accredited Cornish products (Orange 2012, 65). But it is WHS status that has undoubtedly led to the iconisation of the Cornish engine house as a symbol of ethnic pride and identity, in Cornwall and in Cornish communities overseas, for the WHS logo features a prominent golden silhouette of one. The pride in WHS status is encapsulated in the strap line that accompanies this logo which proclaims 'Our Mining Culture Shaped Your World'. Significantly, this strap line is a recognition of the Cornish mining industry as being something

⁴ At 19,710 hectares, this is the largest WHS in the UK (Cornwall County Council 2004).

'home grown' rather than imposed from outside (notably England). In the decade since inscription, over £100,000,000 has been spent remediating and consolidating mine sites and improving the fabric of former mining settlements throughout the WHS.

Moreover, the UNESCO status is an important factor in maintaining the authenticity and integrity of the various sites within the WHS boundaries. Any form of works should not compromise the OUV of the historic mining landscape, which crucially, is viewed in an holistic manner. This has been written into the Cornwall and West Devon Mining Landscape World Heritage Site Management Plan 2013-2018 (Section 5.2.3: Protection of Mineral Resource):

The Cornish Mining World Heritage Site contains extensive secondary mineral deposits (mineral waste dumps) associated with either underground development or mineral processing, and these are important historic context for the mines with which they are associated, and contribute to OUV. Until relatively recently secondary mineral deposits of this kind were essentially unprotected, although under Devon County Council's Minerals Local Plan, Prohibition Orders can be issued to revoke existing planning permissions for the removal of aggregates from mine tips in the Tamar Valley.

The protection of mine waste, which has historically been seen as of lesser importance than the more visible and attractive mine buildings, is also made explicit elsewhere in the Plan (Section 6: Policy framework and strategic actions): 'There is a presumption against the removal, disturbance or burial of historic mine waste within the Site' (Policy P7). The protection of mine wastes is also strengthened by further statements regarding the importance of the historic mining landscape: 'Landscape, nature conservation and agri-environment management regimes will have regard for the authenticity and values of the Site' (Policy C5); 'The historic character and distinctiveness of the Cornwall and West Devon mining landscape will be maintained', (Policy C7).

South Wales

Like Cornwall, the case of South Wales, once the pulsating heart of coal, iron and steel production that helped propel a rapidly industrialising Britain onto the world stage, also highlights the competing imaginings and politicisation of post-industrial landscapes. Following the inexorable post-WW2 decline of coal mining in the Valleys⁵, at the close of the twentieth century and into the new millennium, large scale projects sponsored by the Welsh Development Agency which garnered widespread approval from planners were put into action. These projects promoted the remediation of contaminated land, the removal of spoil heaps deemed to be

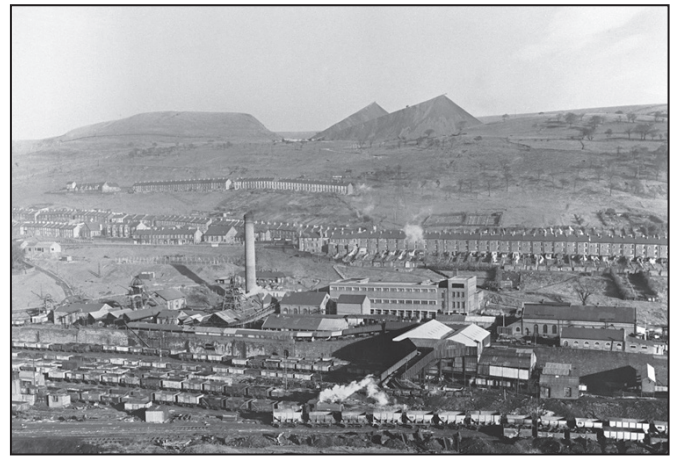


Fig. 5: Waunlwyd in the 1950s, a scene once typical in the Valleys of South Wales. Note the terraced housing cheek by jowl with the pit head and the coal spoil prominent on the horizon. Image in the public domain.

'dangerous and oppressive', and the restoration of former industrial sites. Initiatives such as the European Union's Objective One Programme and the Welsh Assembly's Communities First Programme (Communities First Directorate 2001) were set up to regenerate the former coalfields, but unfortunately many of these schemes failed to connect people with the historic mining landscapes surrounding them.

Due to an association with a harsh industrial past and tragic disasters like Aberfan (1966), coal spoil in particular was often viewed negatively and was seen as of little value. There was also a distinct lack of public 'connection' with former collieries and consequently, many of these then fell victim to vandalism, illegal dumping, off road vehicle use, and neglect. During the late twentieth century and into the new millennium, pit head infrastructure, and particularly the distinctive black heaps of coal spoil, were lost to land reclamation schemes. In some cases, the removal of coal spoil was necessary due to the dangers associated with slope instability, but many were needlessly re-profiled or erased, with the consequent loss of their cultural heritage, landscape value, and associated wildlife (Humphries 2013). Moreover, highly vocal groups supporting the greening of former mine land emerged. Such groups also oppose the resumption of coal mining by open cast methods, fearing for the health and safety of nearby communities, and express concerns for how industrial land is restored afterwards. They wish to see the Valleys go green in more ways than one: Wales would be the first country to put significant fossil fuel resources beyond use (Wales Online 2015).

The impact of such landscape remediation irrevocably impacted some communities in the Valleys. According to Marcus Tanner (2004 186), the approach road to Merthyr Tydfil, a town built on the fortunes of coal mining and iron-founding and which lies approximately 35 km north of Cardiff, now has 'an oddly Scandinavian feel': 'Pine forests line these hills and to anyone over the age of 40, raised on images of South Wales that were as black as the coal it yielded, the belt of emerald greenery has a surreal quality... the old sooty blackness is gone, but the town is grey instead'.

⁵ *Cymoedd De Cymru* (the Valleys) are a number of industrialised valleys running virtually parallel to each other in the South Wales Coalfield, stretching from eastern Carmarthenshire in the west to western Monmouthshire in the east and from the Heads of the Valleys in the north to the lower-lying, pastoral country of the Vale of Glamorgan and the coastal plain around Swansea Bay, Bridgend, the capital Cardiff, and Newport.

An affluent town in the 1840s (Clarke 1848), by 1851 Merthyr Tydfil had overtaken Swansea to become the largest town in Wales. But there was a huge change in the Valleys in the last quarter of the twentieth century, in many ways epitomised by the fortunes of Merthyr Tydfil. According to Tanner (2004, 186-7):

Merthyr is a town of ruined temples, dedicated to a vanished culture. No vines and creepers have engulfed the stonework as in some Latin American jungle, but there is the same air of a forgotten civilisation, and of a way of life that has not only disappeared but seems now incomprehensible. A stay in the town yielded no feeling of a community interacting with the verdant forests that have grown up around it. On the contrary, the townspeople seem to ignore, even resent, their new green belt, as if it were a badge of shame, for the greening of Merthyr is the mark of defeat, testament to the departure of the coal kings and the iron kings who turned this upland parish into the world's first industrial town.

As in Cornwall, conflicting and fluid representations of Welsh identity arguably impact how post-industrial landscapes are viewed and interpreted. As Morris (1998) pointed out on the cusp of Welsh devolution: 'Wales is a country, it is not a State. It has a capital city, but not a Government; its own postage stamps, but not its own currency; a flag, but no embassies; an indigenous language, but not indigenous laws'. And Bowie (1993) cautioned against accepting that the predominant perception of Wales's identity and culture, as different to that of England's, is rooted in the Welsh language. Arguably, Wales has long grappled with the process of defining, understanding, and maintaining its cultural identity or 'Welshness', complicated by its mutually dependent relationship with England and therefore struggles to find its own sense of cultural, social, and political independence—its own identity (Martinez 2012).

This apparent tension can be glimpsed in how the period of the Industrial Revolution in Wales has been perceived. In her paper on ethnic tourism and nationalism in Wales, Prichard (1995) talks of Wales as a conquered nation and the Welsh as victims of injustice at the hands of the English. The most powerful story of victimisation she argues, is told at the numerous mining museums where 'the scars of Wales's industrial history are on display'. She singles out the former colliery, 'Big Pit' near Blaenavon in South Wales, as one of the best examples of the destructive and exploitative forces of the Industrial Revolution, for the wealth that this generated was largely diverted to England. Big Pit is described as an 'unprettified', authentic example of this process, 'a depressing place... where the harshness of work ... is not likely to be lost on visitors ...'.

However, over the next decade, the beginning of a shift away from largely negative perceptions of post-industrial landscapes and mining heritage (exemplified by large scale remediation processes and mining museums that focussed mainly on the defeatist and gloomy aspects of industrialisation), became apparent. The struggle to define Welshness, particularly



Fig. 6: Big Pit Colliery (Pwll Mawr), now part of the Blaenavon Industrial Landscape WHS and major Welsh mining heritage attraction. The town of Blaenavon can be seen in the background. Image, Ainsley Cocks, 2007

evident in the working class Valleys in the late twentieth century (Jones 1992), prompted criticism of industrial landscape remediation processes in places like Merthyr Tydfil. The erasure of coal spoil, pit heads and the grassing over of slag heaps was viewed as far more than a physical disappearance. For some people their evanescence struck at the very roots of what it meant to be Welsh.

Additionally, the erasure from the landscape of the industries that once employed and sustained thousands in the Valleys appeared unjustified, irrelevant even, as so few new jobs were created. Widespread unemployment and the consequent social deprivation and problems that come with it are all too evident in the Valleys today, as BBC correspondent, Mark Easton, noted in 2013: 'These are communities marooned when the economic tide went out' (BBC website). As in Cornwall, mining landscapes became contested spaces: were they derelict, toxic, dangerous, ugly blots on the landscape to be remediated, reclaimed and greened, or vital components of the historic landscape to be cherished with pride as the physical epitome of ethnic identity and/or historical experience?

The inscription of the Blaenavon Industrial Landscape as a UNESCO World Heritage Site (WHS) in 2000, with former colliery Big Pit (*Pwll Mawr*) as one of its showpiece attractions, is arguably evidence of a shift in the political perception of the value ascribed to post-industrial landscapes in the Valleys. The town of Blaenavon and its vicinity is one of the prime places in the world where the full social, economic and technological process of industrialisation through iron and coal production can be studied and understood. It was hoped that the WHS inscription would act as a significant catalyst for urban regeneration in the Blaenavon area (Smreczak 2003) and help in the development and promotion of a sense of social well-being and pride in a 'problem community beset by devastating unemployment, despair and hardship' (John Brown and Company Consultants 1993).

This discourse clearly reflected the influence of political

movements at the time; indeed, the prestigious WHS recognition underscored the depth of governmental (Torfaen County Borough Council), national and local stakeholder and community support for the inscription, illustrated through the Blaenavon WHS Partnership. The shared beliefs and perceptions about place meaning for a majority of the people living in the Blaenavon region successfully converged with the ideological beliefs of those in power, to get the first industrial site in Wales inscribed onto the prestigious WHS List.

Big Pit is now operated by the National Museum Wales which is tied to the objectives of the National Assembly for Wales, and particularly its 'One Wales' agenda (Morgan and Jones 2007). This commits it to helping to build 'a strong confident nation', as well as promoting life long learning, sustainable environments, justice in society, widening participation and cultural diversity (National Museum Wales 2009).

Far from being the 'depressing place' described by Prichard, through its gritty and realistic engagement with history (it is, after all, not a sanitised Disneyesque theme park), Big Pit intelligently questions and explores South Wales's industrial legacy, while showcasing its vital role in the vanguard of the Industrial Revolution. Although the management structure of the Blaenavon WHS is not without its detractors, who question the depth of democratic engagement with the local community (for example, Walker 2014), the Blaenavon WHS is seeking to address this through schemes such as the Forgotten Landscapes Project and support for the local annual World Heritage Day. Of particular interest is that the Forgotten Landscapes Project included a campaign to raise awareness within former coal mining communities of the value of the remaining coal spoil heaps as vital heritage features in the historic mining landscape that are important to wildlife, and to alter people's negative perceptions of them. As local volunteer, Heidi Scourfield, notes, 'The one change, which I think, has had the most important and influential impact on the area is educating the local people. More people in the community are now more aware of the great history that surrounds the area' (Forgotten Landscapes).

Notwithstanding the acute socio-economic problems that continue to blight the Valleys, a process of reimagining and recovering pride in its industrial past has nevertheless taken root in post-devolution Wales, which, far from being a victim of English industrial imperialism, now assertively advertises itself as the world's 'First Industrial Nation'.

AVOCA'S TWIN: PARYS MOUNTAIN MINE, ANGLESEY, WALES

As with the Valleys of South Wales, the remediation and reclamation of areas in Mid and North Wales that were mined for metalliferous minerals, has raised many of the same questions regarding the integrity of these sites. Some 1,300 recorded metal mines have left an indelible mark on the Welsh landscape, including numerous spoil heaps of excavated rock and waste materials with elevated amounts of metals; adits and shafts; abandoned associated industrial buildings and drainage channels. *The Metal Mine Strategy for Wales*

published in 2002 (Howeth, 2002) focused on the fifty non-ferrous metal mines in Wales that were perceived to be causing the most environmental impact.⁶ This report made several important observations and recommendations under four topics: 'Archaeological or historical'; 'Mineralogical'; 'Biological', and 'Other Issues' (which included 'aesthetic landscape'). Of particular interest is the following statement, which clearly highlights how important, even essential, it is to view the historic mining landscape in an holistic manner:

There is more to mining archaeology than standing structures. On every one of the sites listed consideration has to be given to surviving earthworks, access to underground features and the potential for subsurface archaeological evidence. Material that acts as the source of contamination, the tailing heaps, is also a part of the archaeological record. In recognising the importance of individual structures, the assessment of any site is based on its integrity as an industrial landscape, in which the parts contribute to the whole.

Under the EU Water Framework Directive, abandoned mines are a priority for remediation by the Environment Agency. In its published document *Abandoned mines and the water environment* (Environment Agency 2008) the necessity to remediate polluted watercourses is made abundantly clear, but there is also a recognition of the importance of Britain's metal (and coal) mining heritage:

Abandoned metal mines are not only a source of pollution, they are a part of our national heritage and an important reserve of biodiversity. Many sites are designated as Sites of Special Scientific Interest or Scheduled Ancient Monuments. The tin and copper mining areas of Cornwall and West Devon have been declared a UNESCO World Heritage Site. This means that certain treatment methods cannot be employed; however, a collaborative approach may help to deal with the pollution threat.

Moreover, the document also recommends, among other things, that the development of remedial methods which are sensitive to industrial heritage and other protected sites should, if possible, be pursued.

For the purposes of this paper, we focus on one mine site in Wales mentioned in the *Metal Mine Strategy* – the internationally known Parys Mountain (*Mynydd Parys*) Mines near Porth Amlwch on the island of Anglesey. This mine shares the same geology and geochemistry as the Avoca

⁶ Data used to select these mines arose from a database commissioned by the Environment Agency Wales in 1996, that was originally designed to be a central source of all available information on the different mine sites and as a tool to assess their environmental impact. From the information available about each mine, a score was produced to give a rank order of mines having potential or observed environmental impacts. The 1996 method took into account factors such as age and size of workings, which are not necessarily indicators of environmental impact. As part of further information gathering exercises carried out under the Metal Mines Strategy, some of the mines that were highlighted in the 1996 report were found not to be having as significant an impact as predicted.

Mines, both being ore bodies formed from volcanogenic massive sulphides ('VMS') of Kuroko type, and various transnational projects have been undertaken between the two areas (see below). Parys Mountain is one of the most polluting mines in the UK (Mayes *et al.* 2009; Environment Agency 2012) and for this reason it was deemed to be of the highest priority for remedial action. It was consequently one of eight sites chosen for the initial stage of remediation by the Environment Agency (Environment Agency Wales 2002) which demonstrated a willingness to engage with numerous interest groups and took on board their views in its draft strategy (WMS 2002).⁷

Mined since the Bronze Age, and once one of the largest copper mines in the world, Parys Mountain boasts an enormous open cast dating to the late eighteenth century (Rowlands 1966). Continued movement of air and water through old workings generates extremely acidic water, while the oxidation of the waste pyrite in the several million tonnes of surface spoil has led to the production of sulphuric acid, with the result that the surface and underground environment is remarkably acidic (Younger and Potter 2012). Some of the orange-brown pools have extreme pH values of below 2 and contain high concentrations of dissolved iron, copper and other metals, together with dissolved sulphate. There is also an unusual series of weathering products, including the minerals anglesite (lead sulphate, for which Parys Mountain is the world type locality), antlerite (the only record in Wales of this copper sulphate mineral) and of the rare aluminium mineral, basaluminite (Copper Kingdom).

To the casual observer, the oxidation of the iron-bearing ores, and the remains of the calcination process (extensive roasting in kilns), has produced a landscape of dramatic purples, reds, browns, oranges and yellows. The visual impact of the landscape is particularly arresting, as a visitor to the mines noted:

Walking up the slope from the car park I was immediately struck by the vivid range of colours in this rocky, almost moon-like, landscape. The immediate copper mountain environment is truly that dramatic and arresting to the senses... all about me was a mix of shades of ochre - yellow, brown and red. There were brown shades of buff, auburn, rust and copper. I'm sure artistic experts in this field could find far more colour variations than me (Anglesey Today).

A unique and distinctive geochemical environment has thus been generated above and below ground which is inhabited by specially adapted life forms (Jenkins *et al.* 2000). These include remarkable species of acidophilic bacteria (chemolithotrophs) that are tolerant to acidity and heavy metals. These gain their energy from inorganic chemical reactions and are the subject of active research at Bangor University (see for example, Johnson 2012). The unusual

⁷ Whilst the Agency's early concept of mining archaeology had been found wanting, the views expressed in the draft document accorded with those of the Welsh Mines Society, that was encouraged by the involvement of numerous stakeholders.

abundant extra-cellular polysaccharide oozes that form into mats, jelly-like stalactites and gelatinous draperies underground have featured on television. There are also unusual lichens (fungi/algae symbionts) comprising a rich flora of more than 125 species, some of which are very rare; these too are included within the designated SSSIs by the Countryside Council for Wales (CCW)⁸ and have been the subject of detailed surveys (Jenkins *et al.* 2000; Batty and Hallberg 2010).⁹ Parts of the mountain are covered by heathland, which is a habitat type under threat throughout Europe, and as a result has been listed as a priority habitat for conservation. The heathland at Parys Mountain demonstrates heather's ability to survive in an adverse environment.

The *Anglesey Landscape Strategy* (Isle of Anglesey County Council 2011) lists the spoil on Parys Mountain and the heath around its perimeter as of 'high' value within the landscape habitat category, and Parys Mountain as 'outstanding' within the visual and sensory, geological landscapes, historic landscapes and cultural landscape categories. The Strategy further notes that the mine with its 'moonscape' topography has deep symbolic meanings encoded in, and intertwined with, its physical features. It notes that as early as the nineteenth century, the Great Open Cast '... became an important cultural landscape feature, one of the sublime spectacles of its era visited by travellers and artists in search of contemporary aesthetic notions of the beautiful, picturesque or sublime', while in more recent times the mine site has provided a backdrop for films and science fiction programmes. Importantly, the Strategy states that, given the importance and sensitivity of the historic mining landscape of Parys Mountain, it is important that any development or remediation proposals take into account:

- The nature and pattern of the historic landscape fabric
- Any direct or indirect impacts upon upstanding or buried (known and unknown) remains, including mineral deposits
- The distinct habitats associated with the mineral extraction process

However, the value and importance ascribed to this historic mining landscape has not always been recognised, and, rather

⁸ From 1st April 2013, CCW has been amalgamated with the Welsh Environment Agency and Forestry Enterprise to form a single body: National Resources Wales (NRW).

⁹ At least one species is new to Britain and possibly new to science - a *Lecidea* species. The flora of the old spoil heaps and metalliferous rock outcrops is dominated by lichens of the community *Acarosporion sinopicae* which are particularly characteristic of rocks rich in iron sulphide. The most abundant species here include *Acarospora sinopica*, *Porpidia tuberculosa* and *Rhizocarpon obscuratum*, whilst the notable species *Rhizocarpon furfurosus* is a frequent associate. The extant remains of the mine buildings and walls provide further distinctive micro-habitats, such as the copper-rich mortar-filled crevices in which a community characterised by *Psilolechia leprosa* occurs. Other distinctive metallophyte species which have been recorded from Mynydd Parys include *Tremolecia atrata*, *Stereocaulon leucophaeopsis* and *Lecanora epanora*. In less metal rich areas terricolous lichens (those which grow on soil) are found in association with heather *Calluna vulgaris*. The abundant *Cladonia* species in this community include *C. fragilissima* in one of only 3 known localities in Wales.



Fig. 7: The astonishing variety of colours present in the mining landscape of Parys Mountain are reminiscent of an artist's palette. The unfenced opencasts, highly acidic soils and watercourses have been no bar to tourism developments. The iconic windmill above the Great Open Cast has been consolidated and the white structure (top right) is a new footbridge on a heritage trail that crosses a formerly narrow and dangerous arête between two opencasts. Image, Sharron Schwartz, 2013

like the experiences of Schwartz and Cocks in Cornwall, Amlwch native, Bryan Hope, an engineer looking back on the halcyon days of his 1940s childhood, had this to say about the Parys Mountain Mine site :

Health and Safety regulations were unheard of then, and as there were no adults present to chide or to guide, there was no limit as to where our imagination could take us over its broad heather and spoil covered slopes. In a way, the whole strangely beautiful, dangerous and therefore exciting landscape was there for us to do much as we wanted with, and in this way it became in our minds ours by default. For that reason it found a place in our hearts, for no one else seemingly cared for the place, and it became nothing more than an unofficial rubbish dump. The noise and bustle had gone, but in the silence broken only by our laughter, the shrill call of a falcon, the distinctive croak of a raven or the barking of a fox, it became for us boys a magical place full of benign ghosts from another time.

So from childhood, Hope and his local playmates formed a deep bond with the landscape of Parys Mountain which they perceived to be 'theirs by default'. Unsurprisingly, in his adult

life, he jumped at the chance to help the Welsh Mines Preservation Trust (WMPT) with the mid-1990s conservation of the Pearl Engine House (Fig. 8). However, echoing the experiences that occurred with respect to the value ascribed to historic mining landscapes in Cornwall, arriving at the point where such schemes were undertaken was far from a foregone conclusion. Hope notes that some people in authority had unashamedly said that this engine house should have been left to become what they described as 'a romantic ruin', even though it is the earliest surviving Cornish-type engine house at a Welsh metal mine and therefore of significant heritage value (its chimney had already collapsed in 1982). Hope further explains: 'Fortunately, others thought differently and the limited funding available [from the Welsh Heritage Agency, Cadw] was just about sufficient to replace rotting lintels and re-point the crumbling walls, making the building safe once more to be enjoyed and claimed by future generations as *their* heritage' (Anglesey Heritage).

One of the chief drivers of schemes to promote and protect the historic mining landscape is the Amlwch Industrial Heritage Trust Ltd. (AIHT), a registered charity set up in 1997. The AIHT provides a community forum for all of those having an interest in the protection of the historic environment of

Mynydd Parys, Dyffryn Adda and Porth Amlwch, and the conservation of its industrial monuments. It seeks to foster research and development of sites within these areas to the benefit of the local community, to nurture pride in local industrial heritage and to facilitate public access to, and enjoyment of, the sites. In 1998, it applied for funding from various sources to further its work, which included the construction of a viewing platform overlooking the Great Open Cast, a car park for visitors and the provision of a visitor centre at Amlwch (the Sail Loft). The mountain is owned by the Marquis of Anglesey who has leased part of it to the Anglesey Mining Company (AMC). The AIHT has forged a positive relationship with both landowners, obtaining a long-term lease from AMC for the land it owns and a sub-lease from them for the remainder of the surface (and a nominal depth below) that AMC lease from the Marquis. This enabled the AIHT to set up a heritage trail, making use of some pre-existing public footpaths that cross the mountain (Burrows pers. comm.).¹⁰

The extensive surface structures at Porth Amlwch and at Parys Mountain include a wealth of sites for archaeological investigation. Two decades ago, most of them were relatively unknown and many were in a state of poor preservation. The work of the AIHT has ensured that their importance has been recognised and five features have already been scheduled by Cadw: the Pearl Engine House, the Windmill, the Great Opencast, the central Precipitation Ponds and the Mona kilns. Indeed, the Amlwch and Parys Mountain Landscape of Outstanding Historic Interest has recently been included in the Register of Landscape of Historic Interest. This contains 58 sites considered to be the best examples of different types of historic landscapes in Wales and has been compiled by Cadw in partnership with the CCW and the International Council on Monuments and Sites (ICOMOS UK).

Crucially, the environmental issues at the mine site have not been a bar to the development of tourism initiatives. Acid Mine Drainage (AMD) is now a major international problem in the management of abandoned sulphide ore mines and the Parys mines are one of the major polluters of the Irish Sea. The bulk of the drainage from the mine workings previously flowed south, into the Afon Goch De (Red River South), a tributary of the Afon Dulas, which enters the sea through the otherwise high-quality estuarine environment of Dulas Bay. To the north, the site drains to the Afon Goch Gogledd (Red River North) and outfalls through a culvert. The total amount of drainage leaving Mynydd Parys is rather modest, averaging around 10 l/s, but it contains such high concentrations of many ecotoxic metals that the Afon Goch Gogledd is devoid of any freshwater fauna (Younger and Potter 2012).

Besides the problem of AMD, a major flood hazard was discovered. The Parys Underground Group found a decaying concrete dam in the Dyffryn Adda (adit) fitted with a valved pipe which had formerly been opened periodically to flush water into ponds filled with scrap metal, where copper was

precipitated by the 'cementation' process. When these operations ceased, the valved pipe appears to have silted up, resulting in the dam holding back some 250,000m³ of very acidic, metal-polluted water. It was agreed with Anglesey Mining plc., the Isle of Anglesey County Council and the Environment Agency, that this dam be removed to alleviate the potential flooding threat to the town of Amlwch should it fail. This was achieved in 2003 following the dewatering of the mines down to the Parys 45 fathom level. As a result of the dewatering, the lake originally occupying the Great Opencast has now disappeared.

It was anticipated that the dewatering would result in the virtual elimination of acidic drainage to the south of the mountain, but an increase in the pollutant loading to the north. As the Afon Goch Gogledd was already devoid of aquatic life, there would be no immediate impact on the freshwater environment. It also meant that a single water treatment system could in future be constructed to deal solely with the water coming from Dyffryn Adda, without the need for a second treatment system to the south of the mine site. However, questions remained about the possible impact of the diverted waters on the marine environment.¹¹

A 2004 scoping study concluded that active treatment was required for the main Dyffryn Adda discharge which enters the Afon Goch Gogledd, and that further monitoring was needed to fully characterise the variation in flows and water quality. In 2007, a number of potential treatment technologies were reviewed (lime dosing, sulphide precipitation). A pilot-scale field trial was carried out to establish the feasibility of treating the mine water under the aegis of *Celtic Copper Heritage*, an EU funded Interreg 3A project involving Avoca (see below). It was found that a high density sludge treatment plant using lime and sodium hydroxide increased the alkalinity of the water causing the metals in the solution to form particles; a flocculent was then added to bind the particles together to form a solid (DP 2007). Plans have since been set in motion to commission a larger plant.

Prior to the dewatering, the water was prevented from rising further because it flowed out of the Mona Adit into a series of precipitation ponds, lakes and then via the Afon Goch south to the coast at Dulas. An unforeseen consequence of the dewatering of Parys Mountain Mine arose when this flow out of Mona Adit ceased, leaving the settlement ponds to be fed only by rainfall. In the period from late spring to early autumn, when there is generally less rainfall and evaporation is greater, the ponds dried out, allowing the ochre deposits to become exposed. Once exposed and dried, the finest particles were lifted by gusts of wind and transported away from the ponds

¹¹ Subsequent monitoring confirms that the Afon Goch Gogledd is the single largest source of copper entering the Irish Sea (Cu: 10,241 kg/yr; Zn: 24,268 kg/yr: 2003 data) with extremely high concentrations (Cu: 5,490 µg/l; Zn: 13,000 µg/l) even after dilution between the adit and sea (Environment Agency 2008). This tiny stream, around 2 m wide with mean flow of 0.06 m³/s, has the fifth highest flux of Cu in England and Wales (Environment Agency 2008), comparable to the Thames (flow = 67 m³/s; Cu = 11,080 kg/yr), Severn (71 m³/s; 10,430 kg/yr) and Mersey (27 m³/s; 5,100 kg/yr). Concentrations of other metals and metalloids including Cd, As, Fe, Mn are also very high (Younger and Potter 2012).

¹⁰ The trail is covered by an annual insurance which is funded by the sale of 20p leaflets.



Fig. 8: The Pearl Engine House, the earliest surviving Cornish-type engine house at a Welsh metal mine, is an iconic feature of the historic mining landscape of Parys Mountain, and a vital part of the UNESCO GeoMôn Geopark. The chimney (left) collapsed in 1982, and was rebuilt in 2012-13. Since this photograph was taken, the engine house (right) has been consolidated and re-roofed, and will serve as a small interpretation centre.

Image, Sharron Schwartz, 2013

as airborne dust. The levels of arsenic and lead in the dust were deemed to be unacceptably high for inhalation by the residents (particularly children) living at nearby Henwaith (Old works).

Under pressure from those residents, the Isle of Anglesey County Council commissioned remedial work on what was therefore deemed to be contaminated land. This involved re-circulating water to keep part of the area moist, the use of flexible membrane liners to seal the base of some of the ponds and isolating the contaminants in others with capping systems (a geosynthetic product). This was followed up with landscape restoration works to provide a physical barrier, which included planting heather to stabilise the material. Importantly, careful attention was paid to the archaeology to retain the authenticity and integrity of the site, and sections of old walling were rebuilt using traditional local stone walling methods (SKM Enviros 2011). At Parys Mountain, the Environment Agency Wales has demonstrated its willingness to work in partnership with the Coal Authority, the County Council and other local stakeholders (including the AIHT) to design environmental improvements that are sympathetic to the unique ecology, geology and industrial heritage at the site, and to deliver benefits for the wider community (Younger and Potter 2012).

Indeed, intra-agency cooperation has been vital to the delivery and promotion of the industrial heritage assets of Parys Mountain and to realise the tourism potential of this site. The Royal Commission on the Ancient and Historical Monuments of Wales, which runs an interactive Key Stage 2 learning package for local primary schools on the history of Parys Mountain (RCAHMW Learning History), Cadw and the WMPT have been very supportive. In addition a partnership consisting of the Isle of Anglesey County Council, the CCW, Menter Môn¹² and the Gwynedd and Môn RIGS Group (Regionally Important Geological Sites) brought the coveted UNESCO Geopark status to Anglesey in 2009. As the GeoPark Director noted, the GeoMôn Geopark, supported by the Welsh Assembly Government through its Aggregates Levy Sustainability Fund, ‘... will work with the Isle of Anglesey County Council and local businesses, particularly those in the tourism sector, to add value to the local economy in a sustainable way’. Parys Mountain is perceived to be one of its

¹² Menter Môn is comprised of two companies: Menter Môn Cyf which works closely with many partners to foster enterprise on Anglesey and Annog Cyf its trading company. Menter Môn Cyf was incorporated in 1996 as community owned company with the purpose of supporting economic development and to administer the EU LEADER 11 programme.



Fig. 9: The consolidated windmill at Parys Mountain Mine now serves as a shelter for walkers and houses several interpretation boards. This is one of only two windmills to survive on a metal mine site in Britain or Ireland, the other being at the Newtownards Mine near Belfast in Northern Ireland. Photograph, Sharron Schwartz, 2013

key areas, an iconic gem located right in the centre of the Geopark (Isle of Anglesey County Council).

Obtaining Heritage Lottery funding was the culmination of perhaps a decade of applications and consultants' reports commissioned by the AIHT. Its flagship project, the 'Copper Kingdom', was supported by Cadw (the Welsh Assembly Government's historic environment service), through its £19m European funded Heritage Tourism Project, backed by £8.5m from the European Regional Development Fund.¹³ This was part of a wider project on Anglesey under the banner of Mona Antiqua, which represented a total investment for Anglesey of £900,000, with £355,000 of that total being invested in the Copper Kingdom Project. The project was also supported by a £497,000 Heritage Lottery Fund (HLF) grant used during 2012-13 to carry out important works at Pearl Engine House chimney and the iconic windmill on the summit of the mountain, which included the provision of traditional skills training.¹⁴ Various other grants paid for the reroofing and structural repairs to the Pearl Engine house (Fig. 8).

New markers were installed on the pre-existing heritage trail and a new metal walkway was erected between the opencasts that had previously been a narrow and dangerous arête, which the public were advised not to cross. In addition, the creation of innovative IT facilities to link the mountain with the newly

¹³ Further financial support came from the Isle of Anglesey Council, Isle of Anglesey Charitable Trust and Môn a Menai.

¹⁴ This saw the windmill stump consolidated and included taking down and rebuilding the top 1200 mm of masonry with existing fallen stone, stitching cracks with Cintec anchors and re-pointing the masonry with lime mortar. The interior of the mill was excavated and a new oak and stainless steel balustrade was built on the upper floor, where several several interpretation boards have been installed, and which now serves as a shelter for walkers (Grosvenor Construction). The work also involved an archaeological assessment, which cleared out the basement and revealed 4 brick columns along with some iron castings including part of the original gearing cog.

opened and award winning Copper Kingdom Visitor Centre on the quayside in Porth Amlwch via a smartphone app were implemented. The new centre, accommodated in a building that incorporates the old copper ore bins, was opened by Huw Lewis AM, the Minister for Housing, Regeneration and Heritage in July 2012 (HLF 2012). The project was one of 24 to benefit from Cadw's Heritage Tourism Project, funded by the European Regional Development Fund through the Welsh Government. Cadw invested £160,000 into the project with an additional £460,000 from the Môn a Menai programme.

A firing of the rebuilt Pearl engine house chimney hosted by the AIHT and Menter Môn in March 2013 celebrated the rebuilding programme (Cadw 2013). Key to the successful delivery of these projects was the participation of the local community who engaged in '... hands-on conservation and archaeological projects', while '... acquiring heritage related skills'. Indeed, from the outset, the AIHT Chairman, Gareth Wyn Jones, expressed the Trust's wish to hear from members of the local community about their family recollections of the mining at Parys Mountain '... so that they may contribute to the emerging proposals for the mining museum heritage centre. It is key to the project that local people are proud to share their knowledge and heritage with others' (HLF 2011).

Yet again, the example of Parys Mountain illustrates that when the shared beliefs and perceptions about place meaning and identity among a significant number of local stakeholders match the ideological beliefs of those in power, such ambitious historic landscape projects are likely to succeed, despite environmental challenges such as ameliorating the effects of AMD.

IMAGININGS OF IRISH HISTORIC MINING LANDSCAPES: THE CASE OF AVOCA

In its desire for economic self-sufficiency, post-independence Ireland sought to distance itself from the British economy, and presented itself to the world as a bucolic haven, a rural idyll free from the corrupting influences of industrialisation. This view, arguably encapsulated in President De Valera's 1943 St Patrick's Day broadcast (Schwartz and Critchley 2012, 49), was rooted in nationalist opposition to industrial Britain and the identity associated with it (Dowling 1997; O'Callaghan 2009); it is also reflected in contemporary artwork which portrayed the simple rurality of Irish life (Steward 1998). Even the nascent twentieth century tourist industry got in on the act. In the context of tourist myth-making, one of the most enduring stereotypes of Irishness has been the association of Ireland and the Irish people with the land. This concept served to package Ireland as an unpopulated, rural arcadia (Mehegan 2004), a trope that was well utilised by contemporary railway, steamship and hotel companies. Little wonder then, that mid-twentieth century school textbooks could categorically proclaim that there were no mines in Ireland. If there were no mines in Ireland, then it follows there was no mining heritage either, and we would argue that this mindset has contributed to the low profile given to industrial heritage overall in Ireland today.

Moreover, as regards the protection of the historic mining

landscape, the chaotic national listing regimen for Ireland does not help matters, with industrial archaeologists and heritage practitioners noting over a decade ago that none of the national inventories currently purporting 'to deal with all types of industrial heritage in a systematic and comprehensive way' do so (Hamond and McMahon 2002, 12). In the Record of Monuments and Places (RMP), the highest state designation in Ireland, listing of industrial monuments is largely precluded, since the list has a cut off point at 1700. Each site listed in the RMP is comprehensively detailed within the Sites and Monuments Record (SMR). The SMR is a list of monuments issued on a county basis between 1984 and 1992 that evolved out of an inventory compiled by the Archaeological Survey of Ireland (ASI). This took place prior to, and during the time of the 1987 Amendment to the National Monuments Act, which required the establishment of the Register of Historic Monuments (RHM). The RHM was a logistical nightmare as it prescribed that the landowner be notified in writing of the presence of a monument on the RHM upon their lands. It proved impossible to trace all the landowners and the RMP was consequently revived in 1994.¹⁵

The SMR, revised in the light of further research and fieldwork, formed the basis for the statutory RMP established under Section 12 of the National Monuments (Amendment) Act (1994).¹⁶ Similar in format to the SMR, this was issued for each county in Ireland between 1995 and 1998, but it also includes a selection of monuments from the post-AD 1700 period.¹⁷ In 2011, considerable alarm was caused when the Department of the Arts, Heritage and the Gaeltacht (DAHG) announced a proposal to de-list post-1700 AD monuments that had been added to the RMP, thus removing their statutory protection. The DAHG, by its own admission, recognises the inconsistency in listing procedures, stating for instance that SMR's are '... indicative of ASI record holdings and reflect the incremental and organic manner in which material has been added to the archive over many years, especially for monuments dating from the post-1700 AD period' (DAHG Help Document). Following a public outcry about the proposed de-listing, the status of any changes is currently unknown.

Industrial monuments, including those associated with mining, do appear on the National Inventory of Architectural Heritage (NIAH), a section within the DAHG, the work of which involves identifying and recording the architectural heritage of Ireland from 1700 AD to the present day. The NIAH does not currently record many of the smaller scale or more industrial monuments that are integral to the development of Irish history and society during this period and although 1700 is used as a cut-off point, there is no basis in legislation in defining whether a monument is, or is not, archaeological (Irish Archaeology 2011). Indeed, according to the *Frameworks and Principles for the Protection of Archaeological Heritage*, 'date is not in itself a determinant of archaeological significance

or interest. Any material remains which can contribute to understanding past societies may be considered to have an element of archaeological significance' (Dúchas 1999).

In accordance with Section 12 of the National Monuments (Amendment) Act (1994), each county is responsible for recording Protected Structures: buildings that are considered to be of special interest from an architectural, historical, archaeological, artistic, cultural, scientific, social, and/or technical point of view. These are listed in each council's Record of Protected Structures (RPS), the provision for which is set out in Part IV of the Planning Development Act 2000, and they are thus afforded some protection in statutory law.¹⁸ However, there are some issues with the RPS, namely that the list might not be truly representative of the industrial heritage of a given county, that individual listings might be incomplete or erroneous, and that the curtilage of industrial monuments might not be respected and is often not clearly defined. This is especially significant with historic mining landscapes, where elements such as mine wastes might be viewed as unimportant and omitted from the RPS, or in the case of Wicklow, threatened with removal from it (see below).

Crucially, although inclusion on the RPS confers a degree of protection, meaning that the landowner has a duty of care to protect listed buildings/features from decay and/or destruction, in practice this has proved difficult to enforce. As Hamond and McMahon noted over a decade ago, 'Given the vulnerability of our industrial heritage, a record of all surviving sites and those which formerly existed is urgently required', noting that a variety of surveys undertaken by statutory and non-statutory organisations and volunteer groups have previously identified and recorded in the field less than five per cent of Ireland's industrial sites (Hamond and McMahon 2002, 12-13).

This fact was rigorously discussed at the international industrial heritage conference, *The Forgotten State of Industry? Irish Industrial Landscapes and Heritage in a Global Context* organised under the aegis of the Interreg 4B *Metal Links: Forging Communities Together* project, with additional funding from the Heritage Council, Wicklow County Council and The Gathering 2013. In his opening remarks, the then Minister for the Arts, Heritage and the Gaeltacht, Jimmy Deenihan TD, spoke of the need to preserve, protect and promote Ireland's 'rich industrial heritage' and announced plans to apply LEADER funding to heritage projects which would see many historic buildings, monuments and other built heritage features throughout the country being conserved to the highest standard. According to him, 'Such projects will not only provide a source of pride in the local built heritage but also draw tourists and others to visit and enjoy these special places'. He spoke of 2014 as marking the most significant investment in built heritage in recent years and welcomed the Budget allocation of €5m for the Built Heritage Jobs Leverage Scheme (BHJLS), to be directed at

¹⁵ The legislation contained within the RHM is still legally Binding.

¹⁶ RMPs are protected under the National Monuments Acts 1930-2004.

¹⁷ The post-1700 AD monuments were included mainly for counties Cork, Dublin and Galway.

¹⁸ The decision to include buildings on the RPS is made by the elected members and there are obligations on owners and occupiers to ensure the preservation of Protected Structures; assistance is offered by the Council in the form of annual conservation grants, but presently only one or two privately owned structures receive support each year.

renovation projects for buildings that are protected, and that will allow for urgent repairs to heritage buildings (Critchley 2014). Being in state ownership, the Avoca mines were excluded from being prioritised under the criteria of the BHJLS 2014 and received no funds.

Although Ireland has arguably some of the finest industrial landscapes in Europe (several of which are mining related), due largely to the fact that it did not witness the large scale development of the late nineteenth- early twentieth century-period that destroyed many similar sites elsewhere (Rynne 2011), it has yet to fully acknowledge and capitalise on its industrial heritage as other European nations have done, which is why Minister Deenihan's remarks at the abovementioned conference were eagerly received, delegates hoping that this might mark the beginning of a political change in perception of Irish industrial landscapes. With regard to relict mining landscapes, not only are the majority of those in Ireland on a smaller scale than in neighbouring Britain, but, perhaps more importantly, they are not imagined through the prism of ethnic or national identity, as has been demonstrated with respect to Wales or Cornwall, and which has proven to be such a powerful driver for conservation, protection and valorisation.

Rather, historic mining landscapes in Ireland have arguably been perceived as representative of the physical epitome of the historical experience of particular communities, sometimes about which little is known. This can foster a strong desire to rescue former mining landscapes, their industrial monuments and importantly, the people who created and worked in them, in the words of the great Marxist historian, E. P. Thompson, 'from the enormous condescension of posterity' (Thompson 1980, 12). In fact, many schemes to remember, celebrate and even preserve mining landscapes as the workplaces of living members of those communities or of their immediate ancestors, have been initiated by former miners, such as at Silvermines, Slieve Ardagh, Castlecomer, Arigna and Glendalough. Projects to protect mining heritage and promote sustainable heritage tourism initiated by, and embedded in, local communities, mean those communities are able to maintain a collective ownership of the process which also serves to engender a greater sense of pride of place.

The Allihies Co-operative is a fine example of community ownership of a mining heritage project: it has successfully set up the Copper Mining Museum in a former Methodist chapel built by Cornish miners in 1845, and was officially opened by Irish President, Mary McAleese, in 2007. The consolidation of the iconic Mountain Mine Cornish-type engine house under the aegis of the MHTI, and a series of signed walking trails through the historic mining landscape around Allihies, complemented by interpretation boards, are intended to help boost tourism in a remote, rural area. Likewise, the former Monklands Church of Ireland chapel in County Waterford, disused since 1945, has been purchased and restored as a new Visitor Centre serving the UNESCO Copper Coast Global Geopark. The nearby Tankardstown pumping and whim engine houses have also been consolidated with significant input from the MHTI (Critchley and Morris 2005). The Taoiseach (Irish Prime Minister), Enda Kenny, who formally

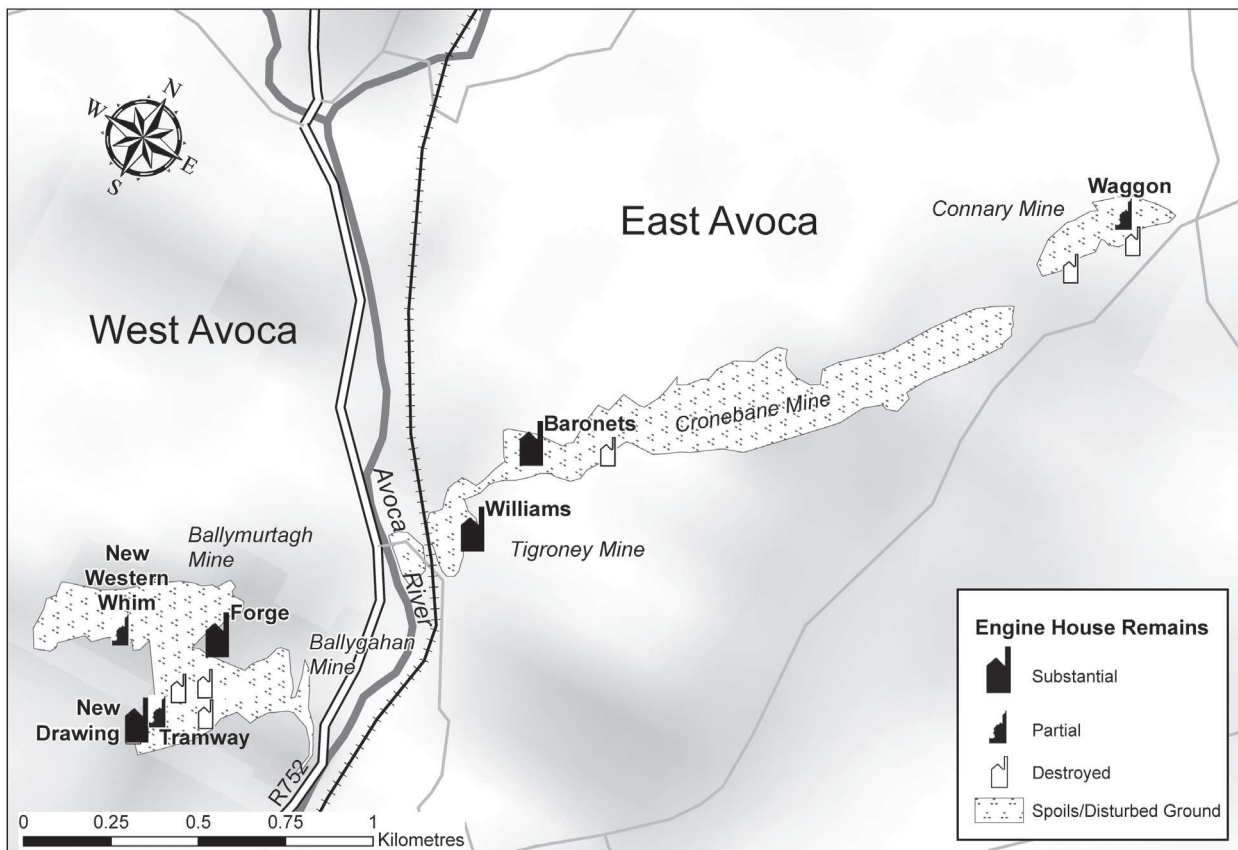
opened this Visitor Centre in November 2013, described the achievements of the Copper Coast Geopark as the 'community fighting back' and pledged governmental support (IT 2013).

However, the case of Avoca could not be more different to those outlined above. The greater part of the mining landscape in the Avoca Valley was acquired by the Department of Communications, Energy and Natural Resources (DCENR, formerly known as the Department of Marine and Natural Resources), which received the land after the cessation of the Receivership of Avoca Mines Ltd. and St Patrick's Copper Mines Ltd.; this has now been vested in the Minister for Finance. The DCENR and its sub-division, the Exploration and Mining Division (EMD) is the state agency responsible for the delivery of a large remediation programme (see below). Despite assurances from the DCENR, which states that the Minister is committed to the long-term remediation of the Avoca former mine site and will '... do so without compromising the environmental, heritage or future tourism potential of the area' (DCENR Letter to Wicklow County Council 2014), this paper demonstrates that this is actually not the case.

Avoca has arguably never been treated in a manner commensurate with its historical importance, as Ireland's premier historic mine site, and, in more than an echo of the manner in which one of the most famous Cornish copper mines (United, see above) was treated, permission was granted by Wicklow County Council (WCC) to turn the Pond Lode open pit on the Ballymurtagh Mine (which it owned after the Receivership from Avoca Mines Ltd.) into an unlined landfill between 1989 and 2002 (Fig. 22), with all of the consequent environmental factors (methane emissions and leachate) arising from this.¹⁹ In addition, the horizontal engine house for the Tramway Incline was demolished by WCC in the late twentieth century. With Ballymurtagh being used as a landfill, it was little wonder that the other abandoned mines in the valley were viewed as an informal dump site with end of life vehicles and white goods being familiar features until relatively recently, when barriers were placed at strategic entry points to prevent rubbish dumping.

Somewhat ironically, it is now the environmental legacy of mining in Avoca that is one of the key priorities for its remediation on the basis of health and safety. Even when the mines were working in the nineteenth century, there were concerns about their environmental impact, as illustrated by a court case involving one of the mining operators. In 1872, Messrs. Williams and Co. of Cornwall (that ran the Tigroney and Cronebane Mines, East Avoca) appeared at the Ovoca Petty Sessions, charged with allowing 'poisonous waters' to flow from their mines into the Ovoca River, which was 'deleterious to fish and contrary to the fishing acts'. During the hearing it was confirmed that the mineral laden water had been discharged into the river that way for 70 years and probably for up to 150 years before that (c1652). As there was no other means of discharge, and the closure of the mines was

¹⁹ The Council stopped using this landfill when the EU Landfill Directive (1999/31/EC) was transposed into Irish law in 2002.



Map 2: The historic mining landscape of the Avoca Valley showing the various mines and extant and non-extant engine houses. The majority of the land is in state ownership

out of the question as upwards of 2,000 people would have been thrown out of employment, the case was dismissed (WNL 1872).

Whilst the environmental impact on the Avoca River was always present, it was largely ignored for the next 100 years, until after the closure of the last phase of working in 1982, when acid rich mine water from the flooded workings started to deposit ochre and heavy metals in the river, causing fish kill. The issue came to the attention of WCC, which in 1992 obtained EU LIFE funding to undertake a study on the Avoca-Avonmore catchment, with the aim of environmental remediation and economic development. Soon after this, the Geological Survey of Ireland (GSI) also obtained EU LIFE funding to undertake an ecological, geological, hydrogeological and mining heritage audit of the Avoca mines (Gallagher and O'Connor 1997; Gallagher and O'Connor 1999). This seminal study was the first attempt at a detailed survey of the mining heritage at Avoca and although its conclusions noted certain health and safety issues, it included the following highly pertinent observation:

The failure of the last mine operator, Avoca Mines Ltd, to undertake remediation of the mine site has preserved relics of modern mining that might otherwise have been lost: open pits with excellent outcrops, accessible adits and shafts, mine buildings and even spoil heaps, which are important features for those interested in mining and industrial heritage. Natural revegetation of the mine site, however slowly it is proceeding, is

creating unusual and attractive habitats. The importance of Avoca as a mine heritage site is enhanced by the knowledge that planning authorities now require rehabilitation of mine sites after closure. Well-preserved mining features are likely to be even rarer in the future (Gallagher and O'Connor 1999, 56-57).

Meanwhile, mineral prospector, Nick Coy, considered Avoca to be the perfect former mine site at which to develop a sustainable mining heritage attraction, due to its strategic location close to Dublin and the fact that the Avoca Valley has been a tourist destination since the nineteenth century. After a protracted and expensive legal search, he managed to acquire a lease offer on the site from the government in 1994. Market research, carried out for his Avoca Mining Heritage Ltd. by the CHL Consultancy Group, indicated that the proposal, as outlined, could attract in excess of 100,000 visitors annually, making the proposed centre one of the major tourist attractions, not only in County Wicklow, but in Ireland. Architectural plans for a mining visitor centre and underground tour were prepared and planning permission was granted by WCC in 1995. Bord Fáilte approved the project and a substantial grant offer from the Department of Finance was agreed (Coy 2003). Efforts to raise matching private capital investment were sourced through the Business Expansion Scheme (BES).

A major stumbling block proved to be potential public liability insurance costs for the project, as none of the major insurance companies were willing to offer cover. Investors were also looking for asset backed projects and hotel investments

soaked up all the available BES funds. The Avoca plan was always looked at as a commercially viable operation that would stand alone without annual subvention from government bodies. Even though it did not come to fruition at that time, Nick Coy fervently believes that Avoca is the only mine heritage site in Ireland that has the potential to function independently (Coy pers. comm.).

In 1995, the Avoca Mines Heritage Project was initiated under the umbrella of the Vale of Avoca Development Association (VADA) with the objective of raising awareness within the local community of the importance of the historic mining landscape, and to seek the conservation of its various monuments and features, perceived to be under threat from weathering, vandalism and benign neglect (Merrigan 2003, 29-30). A visit to Cornwall was undertaken where several high profile mining heritage projects were then under way (see above), with the aim of exploring the best ways of preserving the relict mining landscape of Avoca. After this fact finding visit, it was decided to promulgate plans to develop a public park with a mining heritage theme in Avoca. In order to build intra-agency synergy and to involve the local community and key stakeholders, a meeting of all interested and involved parties was called. A steering committee was formed, chaired by Tony O'Neill of WCC (Development Executive),²⁰ with representatives from WCC (Development and Technical); the GSI; the Department of Marine and Natural Resources; Dúchas (Irish Heritage Service); the Eastern Region Fisheries Board (ERFB); Wicklow Rural Partnership; VADA; Wicklow County Tourism; Midlands-East Regional Tourism Authority (MERTA) and Coillte (Irish Forest Service), with the aim of establishing the Avoca Mines Trust.

Leading on from consultation with the steering committee, Kenneth Brown, an industrial heritage practitioner with specialist knowledge of Cornish steam engine technology and David Slattery, a heritage architect, were commissioned to prepare reports on the Avoca Mine Site and its monuments in order to more fully understand it (Brown 1997 and 2002). Through the auspices of the Wicklow Rural Partnership, a workplan for consolidation of the extant mine buildings was developed and the Avoca Mines Heritage Project became involved in the *Celtic Copper Project*. This LEADER funded transnational project with partners in West Cornwall and Anglesey, Wales, aimed to share best practice in the promotion of sustainable mining heritage tourism and mine conservation. These three important historic mining areas share many similarities, not least the use of high pressure steam engine technology and transport infrastructure (ports and mineral tramways), but also the significant labour migration between them, which it was planned to explore through genealogy.²¹

In the late 1990s, the government department responsible for the mine site (then known as the Department of Marine and Natural Resources) was very co-operative and regarded the

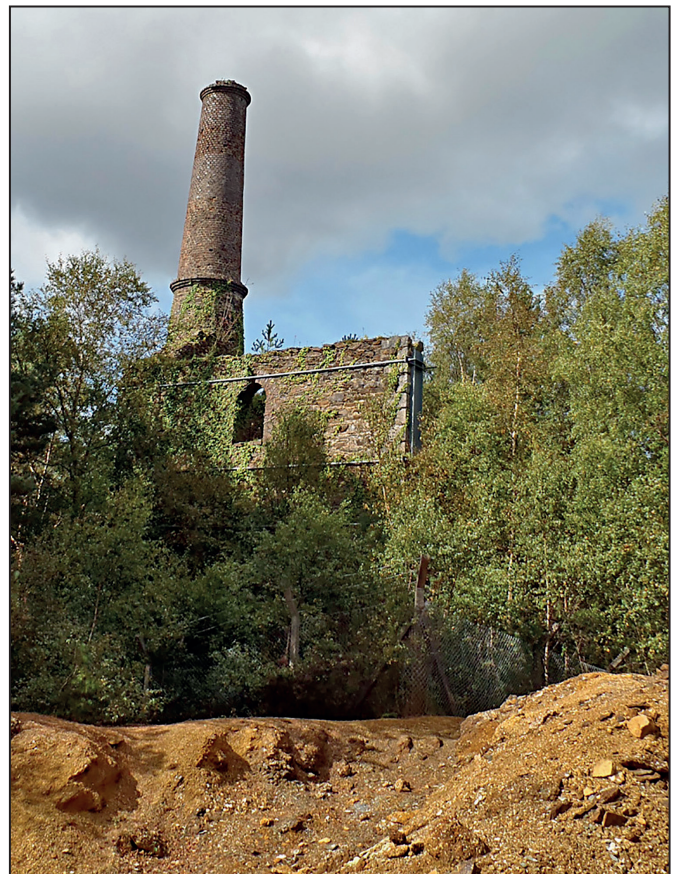


Fig. 10: Steel bracing was placed around the wing wall of Baronet's whim engine house on the Tigroney Mine in 2002 to prevent it from collapsing. The work was funded by Wicklow County Council. Image, Sharron Schwartz, 2011

themed mine park proposal favourably, but there were concerns over AMD to be surmounted (Merrigan 2003, 30). The Trust managed to secure EU Leader and national funding, supplemented by local fundraising, which facilitated urgent conservation work on the most threatened mine buildings between 2000 and 2006. The most important works included re-pointing the stonework of several of the remaining chimney stacks and installing lightning conductors; steel bracing of the wing wall of Baronet's Engine House and repair of the tramway arch, the only authentic drystone mineral tramway arch in the country. Significant support to the works was given by WCC and the Heritage Council via conservation grants. Despite an expenditure of over €120,000, there were no funds available for conservation works on the main body of the engine houses and other important features (such as the ore bins).

Hopes remained high for the future protection and further preservation of the mining heritage when new funding was obtained in 2004/05. This arose out of concerns about AMD, described above in relation to Parys Mountain, which was severely affecting the water quality of the Avoca River. Since mining operations ceased in 1982, AMD has been emanating from the mine workings and tailings piles. Two major adits, the Deep and Ballymurtagh Adits, discharge AMD, characterised by elevated concentrations of heavy metals, acidity and sulphate, directly into the Avoca River. Other adits

²⁰ This committee is no longer meeting due to the lack of permission to progress the project.

²¹ Visits were made to all three areas and the Avoca Mines Heritage Project participated in the 1999 pan-European mining heritage MINET Conference held at Nenagh in County Tipperary (see Merrigan 2003, 29-30).

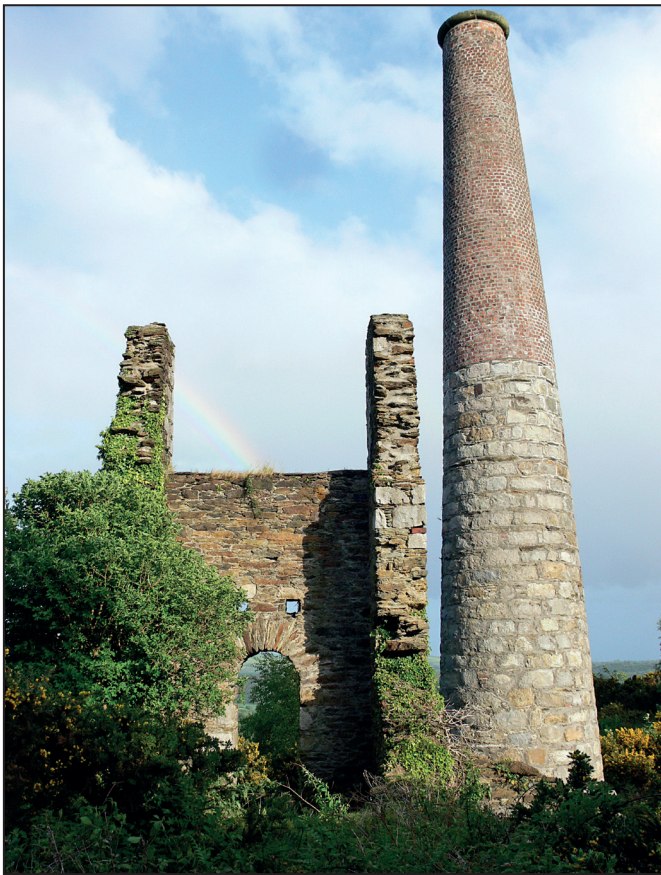


Fig. 11: Forge Engine House on the Ballymurtagh Mine in 2007, after works had been undertaken to consolidate it in 2000. Image, Martin Critchley, 2007

(with seasonal flows), surface runoff from spoil, groundwater discharge and bank intrusion also pollute the river, resulting in severe contamination (Gaynor and Gray, 2004; Gray, 1998). Ecosystem destruction, caused primarily by ochre deposition and an associated thick layer of precipitated metals, is obvious in the reaches of the river immediately downstream of the mines, and the extremely poor river quality caused by AMD has resulted in significant losses of macroinvertebrate species, fish, and other native biota, with impacts evident in the entire river downstream of the mine site (Gray and Delaney, 2010).

This had resulted in the setting up of a management group consisting of WCC, the Department of Marine and Natural Resources, the Environment Protection Agency (EPA), ERFB, the GSI, the Irish Farmers Association, Coillte, VADA, the Avoca Mines Heritage Trust, Annamoe Trout Fisheries, the MHTI, Fáilte Ireland, accommodation providers, industry, landowners, angling associations and community groups. With funding of €51,182 from the Tourism Angling Measure scheme, the University of Newcastle was appointed to carry out a desktop study with the aim of reducing the AMD. Its findings suggested that restoring the Avoca River could realise the potential for it to become one of the top five salmon fisheries in the country, creating €750,000 per year in fishing-related revenue, which could give a significant economic boost to the local community. The construction of two pilot treatment plants was recommended, to demonstrate mine water treatability where the adits discharge into the Avoca



Fig. 12: Drystone tramway arch at Ballymurtagh Mine. Image, Sharron Schwartz, 2007

River (IT 2004).

The group again applied for funding and received €296,820 under an EU Ireland/Wales 3A Interreg programme for a project known as *Celtic Copper Heritage* with the ERFB as the lead partner and Parys Mountain, Anglesey, as the Welsh partner site. A number of initiatives were undertaken in Ireland during this project, including the establishment of a web site (with content for schools), the design of two walking routes across the mines with accompanying leaflets and interpretation boards and the installation of a pilot plant to treat AMD from the Ballymurtagh Adit. However, whilst the pilot plant (Fig. 14) successfully demonstrated that active chemical treatment of the mine water could remove heavy metals and oxides, and neutralise the pH, and while recommendations were made for the installation of a full scale plant on the River (BP 2006; Unipure 2006 and 2007), progress stalled over the implementation of the walking trails and interpretation boards. The walking trails were severely constrained by the refusal of the EMD, the state agency responsible for the management of the site, to allow public access to any significant parts under state ownership. Consequently, the two walking routes were largely confined to roads with only single viewpoints onto the mine sites on either side of the valley. Similarly, the interpretation boards were not erected because of access problems.

A feasibility study, named the Avoca Mines Experience, had been undertaken under the aegis of the Avoca Mines Heritage Trust by Seán Harrington Architects which included a plan for the provision of access to the mines for walkers, the conversion of an existing building (the former copper mines office) to a visitor centre and the development of a memorial park to miners. The plans for the Avoca Mines Experience have not been implemented, for reasons outlined below.²² For while

²² Interestingly, the Avoca mining landscape with its Cornish-type engine houses is of sufficient interest to the Cornish Mining World Heritage Site to consider it an exemplary illustration of the dissemination of Cornish mining technology and labour overseas. It could feasibly be considered as part of



Fig. 13: Williams' Pumping Engine House on the Tigroney Mine, accommodated a 60-inch vertical cylinder steam engine. Built at the Perran Foundry in Cornwall, a concern in which the owners, Messrs Williams, had an interest, this was the largest engine ever erected on an Irish mine. Architecturally significant, having had a back bob and with the walling of its boiler house partially intact, the chimney stack was consolidated in 2003/04, but the remainder of the monument, being colonised by ivy and tree saplings, is in urgent need of consolidation. Image, Martin Critchley, 2007

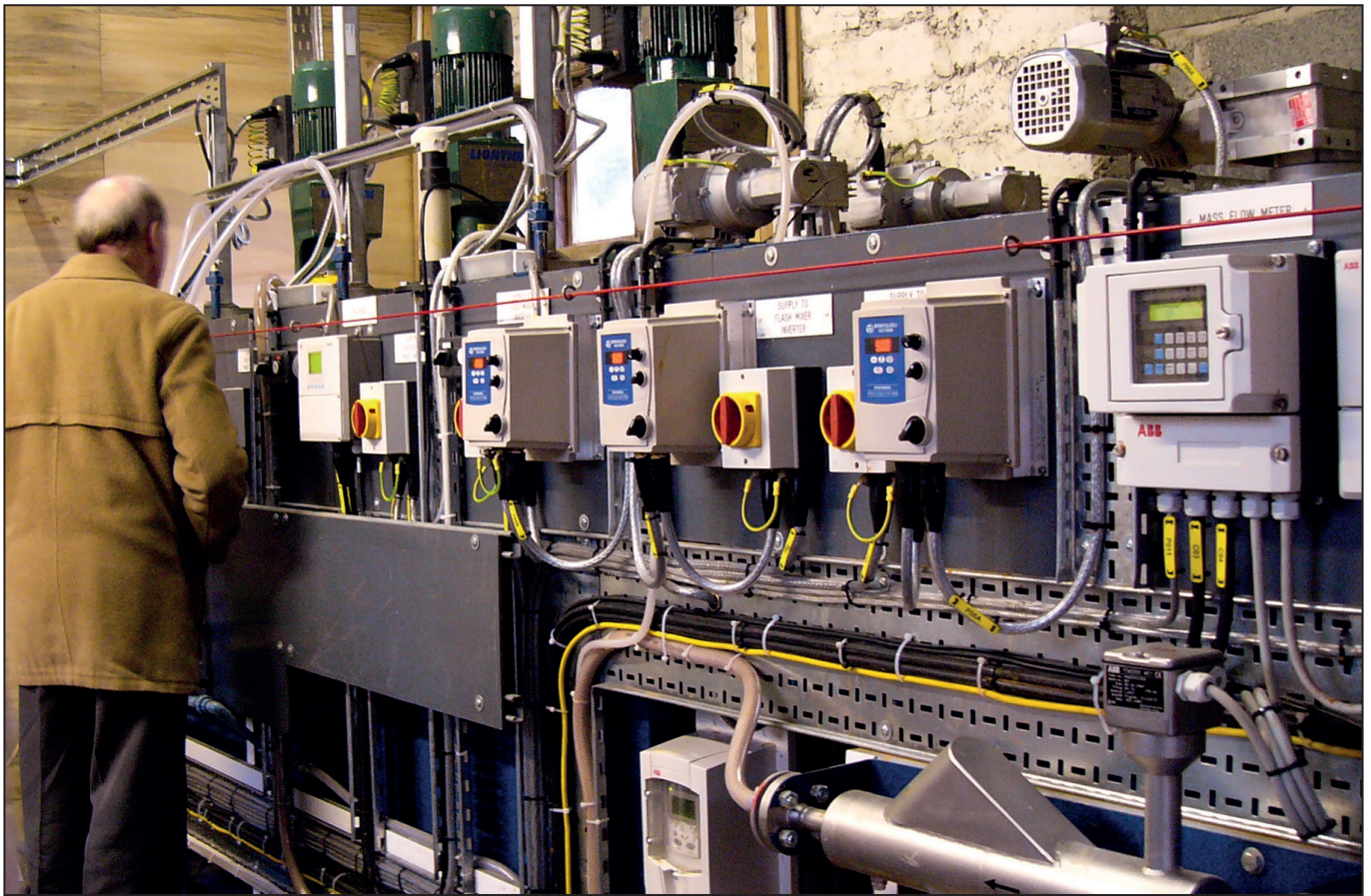


Fig. 14: The pilot water treatment plant installed at Avoca under the aegis of the Celtic Copper Heritage project. This demonstrated that AMD emerging from the mine adits could be treated. Image, Martin Critchley, March 2006

mining heritage projects in Anglesey and Cornwall have gone from strength to strength, with the inscription of Cornwall and west Devon's mining landscapes as a UNESCO World Heritage Site in 2006, and Parys Mountain Mine as part of the UNESCO GeoMôn Global Geopark in 2009, those in Avoca have been stymied by the state. The main reason for this lies in the land ownership, for the mines, both surface and sub-surface, are the property of the state. Where once the Department of Marine and Natural Resources regarded the local community's plans for a themed mine heritage park favourably (Merrigan 2003), its successor, the DCENR, now appears to be completely hamstrung by concerns about health and safety, which has so far precluded any development of the mine site as a heritage attraction or local amenity.

During the first decade of the present century the EMD and the Environmental Protection Agency (EPA) became increasingly concerned about the potential environmental and human health risks of abandoned mine sites in Ireland. In fact, such concerns were first raised in 1999 with the death of cattle adjacent to mine tailings at Silvermines in County Tipperary (IT 2000; Farrell undated). A subsequent multi-agency study at Silvermines identified several areas of risk including high lead levels in a school playing field. Silvermines was successfully rehabilitated starting in 2007 with government

funding, the disbursement of which was aided by active cooperation between the local authority (North Tipperary County Council) and the MHTI, to undertake conservation works on the historic mine buildings at Silvermines and the protection of historic surface waste (Morris 2011). The conservation works were co-funded by an Atlantic region Interreg 3B project (*Green Mines*). The success of the cooperation between government authorities and the MHTI has not been replicated at Avoca, despite the MHTI's best efforts to offer to work in partnership with the EMD.

Following on from the concerns raised at Silvermines and on foot of the EU Extractive Waste Directive (2006/21/EC), the EPA and the GSI undertook an inventory of closed mine waste facilities (as required under Article 20 of the Directive). This three year study (2006-2008) was published in 2009 (Stanley *et al.* 2009). At Avoca, one of the first sites to be studied, high metal concentrations were apparent at adit discharges and were observed in the river adjacent to the mine. Groundwater in the immediate vicinity of the mine was noted to be enriched with ecotoxic minerals as a consequence of interaction with solid mine waste. As at Parys Mountain, large volumes of surface spoil remain on the site, creating a highly acidic environment that can contain in excess of 1 % Pb, Cu or Zn. Concentrations of As are also high. Though not major components of the ore, Pb and As are the main elements of concern in solid waste. The median Pb concentration for spoil in the district is 2,846 mg/kg, while sediments downstream of

a future UNESCO transnational 'Cornish Mining' World Heritage Site, but only if the political will to advance this in Ireland was apparent.

the site have high concentrations of Cu, Pb and Zn, and heavy metal enrichment is apparent up to 10 km from the site, where 177 mg/kg copper was recorded.

The on-going concerns over the environmental legacy at Avoca prompted the DCENR in 2007 to commission American company, Camp Dresser McKee (now known as CDM Smith-Ireland), to undertake a full characterisation of the site, a risk assessment and the design of a remediation plan. Although to our knowledge, they have no prior experience of remediating historic mining landscapes, their remit was to prepare a realistic, cost-effective, and achievable integrated management plan for the Site that addresses a variety of issues, including human and ecological concerns, safety and physical hazards, heritage, future uses, and long-term site management. Their report (CDM 2008 *et seq.*), which we argue falls way short of accepted best practice standards for the remediation of similar historic mining landscapes in the neighbouring UK, contradicts elements of the earlier site report of Gallagher and O'Connor (1999) and concludes that unsafe conditions are perceived to exist as a result of abandoned shafts and adits, unstable spoil heaps and opencast walls, with the potential for slope failure/collapse.

It also recommends a mixture of active and passive treatment of AMD, yet ignores the possibility of adopting remediation by co-treatment with municipal wastewater using the activated sludge process. This innovative approach to AMD remediation is based on the premise that combining AMD with wastewater, activated sludge, or digested sewage sludge, can effectively neutralise acidity and remove metals in a highly cost effective manner and it has been extensively researched at Trinity College Dublin by the Water Technology Research Group (Water Technology Research Group). CDM recommend removing the spoil of Mount Platt (on the grounds of slope instability and AMD runoff) to in-fill the Cronebane Open Pit, and the capping or removal of much of the spoil across the entire Avoca site, dramatically and irreversibly altering the historic mining landscape by, in effect, virtually expunging it from the Avoca Valley.

The report does acknowledge that the area contains many historic structures of industrial archaeological, heritage, and cultural importance, including engine houses, the Tramway Arch and the Tigrony Ore Bins, but observes that some of these structures are 'unsafe and in need of repair'. There is a token regard to the mining heritage of the site which includes an incomplete inventory by persons not known to be versed in industrial (mining) archaeology. Unsurprisingly, the report contains little in the way of recommendations to preserve, protect and make accessible the mining heritage, a point that was highlighted by the team working on the *Celtic Copper Heritage* project: 'As part of the stakeholder process we note that little attention has been paid to the mining heritage and opportunities that mining heritage can and should create for local regeneration'. The estimated total cost of the remediation works, if fully implemented, was €60 million, but as far as we are aware, there was no budgetary element given over to archaeological investigations, interpretation, visitor access, or the conservation of extant nineteenth century mine buildings listed in the RPS, despite the DCENR having a duty of care to

them as the landowner.

CDM Smith's website has this to say about their €60 million 'cost effective' project, undertaken 'with modern thinking in mine rehabilitation' and with the support of the local community (points which we contest) - and it is particularly alarming that they classify 'buildings' as a 'negative legacy' of mining in Avoca:

Mining had brought prosperity to the area, but closure left a significantly negative legacy, including buildings, open pits, tailing impoundments, waste heaps, mine discharges, and contaminated streams and sediments... Building on past work, we prepared a realistic, cost-effective and achievable integrated management plan/feasibility study for the €60 million remediation of the Avoca site. The project involved the engagement of area stakeholders and the alignment of sectoral interests that have developed over the years in the development of a coordinated approach to remediating the damage left by mining at Avoca. This project provided an unparalleled opportunity to achieve this engagement and agreement from local stakeholders, who include not only state and regional bodies, but also the local community of Avoca... Thus, it was timely and necessary that this study was undertaken to allow the disparate strands of past work to be assessed objectively, augmented with additional data where necessary, and assessed with modern thinking in mine rehabilitation (CDM Smith website).

In light of the economic downturn and austerity measures instituted in Ireland at the time, funds were not available for the full remediation, but €3m was secured from the cabinet in 2014 and CDM Smith-Ireland, in conjunction with Bruce Shaw Partnership and GWP Consultants LLP., were contracted to supervise 'urgent safety works' during a three year contract that commenced on the 19th December 2013. Work will be undertaken on the grounds of health and safety to make safe hazards arising from adits, shafts, and unstable spoil heaps, and further fencing and signage will be provided.

Meanwhile, in 2008, the Avoca Mines Heritage Project Committee had made a representation to the Environment Committee of the Houses of the Oireachtas to protect the integrity of the mine site. The Committee was advised by the EMD to wait for the consultants' concluding report before any further plans were promulgated. In 2011-2012, the National Trails Office in Ireland (the Government authority in trail development) walked the mine site and concluded that, in their opinion, the site posed no discernable dangers and was therefore suitable for the development of heritage walking trails. However, despite the advice of these experts, and the continued lobbying by the Avoca Mines Heritage Project and local tour operators, including the arranging of visits/visitation of a series of Ministers of State in the DCENR, permission to develop trails has been staunchly refused by the EMD.

In a letter of December 2014 to WCC's Planning Department referring to the *Feasibility Study for Management and Remediation of the Avoca Mine Site* by CDM in 2008, the



Fig. 15: Some of the discrete elements that together constitute the nationally significant historic mining landscape of East Avoca, can be seen in this image: a nineteenth century Cornish-type engine house; twentieth century ore bins and the concrete base of a crusher; large areas of colourful mine spoil and an open pit that offers an opportunity to view an exposure of volcanogenic sulphide mineralisation. Image, Martin Critchley, 2011



Fig. 16: A dramatic view down into the Cronebane Pit, East Avoca. Note entrances into old workings high up in the rock face. This, and the East Avoca Pit, offer unique opportunities to view exposures of volcanogenic sulphide mineralisation and are the best examples in Ireland of a cross section of a supergene or gossan zone of an oxidised orebody. The range of colours and unusual topography has attracted artists and film makers. Image, Martin Critchley, July 2005

DCENR noted that this included a Health and Safety Audit that had identified many areas of attention, the most urgent of which were being addressed through a three year programme of safety works in addition to on-going monitoring of the site:

The Department considers that until the risk of these hazards identified in the Health & Safety Audit are reduced or eliminated, the Avoca mining area is unsafe for access by the public (DCENR Letter to WCC Planning Dept).

All public access, surface and sub-surface, has since been forbidden, which means that the buildings for which the EMD has a duty of care, including the internationally significant Cornish-type engine houses, recently fenced off and inaccessible, languish in a state of benign neglect, quietly being subsumed by vegetation.²³ However, the alleged dangers posed by the site that preclude public access seem to be no bar to film crews. In 2015, two production companies were granted access to the Cronebane Open Pit: one for the blockbuster *Vikings* TV series, produced by Irish and Canadian

²³ The DCENR, the landowner of significant parts of the former mines, has not contributed any capital towards the previously completed consolidation works to any of the listed structures. Work to stabilise several of the most threatened structures on the RPS between 2000 and 2006 was undertaken with finance from WCC, the Heritage Council and via fundraising within the local community. Tree cutting was undertaken in the vicinity of Williams' Engine House in 2013, by volunteers at the instigation of the Avoca Heritage Committee.

companies (Octagon Films and Take 5 Productions) and the other for the critically acclaimed *Penny Dreadful*, a British-American horror drama television series created for Showtime and Sky.

As described above, the situation at Parys Mountain, which shares the same geochemistry and environmental issues, and is subject to the same EU legislation regarding soil and water quality as Avoca, could not be more different. There, intra-agency support has delivered a network of walking trails with signage and interpretation boards with limited recourse to remedial works. As a member of the AIHT states: 'there is no impediment to visitors to the mines and indeed there have been long established public footpaths across the area. There are warning notices to visitors over general safety on the mountain paths, but toxicity is not specifically mentioned – it is considered that the exposure time for visitors to the mountain would not be sufficiently long' (David Jenkins, pers. comm.). The landowner allows the public onto the Parys Mountain mine site at their own risk and it would be expected that visitors are able to take care of their own safety within the confines of the walking trails. No one is suggesting that walking trails traverse the Avoca open pits or be within proximity to uncapped shafts, and as the mine buildings deemed to be dangerous are fenced off and inaccessible, it is difficult to see why this model has not been adopted at Avoca.

Of great concern is the fact that the DCENR has requested, as part of its submission to the review of the Wicklow County

Development Plan (2016-2022), that the spoil heaps and open pits be removed from the Record of Protected Structures. The Planning Act of 2000 allows for the RPS to include a curtilage around structures and can include the protection of structures in associated (but not contiguous) lands. The RPS for the current Draft County Development Plan (2016-2022) has redefined the structures to be protected at the Avoca mines and removed any reference to the spoil and associated disturbed lands. Yet, WCC already accepts the importance of mining spoil in the Draft Wicklow County Development Plan (Chapter 10: Heritage, page 205):

Much evidence remains at each of these sites of former mining activity in the form of engine houses, machinery, adits, spoil heaps and drainage channels...

We therefore argue that the removal of mining spoil from the RPS would contradict the value of the above statement. Crucially, we argue that this could give the state carte blanche to remove spoil, cover over spoil heaps with inappropriate materials, in-fill the open pits and eventually to remove the iconic 'Mount Platt' waste tip, as recommended in the CDM Report. Spoil and disturbed land associated with mining are important natural habitats for both flora and fauna (Good 1999; Fay and Mitchell 1999) and bryophytes have been recorded at several of these (Holyoak and Lockhart 2009, 2011; Lockhart, Hodgetts and Holyoak 2012). Some local people do not wish to see the mine spoil removed or re-vegetated with grass and have expressed their concerns about this aspect of CDM's report: '... [re-vegetating] would not be in contextual sensitivity to the heritage of the area. I would suggest that [it] be re-vegetated with heather and plants that propagate naturally in this landscape' (Porter 2008); this latter was done at the Parys Mountain Mine following remediation works at Henwaith. Moreover, the CDM view might also mark the thin edge of the wedge for mining landscapes elsewhere in County Wicklow and beyond, that are owned by the state, if their argument goes unchallenged.

The language used in the DCENR's 2014 letter to Wicklow County Council's Planning Department, referring to the Health and Safety Audit carried out by CDM in 2008, and arguing the need to remove spoil and disturbed ground from the RPS is indeed telling:

Spoils are mining waste material. The spoils at Avoca Mines are contaminated with heavy metals and arsenic that pose a risk to human health... The Feasibility Study shows that rainfall interacts with these spoil heaps producing acid mine drainage, dissolving heavy metals and transporting the metal load to the river and groundwater. It also demonstrates that this is resulting in contamination of the Avoca River and the groundwater. The contaminants within the Tigroney Spoil are considered to be in environmentally significant concentrations that supports the capping of the Tigroney Spoil Area to prevent exposure to humans, plants and animals and to prevent contaminated surface runoff and infiltration into the groundwater, that both ultimately discharge into the Avoca River. The continuing designation of these spoil heaps (mine



Fig. 17: Twin Shafts whim engine, Ballymurtagh, after condolidation works were undertaken in 2005/06. Image, Martin Critchley, 2011

waste) as protected structures, delays and limits their essential remediation, and will result in the continuation of environmental impact...

Likewise, the East Avoca Pit and Cronebane Pit are singled out as posing risk factors from medium to high, due to rock fall, failure and slab slides: 'the south eastern face of the East Avoca Pit has been identified [as] the most hazardous in the entire site'. The letter concludes:

... 'to provide a high level of protection to the environment' along with consideration of the untapped potential of Avoca mines and built heritage, it is important that the mine piles/mine waste is made safe and as such the designation of this material as protected structures should be removed to facilitate the remediation of mine waste without detriment to the heritage of the town [Avoca].

The open pits and other important surface features on both sides of the Avoca Valley have been listed as county geological sites (Meehan *et al.* 2014) in the Draft Wicklow County Development Plan (2016-2022) which should, in theory, protect them from 'inappropriate development that would adversely affect their existence, or interpretation' (County Wicklow Heritage Plan 2009-14, 82) The Cronebane and the East Avoca open pits offer unique opportunities to view exposures of volcanogenic sulphide mineralisation and are the best examples in Ireland of a cross section of a supergene or gossan zone of an oxidised orebody. Indeed, the *Celtic Copper Heritage* project team noted their concern for the future of the spoil heaps and open pits in 2008, describing them as a significant asset in any future opportunity for education and economic development in the area:

... they represent perhaps the most significant opportunity to view our geological and mineralogical heritage in the whole of Ireland... they are in fact a geological heritage of world significance' (Doyle *et al.* 2008).



Fig. 18: Emergency works being undertaken without planning permission by Irish Rail at White Bridge, Tigroney, in October 2014. Sub-surface archaeology was exposed and damaged by heavy earth moving machinery and large quantities of mine spoil were moved around the site, disturbing rare mineral exposures. Wicklow County Council was forced to issue an enforcement notice on Irish Rail to stop the works. Image, Martin Critchley, 2014

Indeed, Dr Aidan Doyle of Newcastle University, the *Celtic Copper Heritage* project manager, later expressed his disgust for the DCENR's plans for remediation of Avoca's historic mining landscape: 'Similar places around the globe would be UNESCO world heritage sites. The east side [of Avoca] is one of the finest examples of exposed geology' (TST 2010). However, the designation of county geological site, as yet, carries no statutory power, which leaves the open pits vulnerable to drastic interventionist works.²⁴

However, the Council of Europe's European Landscape Convention, to which Ireland is a signatory, recognises the importance, not just of high quality landscapes, but also 'degraded' areas:

Acknowledging that the landscape is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognised as being of outstanding beauty as well as everyday areas; (European Landscape Convention 2000).

Furthermore, 'degraded' landscapes are recognised in the *National Landscape Strategy for Ireland 2015–2025* (Department of Arts, Heritage and the Gaeltacht 2015) and are likely to be included in the National Landscape Character

²⁴ The fact that the government is short of €57 million to undertake the full remediation measures recommended by CDM, probably offers Mount Platt and the Cronebane and East Avoca open pits, a stay of execution in the short term.

Assessment arising from this strategy. In light of the clear support for 'degraded' landscapes both in the European Landscape Convention and Ireland's National Landscape Strategy, we argue that it would be highly inappropriate for WCC to threaten the examples *par excellence* of degraded landscapes in the county, by removing the protection given to the spoil and disturbed ground at the Avoca Mines. Additionally, it has been proven by various consultancies listed above, that the Avoca Mines have significant tourism potential, and we understand that WCC is considering a tourism strategy for them. Indeed, Simon Harris TD, who visited the mines with the Avoca Heritage Committee in June 2015, stated,

Avoca is rich in mine heritage and this is an aspect of Wicklow's history which I believe should be further explored in terms of its tourism potential. I look forward to working with the Avoca Heritage Committee in ensuring that these mines are preserved and brought to wider public attention (Harris blog 2015).

But we argue that the proposed removal from the RPS of the colourful spoil heaps and disturbed land that so characterise this historic mining landscape, would seriously undermine this strategy before it is put in place.

The DCENR has begun remediation works in accordance with the recommendations contained in the CDM report, which have caused alarm, as have the October 2014 'emergency works' of Irish Rail (Fig. 18). These were undertaken at the White Bridge site adjacent to the Tigroney Mine, in order to



Fig. 19: The iconic ore bins at Tigroney dating to the 1960s which, after pressure was brought to bear on the DCENR, will now be properly conserved. The surrounding spoil is however, earmarked for removal, thus degrading the authenticity of the site. Image, Martin Critchley, 2012

stabilise the Tigroney Deep Adit (access tunnel) and apparently did not require planning permission from WCC. This tunnel runs about five metres below the Dublin to Rosslare railway line, its portal is within the railway embankment, and the embankment was deemed to be at risk of subsidence. A considerable amount of spoil was excavated and moved about the site, prompting the MHTI and the Avoca Heritage Committee (successor to the Avoca Mines Heritage Project) to submit written complaints to WCC's planning department about the undesirable effects of these works.

Damage was inflicted on sub-surface archaeology consisting of a series of wooden launders used in copper precipitation processes, and consolidated spoil which contained vital contextual archaeology regarding the development of the Tigroney Mine was disturbed. In addition, an exposure of the rare copper sulphate, chalcantite was destroyed (Critchley 2014, 2014/15, 2015). There has also been no attempt to reconstruct the adit portals in a manner commensurate with their contemporary form, to maintain the visual authenticity and integrity of the site. This forced WCC to issue an enforcement notice on Irish Rail to stop the works. The actions of Irish Rail, supervised by CDM Smith and tacitly sanctioned by the EMD - which undertook to open the 850 Level on the back of this work - underscore the current lack of knowledge and regard for industrial heritage that seems to be regrettably evident within many Irish government agencies.

A new planning application for works at Tigroney was submitted by the DCENR in May 2015 which included retrospective planning permission for the works undertaken in autumn 2014 (subject to the enforcement notice); works on the 850 adit (to rebuild the adit entrance to the bedrock, install piping to channel water and gate the entrance); conservation of the ore bins (Fig. 19); covering of the mine spoil; and the establishment of a cover of vegetation.



Fig. 20: Retention of access to the 850 Level is important for future geological, geochemical, geobiological and historical research. In this image, chemolithotrophs (acid loving bacteria) have formed extra-cellular polysaccharide oozes that hang down in jelly-like stalactites on the ladder rungs and centre left, while the wooden boxes are the remains of an experiment undertaken in the 1980s to precipitate copper from the stopes using a weak acid. Image, Martin Critchley, 2009

The MHTI contested the need for permanently gating the 850 level, pointing out its continuing access value as regards geological, geochemical, geobiological and historical research (Fig. 20),²⁵ as a vital access point for the monitoring of the hydrology of the site; and because of its importance in the development of any future underground heritage attraction. The MHTI also strongly objected to the dismantling of the iconic ore bins (allegedly for unspecified off-site conservation works) at Tigroney, along with the removal of the spoil surrounding these. These concerns were largely dismissed by CDM Smith, but they did agree to provide a detailed methodology for the conservation of the ore bins (Critchley 2015). Following further written submissions by the MHTI to WCC, a number of conditions were placed upon future works, including methodologies to be approved by county engineers, a detailed 3D laser survey of the 850 level to be carried out, and a suitably qualified archaeologist to be present on site (the MHTI recommended this person be well versed in mining

²⁵ In 2015 a post-doctoral researcher from Bangor University contacted the MHTI about underground access to the Avoca Mines for the purposes of studying its microbiology. A message was sent to the EMD requesting permission for this person to access the 850 level, but no reply was received.

archaeology). Planning permission was granted for the capping or recapping of several shafts, for landscaping and vegetation cover at Tigroney, and for the removal of the ore bins for conservation, the installation of a pipe in the 850 level and the gating of the level.

However, since permission was granted, scrutiny of the planning application (Wicklow County Council 2015) in conjunction with the reports of the original studies has revealed it contains several flaws. Appendix B: Environmental Report of the submitted application contains errors in the calculation of percentage metals by a factor of 10 too large when converting from mg/kg to percentage. The application reports arsenic at 1.2% and lead at 19.5% but the correct values are 0.12% and 1.95% respectively (p. 14). Also, the total amount of bioavailable arsenic and copper, and bioavailable lead and zinc in the mine spoils is given at 8% but the correct calculation should be 0.8% (p. 16). The metal values quoted for the spoil tips are only based upon sub-surface samples, whilst surface values from XRF surveys are a lot lower and are either less than, or only slightly above, those acceptable for recreational visitors. These values would have far less serious implications for White Bridge residents who were concerned about the potential dangers of inhaling mineral dust.²⁶

We conclude that the spoil tips only present an increased hazard to visitors if the surface is disturbed and buried waste is exposed. Mathematical errors like these, and the use of sub-surface rather than surface data, throw into question the validity of other data presented in the DCENR planning application and whether it is necessary to 'remediate' this site at the level suggested. This includes spoil removal in the vicinity of the ore bins and its replacement with 'Barleycorn gravel' (an orange coloured aggregate), seeding of new vegetation and the re-profiling and capping of the spoil in the wider vicinity, all of which will undoubtedly severely degrade and destroy the integrity and authenticity of this site. Clearly there are serious questions to be asked about the competence of the consultants advising DCENR as a result of such fundamental errors.

Shaft capping commenced in October 2015 at West Avoca (and was to include Whelan's and Air Shafts), but was halted by WCC when it was discovered that New Western Shaft to the west of these had been capped without planning permission. On top of this barely believable fiasco, in situ archaeology had clearly been disturbed at New Western Shaft (despite the presence of an supposedly qualified archaeologist) and even more disquieting, is that the newly capped shafts do not include any form of ventilation. The MHTI registered its concerns to WCC that a lack of ventilation could reduce the air quality of the underground workings and cause dangerous build-ups of any methane and other gases which might enter the workings from the unlined landfill in the Pond Lode open

²⁶ Moreover, the Environmental Report also uses data obtained prior to the disturbance and mixing of the spoil tip in late 2014 during unauthorised works by Irish Rail, and thus would not be representative of the current status.



Fig. 21: Chimney at Waggon Shaft, the only extant remains of three engine houses that were erected at Connary Mine. If CDM's remediation plans are carried out, there will be little spoil left at this mine site, thus divorcing this sole surviving monument from its landscape context. Image, Martin Critchley, 2008

pit. Moreover, shaft capping minus any ventilation flies in the face of best practice elsewhere, which recommends this to avoid impacts on a mine's hydrology – where changing ground water levels might cause air pressurisation and subsequent 'blow-outs' (Critchley and Schwartz 2015). We understand that the EMD requested, and was subsequently granted, retrospective planning permission for New Western Shaft.

If the cavalier methods of working based on fundamentally flawed data demonstrated so far are anything to go by, we argue that the intended outcome at Tigroney will mark the commencement of the divorcing of the extant physical remains from their landscape context across the entire valley (resulting in the 'Surrey with engine houses' scenario in Cornwall or the 'surreal belt of emerald greenery' surrounding Merthyr Tydfil, justifiably lambasted in the early days of large-scale mine site remediation). There is likely to be a loss of underground access for researchers because of concrete capped shafts and gated adits, and the potential destruction of yet more unrecorded and/or buried archaeology as works progress. The MHTI has categorically stated its opposition to such remediation measures, which, far from being undertaken 'with modern thinking in mine rehabilitation', are, as described above, now held up for reproach in Cornwall and Wales as the way *not* to remediate *historic* mining landscapes. Meanwhile, no remedial measures are yet in place at the Avoca mine site to treat the AMD, for which a sustainable, reliable, and long-term treatment system is urgently needed.

As demonstrated with respect to Wales and Cornwall, the planned works at Avoca bring into sharp perspective the issues problematising remediation processes. 'Place' – the meaning of the landscape – is socially constructed at many levels by many individuals and groups, so that the relict mining landscape of Avoca is experienced quite differently by different people. It has multiple meanings and identities which can appear contradictory and competing. The very idea that a post-industrial degraded landscape such as Avoca might be of intrinsic aesthetic or cultural value to individual or group



Fig. 22: The relict mining landscape of the Avoca Valley, which is of superlative heritage value; 1: The Avoca River which is affected by AMD and under the terms of the Water Framework Directive (set out in 2000), requires attention from source to sea; 2: The tree covered Bell Rock, a prominent feature of the Avoca Valley; 3: Site of the unlined landfill that was in use by Wicklow County Council between 1989 and 2002. The waste was placed in the former Pond Lode open pit which can be seen in historic photographs (see Fig. 2); 4: Engine House at Twin Shafts which underwent urgent consolidation works between 2005 and 2006, the work of which was financed by a conservation grant from Wicklow County Council; 5: Forge Engine House on the Ballymurtagh Mine which was consolidated in 2000 with LEADER funding; 6: The former copper mines offices of the last operator, Avoca Mines Ltd. The local heritage group had hoped to turn this building, owned by Wicklow County Council, into a visitor centre for the valley's mining heritage. However, since the building served as offices for the Celtic Copper Heritage project (which finished in 2008), it has been subjected to considerable vandalism and theft, with the result that its historic fabric has been severely degraded; 7: The White Bridge which crosses over the Avoca River. The area immediately in front of this was the site of Irish Rail's 'emergency works' (see Fig. 18); 8: The Dublin to Rosslare Railway line, the embankment of which was deemed to be at risk of subsidence. This prompted the 'emergency works' in the autumn of 2014 in order to stabilise the Tigroney Deep Adit which passes under the embankment; 9: Site of the iconic 1960s ore bins that are a unique feature in Ireland. Following concerns raised by the MHTI and the Avoca Heritage Committee about their removal from the site, the DCENR has agreed to ensure that a suitable conservation plan will be put in place to preserve them; 10: Williams Engine House on the Tigroney Mine. This accommodated the largest engine ever set to work on an Irish mine (a 60-inch vertical cylinder pumping engine) manufactured in Cornwall. Architecturally significant (having had a back bob), it is of superlative heritage value and demonstrates the close links Avoca shared with nineteenth century Cornwall. Many mining areas in Cornwall are a part of the UNESCO Cornish Mining World Heritage Site (WHS), and the Avoca Valley is of sufficient interest to its management team to consider it an exemplary illustration of the dissemination of Cornish mining technology and labour overseas. The Avoca Mines could feasibly be considered as part of a future UNESCO transnational 'Cornish Mining' WHS, but only if there is sufficient interest at Irish government level to progress this, and, more importantly, if the authenticity and integrity of the landscape is not lost due to the DCENR's 'remediation' plans. Image: A panorama of several shots by M. Critchley, 2008

identities and worthy of financial investment to preserve it as an amenity with socio-economic benefits to the local community, is not an easy concept for many politicians and state agencies to grasp.

To the Irish government, the Avoca mining landscape is a poisoned, dangerous, blighted place, which has to be remediated to be compliant with health and safety and EU regulations. There seems to be little recognition that this landscape is imagined quite differently by, and carries a variety of meanings for, various users, many of whom do not wish to see its authenticity and integrity compromised to the point where it no longer resembles a mining landscape.

Geologist, Matthew Parkes, eloquently captures what the site means to him:

If I stand on the Mottee Stone... and look over the Avoca valley, I see not eyesores, but awesome pits, symbolic of so many things. I see not a scarred landscape, but a history – a visible record of human endeavours – a mine heritage landscape... the landscape of mined areas becomes suffused into people's consciousness, and becomes part of their local identity (Parkes 1999, 75).

Writing in 2008, Nick Coy sees the tourism potential of the mines, which he claims have 'unlimited possibilities'. He laments the fact that the action of the state will result in the destruction of the one and only mine site of its kind in Ireland:

Avoca may not have the public and media attention currently given to the motorway conflict near the Hill of Tara. Yet in its own way the Vale of Avoca is as unique and significant to the mining and industrial heritage of Ireland as Tara is to the Golden Age. Its destruction, for that is what would be the result, under the guise of rehabilitation, would be an act of almost criminal folly (Coy 2008).

To a local journalist, the Avoca Mines retain a 'raw and terrible beauty', that shatters the picture postcard vision of rural tranquillity. Yet precisely the bits that John Hinde would eschew, could, however, be attractive to film makers, bringing much needed revenue to the county:

The disused mine at Cronebane has been fenced off. Still it is quite possible to walk a circuit of a place that is quite magnificent in its abandoned rawness, a mighty pile of shattered, discarded, wasted, earthless rock with deeply evacuated canyons at either side. Cronebane offers a terribly desolate yet weirdly beautiful landscape. It could make a great film set. Cue Clint Eastwood aboard a not so noble steed, wearing a poncho and chewing his cigarillo. Or maybe Mel 'Braveheart' Gibson would consider a return to Wicklow, if ever they make more Mad Max (WP 2007).²⁷

27 Since this newspaper article was published, as noted above, access to



Fig. 23: Iron Hat Avoca I, Oil on Canvas, 25x30cm, Stephen Lawlor 2010. By kind permission of Stephen Lawlor

Dublin-born artist, Stephen Lawlor, draws inspiration from the immense beauty and dynamism of the naturally abstracted mining landscapes of both Avoca and Parys Mountain. He has created fourteen hauntingly beautiful paintings in his *Cu Collection* (2010) which explore what many might perceive to be 'the seemingly unpromising subject of disused copper mines' at the twin sites in Anglesey and Wicklow.²⁸ As we have seen, early twentieth century landscape painting in Ireland was intimately associated with a national vision, so that the idealised portrayal of rural locales became part of an assertion of a unique cultural identity (Steward 1998, 19). Mining most definitely did not feature in these works.

However, Irish landscape art has evolved dramatically since then to become as much a reflection of the artist's engagement with the genre as a response to a particular place. Lawlor's work reflects this shift, and his *Iron Hat* series, inspired by Avoca, with its emphasis on *chiaroscuro* which the thickly applied paint seems to both store and emit, strips down the Romantic vision of the landscape, abstracting and re-imagining it (see Fig. 23). His work acknowledges that the wastes from the mining industry are more than just visual, physical, or chemical presences on the landscape, but that they also embody powerful and important cultural meanings that give meaning to place identity (Quivik 2007). 'His [Lawlor's] trademark mastery of colour, light and shade adds intensity and movement to the works, which seem to echo the drama of the lives of those who worked in this historically, sociologically and geologically significant landscape' (Leen 2009, 60-61):

the Cronebane opencast has been granted to film companies. However, if the plans advocated by CDM are undertaken, which involve in-filling of this open pit with spoil from Mount Platt, there will no longer be a suitable location to film in.

28 The *Cu Collection* was the result of a commission from Dr Aidan Doyle of Newcastle University, to visually investigate the twin copper mines at Avoca and Parys Mountain, Wales, as part of the Interreg-funded transnational *Celtic Copper Heritage* project.

Left behind is a landscape built of a fabulously rich array of colours betraying the vast cocktail of minerals found in its soil. It has a magical presence. Lawlor is aware of its randomness, and has tried not to reproduce it objectively. He has abstracted the colours, the form, and the scale to distance himself from anything literal – and to reference the processes that played upon each area, from volcanoes to industrialisation and the social and environmental consequences of it – and recognises the potential of this naturally abstracted landscape, which offers a newfound freedom and perplexity to his work. The land around Amlwch and Avoca has been through the wringer. At one time or another it has been washed and eroded, melted and burnt, gashed and lacerated and wounded and scarred, oxidised and bleached, and modelled and moulded. And Lawlor gets this... Paint is the key issue; and colour; and light and shade, which give the work the drama and energy and movement, present in beautiful landscapes of the Wicklow Mountains and Mynedd Parys. (ArtSlant London 2010).

Lawlor himself criticises the ‘ignorance’ of state bodies which he claims has put one of the country’s most beautiful terrains in ‘threat of destruction’. This is all the more galling, as the Welsh authorities have turned Parys Mountain Mine and Amlwch into ‘a spectacular tourist attraction’:

The mine [Avoca] is in arguably the most beautiful valley in Ireland and its fascinating industrial history is totally ignored. What remains of the East Avoca mine is fenced off and hidden ... as if it were an eyesore... If I hadn’t seen other places I’d have nothing to compare Avoca to, I’d have thought this is what you do with old mines... The other countries value things but we don’t. We just destroy things. We’re using safety as a cover; to fill it in, grass over it and forget about it. That’s quite shocking (TST 2010).

But perhaps, most importantly, to local people like co-author, Marie Merrigan, echoing the observations of Sir Neil Cossons (2012, 9) regarding the importance of ensuring that the views of local stakeholders are not downplayed, marginalised or ignored when considering how to remediate historic mining landscapes, the Avoca mining landscape is central to their sense of identity and of place:

Avoca is not just a derelict minesite, it is all that remains of what was once a glorious industrial past. It symbolises Avoca’s identity as a mining community. The transformation of the neglected and abandoned industrial site into a positive asset and an integral part of the local community will give the community a sense of pride in their industrial heritage and help to ensure continuity of social as well as physical heritage into the future. In today’s global village mentality, retention of individuality is very important. The loss or transformation of their mining environment would be culturally traumatic for a mining community (Merrigan 2003, 30).

CONCLUDING THOUGHTS AND OBSERVATIONS

Unlike in Cornwall or Wales, the overall national political attitude towards Irish industrial heritage has, to date, been ambivalent at best, a hang over perhaps of the view of the Irish nation as being inextricably linked to an idealised rurality. Until our industrial heritage is widely acknowledged by our government as a valued component of Irish history, and industrial sites are perceived to be heritage assets worthy of being recorded and offered the highest state designations and protections, rather than derelict sites to be erased, or contaminated eyesores that require urgent remediation, things are unlikely to change.

This paper has shown that, despite the rhetoric from state agencies about wanting to protect the heritage of the Avoca mining landscape, their recent actions betray their actual ideological views and imaginings of it. These do not coalesce with the shared beliefs and perceptions of the majority of the local community and many vital stakeholders, who feel alienated from the decision making process. There is no equivalent of the democratic, inclusive partnership forums set up to deliver large scale mining heritage projects, as demonstrated with respect to Wales and Cornwall, where Avoca is concerned. Many groups and individuals consider it crucial to retain the authenticity and integrity of the relict mining landscape of Avoca, so that it may be transformed into a nationally significant mining heritage park of benefit to the local economy. Yet, recent government actions appear to demonstrate little regard for such aspirations.

This paper has demonstrated that when state agencies/political authorities act in tandem with local communities and vital stakeholders to work on preserving and valorising historic mining landscapes, as has occurred in some of the mining regions of South Wales, Anglesey and Cornwall, a successful outcome is significantly more likely. Until the political climate changes in Ireland, it seems inevitable that the Avoca Mines will be systematically sanitised and erased, despite such practises being avoided where possible in many historic mining regions of the UK. Such a drastic intervention has not been proposed for the historic mining landscape of Avoca’s sister site, Parys Mountain, so why is this being carried out at Avoca?

Whilst we acknowledge that some degree of remediation is necessary for the purposes of health and safety, it is the *extent* of intervention proposed in the CDM Smith report which, as we have demonstrated, is based on flawed and dubious data and methodologies, that alarms us. Indeed, we question whether the costs outweigh the benefits. And, as regards compliance with EU legislation on soil and water quality, cannot a derogation be applied for that exempts the state from having to totally destroy the character of this superlative historic landscape? There is not another Avoca in Ireland. The level of post-closure remediation at twentieth century mine sites such as Tynagh and Lisheen (see Morris this journal) portends the potential fate of one of our most cherished historic mining landscapes if CDM Smith’s remediation plans are not challenged: the almost complete obliteration of surface

features, bar a few fenced off and unconsolidated mine buildings, on the grounds of environmental and health and safety requirements. Quite simply, there will not be much left to turn into a mining heritage park or visitor attraction.

Almost three years ago, Stephen Donnelly TD, meeting with the Avoca Mines Trust, VADA, and local tour operators, expressed his concern about the proposed remediation works:

Realising the potential [of the site] requires a change in position from the government. They need to acknowledge that it is a heritage site. And instead of seeing Avoca as a problem that needs to be solved, see it as a potential win for the local community and the local economy (WT 2013).

So far our government shows little sign of shifting its position and the future for the relict mining landscape of Avoca looks decidedly bleak.

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REFERENCES

- Baeten, J., 'Post Mining Landscape: Conference Documentation (Bergbau Folge Landschaft: Konferenzdokumentation) Internationale Bauausstellung Fürst-Pückler-Land', *The Journal of the Society for Industrial Archaeology*, 35:1/2, 2009, pp. 119-120.
- Batty L.C. and Hallberg, K.B. (eds.), *Ecology of Industrial Pollution*, Cambridge 2010.
- Bowie, F., 'Wales from Within: Conflicting Interpretations of Welsh Identity', in MacDonald S., (ed.), *Inside European Identities*, Providence, 1993.
- Bristow, C. and Sparrow, C., 'Former sites of Metalliferous mining - geological and mineralogical aspects', in N. Johnson *et al.*, *The Conservation Value of Metalliferous Mine Sites in Cornwall*, Truro, 1996, pp. 21-29.
- Brown K., *Draft Report on immediate action recommended to conserve East and West Avoca Mine Site*, Vale of Avoca Development Association, 28 January 1997.
- Brown, K., 'A Unique Cornish Engine House - Williams' in Avoca', *Journal of the Mining Heritage Trust of Ireland*, 2002, pp. 21-34.
- Brown, K., and Acton, B., *Exploring Cornish Mines*, Volume 1, Truro, 1994.
- Burt, R., Burnley, R., Gill, M. & Neill, A., *Mining in Cornwall and Devon: Mines and Men*, Exeter, 2014.
- Cassell, M. S. and Myron, O.S., 'Perspectives on Landscapes of Industrial Labor', *Historical Archaeology*, Vol. 39:3, 2005, pp. 1-7.
- CDM, *Feasibility Study for Management and Remediation of the Avoca Mining Site, Full Report*, 2008.
- CDM, *Feasibility Study for Management and Remediation of the Avoca Mining Site, Vol 1. Data Report*, 2008.
- CDM *Feasibility Study for Management and Remediation of the Avoca Mining Site, Vol 2. Conceptual Site Model, Human Health Risk Assessment, Ecological Risk Assessment*, 2008.
- CDM *Feasibility Study for Management and Remediation of the Avoca Mining Site, Executive Summary*, 2008.
- Chapman, M., *The Celts: the construction of a myth*, London, 1992.
- Cornwall County Council, *Nomination of the Cornwall and West Devon Mining Landscape for inclusion on the World Heritage List*, Truro, 2004.
- Cornwall Council, *Cornwall and West Devon Mining Landscape World Heritage Site Management Plan (2013-2018)*, Truro, 2013.
- Cossons, N., 'Why Preserve the Industrial Heritage?' in J. Douet (ed.), *Industrial Heritage Retooled: The TICCIH Guide to Industrial Heritage Conservation*, Lancaster, 2012, pp. 6- 23.
- Cowman, D., 'The Mining Community at Avoca 1780-1880', in K. Hannigan and W. Nolan, *Wicklow History and Society, Interdisciplinary Essays on the History of an Irish County*, Dublin, 1994, pp. 761-788.
- Coy, N., 'Mine Heritage in Ireland: Concepts and Developments - Part 1. Avoca Mines: Historical Background and Proposed Development', in J.H. Morris and M., Parkes, (eds.), *Mine Heritage and Tourism A Hidden Resource*, Mining Heritage Trust of Ireland, Dublin, 2003, pp. 27-28.
- Critchley, M., 'The Best Irish Industrial Heritage Conference in a Decade', *Newsletter of the Mining Heritage Trust of Ireland* 63, 2014.
- Critchley, M., 'Concerns Over Track Stability Works by Iarnród Éireann at East Avoca', *Newsletter of the Mining Heritage Trust of Ireland* 66, 2014.
- Critchley, M., 'Update on the Iarnród Éireann Works, East Avoca, County Wicklow', *Newsletter of the Mining Heritage Trust of Ireland* 67, 2014/15.
- Critchley, M., 'The Avoca Mines Remediation Works, County Wicklow: An Update', *Newsletter of the Mining Heritage Trust of Ireland* 68, 2015.
- Critchley M.F. and Morris, J.H., 'Conservation works at Tankardstown Mine, Bunmahon, Co. Waterford', *Journal of the Mining Heritage Trust of Ireland*, 2005, pp. 75-79.
- Critchley, M. and Schwartz, S.P., 'The Avoca Mines Remediation Works, County Wicklow: An Update', *Newsletter of the Mining Heritage Trust of Ireland* 70, 2015.
- Department of Arts, Heritage and the Gaeltacht, *National Landscape Strategy for Ireland 2015 – 2025*, Dublin, 2015.
- Department for Culture, Media and Sport - *Buildings*,

- Monuments and Sites Division (DCMS), World Heritage Sites – The Tentative List of The United Kingdom of Great Britain and Northern Ireland*, London, 1999.
- Dillon, M., 'Coalisland: The Evolution of an Industrial Landscape', *Studia Hibernica*, No. 8, 1968, pp. 79-95.
- Dowling, M., "'The Ireland that I would have": De Valera and the creation of an Irish national image', *History Ireland* 5:2, 1997, pp. 37-41.
- Dúchas, *Framework and Principles for the Protection of the Archaeological Heritage*, Dublin, 1999.
- Editorial, *Industrial Archaeological Review* 12:1, 1989.
- Environment Agency Wales, *Metal Mine Strategy for Wales*, Bristol, 2002.
- Environment Agency, *Abandoned mines and the water environment*, Bristol, 2008.
- Council of Europe, *European Landscape Convention, CETS No.176*, Florence, 2000.
- French, C., 'Cornwall's Historic Tin Streams and Mine Sites Under Threat', *Journal of the Trevithick Society* 21, 1994, pp. 61-64.
- Fay, D., and Mitchell, D.T., 'A preliminary study on the mycorrhizal associations of tree seedlings growing on old mine spoil at Avoca, Co. Wicklow', *Biology and Environment, Proceedings of the Royal Irish Academy*, Vol. 99B No. 1, 1999, pp. 19-26.
- Gallagher, V. and O'Connor, P.J., *Characterization of the Avoca Mine Site: geology, mining features, history, and soil contamination study*, GSI Technical Report MS/97/1, 1997.
- Gallagher, V. and O'Connor, C. 'Review Article - The Avoca Mine Site', *Biology and Environment, Proceedings of the Royal Irish Academy*, Vol. 99B No. 1, 1999, pp. 43-57.
- Gaynor, A., and Gray, N.F., 'Trends in sediment metal concentrations in the River Avoca, South-east Ireland', *Environmental Geochemistry and Health* 26, 2004, pp. 411-419.
- Good, J.A., 'Recolonisation by Staphylinidae (Coleoptera) of Old Metalliferous Tailings and Mine Soils in Ireland', *Biology and Environment, Proceedings of the Royal Irish Academy*, Vol. 99B No. 1, 1999, pp. 27-35.
- Gray, N.F., 'Acid mine drainage composition and the implications for its impact on lotic systems', *Water Research* 32(7), 1998, pp. 2122-2134.
- Gray, N.F., and Delaney, E., 'Measuring community response of benthic macroinvertebrates in an erosional river impacted by acid mine drainage by use of a simple model', *Ecological Indicators* 10, 2010, pp. 668-675.
- Hamond, F., and McMahan, M., *Recording and Conserving Ireland's Industrial Heritage*, the Heritage Council, Dublin, 2002.
- Harner, J., 'Place Identity and Copper Mining in Sonora, Mexico', *Annals of the Association of American Geographers*, Vol. 91, No. 4, 2001, pp. 660-680.
- Holyoak, D.T., and Lockhart, N., 'Notes on some rare and newly recorded bryophytes of metalliferous mine sites in Ireland', *Journal of Bryology* 31, 2009, pp. 267-282.
- Holyoak, D.T., and Lockhart, N., 'A Survey of Bryophytes and Metallophyte Vegetation of Metalliferous Mine Spoil in Ireland', *Journal of the Mining Heritage Trust of Ireland* 11, 2011, pp. 3-16.
- Hudson, P., *The Industrial Revolution*, London 1992.
- Inglis, H.D., *Ireland in 1834. A journey throughout Ireland, during the spring, summer, and autumn of 1834*, Vol. 1, London, 1835.
- Isle of Anglesey County Council, *Ynys Môn The Isle of Anglesey Landscape Character Area Update*, 2011. Vol. 1, London, 1835.
- Jenkins, D. A., Johnson, A. H. and Freeman, C., 'The Cu-Pb-Zn mines on Mynydd Parys: mineralogy, microbiology and acid mine drainage', in: J. D. Cotter Howells, L. S. Campbell, E. Valsami Jones and M. Batchelder (eds.), *Environmental Mineralogy: Microbial Interactions, Anthropogenic Influences, Contaminated Land and Waste Management*, Mineralogical Society of Great Britain and Ireland, London, 2000, pp. 161-179.
- John Brown and Company Consultants, *Torfaen Tourism Development Strategy*, Blaenavon, 1993.
- Johnson, N., Payton, P., and Spalding, A., (eds.), *The Conservation Value of Metalliferous Mine Sites in Cornwall*, Truro, 1996.
- Johnson, D.B., 'Geomicrobiology of extremely acidic subsurface environments', *FEMS Microbiology Ecology*, Volume 81, Issue 1, 2012, pp. 2-12.
- Jones, R.M., 'Beyond Identity? The Reconstruction of the Welsh', *Journal of British Studies*, Vol. 31, No. 4, Britishness and Europeanness: Who Are the British Anyway? 1992, pp. 330-357.
- Kearns, K.C., 'Ireland's Mining Boom: Development and Impact', *American Journal of Economics and Sociology*, Vol. 35, No. 3, 1976, pp. 251-270.
- Laws, P., *Cornish Engines and Engine Houses in the Care of the National Trust*, London 2nd ed., 1978.
- Leen, C., 'Mining the Landscape', *Irish Arts Review* 26:4, 2009, pp. 60-61.
- Lockhart, N., Hodgetts, N. and Holyoak, D.T., *Rare and threatened bryophytes of Ireland*, Holywood, 2012.
- Mayes, W.M., Johnston, D., Potter, H.A.B., & Jarvis, A.P., 'A national strategy for identification, prioritisation and management of pollution from abandoned non-coal mine sites in England and Wales. I. Methodology development and initial results', *Science of the Total Environment*, 407(21), 2009, pp. 5435-5447.
- Meehan, R., Parkes, M., Gallagher, V., Hennessy, R. and Gatley, S., *The Geological Heritage of Wicklow: An audit of County Geological Sites in Wicklow*, 2014.
- Mehegan, A., 'The Cultural Analysis of Leisure: Tourism and Travels in Co. Donegal', *Circa Art Magazine* 107, Spring 2004, pp. 58-62.
- Merrigan, M., 'Mine Heritage in Ireland: Concepts and Developments - the Avoca Copper Mine - A Future from our Past', in J.H. Morris and M., Parkes, (eds.), *Mine Heritage and Tourism A Hidden Resource*, Mining Heritage Trust of Ireland, Dublin, 2003, pp. 29-30.
- Morgan R. and Jones, I.W., *One Wales: A Progressive Agenda for the Government of Wales*, Welsh

- Assembly Government, Cardiff, 2007.
- Morris, B., 'The Lisheen Mine, Co. Tipperary: Planning a World Class Closure', *Journal of the Mining Heritage Trust of Ireland* 15, 2015, pp. 93-103.
- Morris, J., *Wales: Epic Views of a Small Country*, London, 1998.
- Morris, J.H., 'The Man Engine House, Allihies, County Cork: A pictorial record of conservation works completed in November 2002', *Journal of the Mining Heritage Trust of Ireland* 2, 2002, pp. 35-39.
- Morris, J.H., 'The Man Engine House, Allihies, County Cork: A pictorial record of conservation works in 2003', *Journal of the Mining Heritage Trust of Ireland* 3, 2003, pp. 33-40.
- Morris, J.H., 'Conservation of the 19th Century mine heritage buildings at Silvermines, Co. Tipperary', *Journal of the Mining Heritage Trust of Ireland* 11, 2011, pp. 81-112.
- Mitchell D., *The lie of the land: Migrant workers and the California landscape*, Minneapolis, 1996.
- Moles, N.R., Kelly, M., and Smyth, D., 'Environmental legacy of C19th lead mining and mineral processing at the Newtownards Lead Mines', *Journal of the Mining Heritage Trust of Ireland* 15, 2015, pp. 41-53.
- National Assembly for Wales, *Communities First Directorate: Communities First guidance*, Cardiff 2001.
- National Museum Wales (Amgueddfa Cymru), *Operational Plan 2009/10*, Cardiff, 2009.
- O'Callaghan, J., *Teaching Irish Independence: History in Irish Schools, 1922-72*, Newcastle upon Tyne, 2009.
- Orange, H., 'Cornish Mining Landscapes: Public Perceptions of Industrial Archaeology in a Post-Industrial Society', unpublished PhD thesis, University College London, 2012.
- Palmer, M., 'Archeology or Heritage Management: The Conflict of Objectives in the Training of Industrial Archeologists', *The Journal of the Society for Industrial Archeology*, Vol. 26, No. 2, 2000, pp. 49-54.
- Parkes, M. A., 'The Aesthetics of Restoring Old Workings', *Biology and Environment, Proceedings of the Royal Irish Academy*, Vol. 99B No. 1, 1999 pp. 75-76.
- Payton, P., 'Derelict land and cultural identity - the case of Cornwall', in N. Johnson *et al.*, *The Conservation Value of Metalliferous Mine Sites in Cornwall*, Truro, 1996, pp. 9-14.
- Pollard, S., *Peaceful Conquest: The Industrialisation of Europe, 1760-1970*, Oxford, 1981.
- Pritchard, S.R., 'Ethnic Tourism and Nationalism in Wales', *Annals of Tourism Research*, 22:1, 1995, pp. 35-52.
- Purvis, O.W., 'The botanical interest of mine spoil heaps - the lichen story', *Journal of the Russell Society* 3, 1993, pp. 45-48.
- Quivik, F.L., 'The Historical Significance of Tailings and Slag: Industrial Waste as Cultural Resource', *The Journal of the Society for Industrial Archeology*, 33:2, 2007, pp. 35-52.
- Richards, E., 'The Margins of the Industrial Revolution', in P. O'Brien and R. Quinault (eds.), *The Industrial Revolution and British Society*, Cambridge, 1993.
- Rodman, M. C., 'Empowering Place: Multilocality and Multivocality', *American Anthropologist, New Series*, 94:3, pp. 1992, 640-656.
- Rowlands, J., *Copper Mountain*, Anglesey, 1966.
- Rynne, C., *Industrial Ireland 1750-1930: An Archaeology*, Cork, 2006.
- Rynne, C., 'Record of Monuments and Places', *Newsletter of the Industrial Heritage Association of Ireland*, 2011, pp. 6-7.
- Schein, R. H., 'The place of landscape: A conceptual framework for an American scene', *Annals of the Association of American Geographers* 87:4, 1997, pp. 660-80.
- Schwartz, S.P., *Voices of the Cornish Mining Landscape*, Truro, 2008.
- Schwartz, S.P., and Critchley, M.F., 'The Lead Ore Dressing Floors at Glendalough and Glendasan, County Wicklow 1825-1923: A History, Survey and Interpretation of Extant Remains', *Journal of the Mining Heritage Trust of Ireland* 12, 2012, pp. 5-52.
- Schwartz, S.P. and Critchley, M.F. 'A history of the silver-lead mines of County Down, Northern Ireland', *Journal of the Mining Heritage Trust of Ireland* 13, 2013, 23-95.
- Schwartz S.P., and Lorenc, M.W., 'From Mining the Landscape to Mining Wallets: Mining Heritage Tourism in Four European Regions', T. Słomka (ed.), *Geotourism: A Variety of Aspects*, Kraków, 2011, pp. 261-296.
- Sharpe, A., *The conservation of historic mine buildings in Cornwall: practical guidelines to assist conservation of similar buildings internationally*, Truro, 2005.
- SKM Enviro, *Contaminated Land Remedial Works at Henwaith Settlement Ponds, Parys Mountain, Amhwch, Anglesey: Verification Report*, 2011.
- Smreczak, B., 'Destination Blaenavon': *Blaenavon Industrial Landscape Marketing Strategy*, Blaenavon World Heritage Site, Blaenavon, 2003.
- Smyth, W.W., *Records of the School of Mines and of the Science Applied to the Arts, Vol. 1 Part III On The Mines of Wicklow and Wexford*, London, 1853.
- Spalding, A., 'The importance of metalliferous mining sites in Cornwall for wildlife', *Cornish Studies* 3, 1995, pp. 161-175.
- Spalding, A., and Haes, E.C.M., 'Contaminated land - a Resource for Wildlife: A Review and Survey of Insects on Metalliferous Mine Sites in Cornwall', *Land Contamination and Reclamation* 2, 1995, pp. 24-29.
- Spalding, A., Edwards, T., Sinkins, B., Purvis, O.W., and Stewart, J., 'Nature conservation value of metalliferous mining sites', in N. Johnson *et al.*, *The Conservation Value of Metalliferous Mine Sites in Cornwall*, Truro, 1996, pp. 31-39.
- Stanley, G., Gallagher, V., Ni Mhairtín, F., Brogan, J., Lally, P., Doyle, E., and Farrell, L., *Historic Mine Sites – Inventory and Risk Classification Volume 1, A joint study carried out by The Environmental Protection Agency and The Geological Survey of Ireland*,

- Geological Survey of Ireland, Environmental Protection Agency Exploration and Mining Division, Dublin, 2009.
- Stewart, A., *Coalisland, County Tyrone, in the Industrial Revolution, 1800-1901*, Maynooth studies in local history, no. 43, Dublin, 2002.
- Steward, J.C., 'The Irishness of Irish Painting,' in J. C. Steward (ed.), *When Time Began to Rant and Rage: Figurative Painting from Twentieth-Century Ireland*, 1998.
- Tanner, M., *The Last of the Celts*, New York, 2004.
- Thompson, E.P., *The Making of the English Working Class*, London, 1980 (reprint).
- Unipure Europe Ltd., *Avoca Pilot Plant Project. Mine Water Pilot Plant Trials*, Prepared for the Eastern Regional Fisheries Board, 2006.
- Unipure Europe Ltd., *Avoca Mines Pilot Plant Treatment Trials: A Report to Celtic Copper Heritage*, Monmouth, 2007.
- Walker D., 'Local World Heritage: Relocating Expertise in World Heritage Management' in Schofield, J. (ed.), *Who Needs Experts? Counter-mapping Cultural Heritage*, Farnham, 2014, pp. 181-202.
- Walsh, F., 'Base Metal Mining in the Irish Republic', *Geography*, Vol. 63, No. 2 1978, pp. 114-117.
- Westland, E. (ed.), *Cornwall: The Cultural Construction of Place*, Penzance, 1997.
- Wicklow County Council, *Draft Wicklow County Development Plan (2016-2022)*, Wicklow, 2016.
- Wicklow Heritage Forum, *County Wicklow Heritage Plan 2009-14*, Wicklow, 2009.
- Yamin, R., and Metheny, K.B., (eds.), *Landscape Archaeology: Reading and Interpreting the American Historical Landscape*, Knoxville, 1996.
- Yau, H., and Gray, N. F., 'Riverine Sediment Metal Concentrations of the Avoca-Avonmore Catchment, South-East Ireland: A Baseline Assessment', *Biology and Environment: Proceedings of the Royal Irish Academy*, Vol. 105B, No. 2, 2005, pp. 95-106.
- Newspapers**
- BP *Bray People*, 24 August 2006.
- DP *Daily Post*, 7 November 2007.
- IT *Irish Times*, 5 February 2000; 5 February 2004; 24 November 2013.
- TST *The Sunday Times*, 19 September 2010.
- WMS *Welsh Mines Society*, newsletter 42, April 2002.
- WNL *Wicklow News-Letter*, 18 May 1872.
- WP *Wicklow People*, 1 February 2007.
- WT *Wicklow Times*, 3 December 2013.
- Internet Sources**
- Anglesey Heritage, <http://www.angleseyheritage.com/voices/bryan-hope/2012/10/strangely-beautiful-but-dangerous/> Accessed 14 January 2016.
- Anglesey Today, <http://www.anglesey-today.com/copper-mountain.html> Accessed 14 January 2016.
- ArtSlant London 2010 Lawlor Exhibition <http://www.artslant.com/lon/events/show/84940-cu> Accessed 26 December 2013.
- Assessing the Impacts of metal mines in Wales. Available from: https://www.researchgate.net/publication/228937405_Assessing_the_Impacts_of_metal_mines_in_Wales Accessed 30 December 2013.
- BBC Website, Eason, M., 'The unbearable sadness of the Welsh valleys' 25 June 2013 <http://www.bbc.com/news/magazine-23028078> Accessed 3 November 2015.
- Cadw newsletter 'Symbolic Celebratory Firing', 1 March 2013. <http://cadw.gov.wales/about/news/archive/symbolic-celebratory-firing/?lang=en> Accessed 30 December 2015.
- CDM Smith website 'Uniting to Clean a Tarnished Legacy: reversing copper mining contamination in Avoca, Ireland', <http://cdmsmith.com/en/Solutions/Environment/Uniting-to-Clean-a-Tarnished-Legacy.aspx>. Accessed 30 December 2013.
- Copper Kingdom Centre <http://www.copperkingdom.co.uk/centre.html> Accessed 24 November 2015.
- Copper Kingdom Environment <http://www.copperkingdom.co.uk/environment.html> Accessed 24 November 2015.
- Cornwall Council News <http://www.cornwall.gov.uk/default.aspx?page=35665> Accessed 30 December 2013.
- Coy, N., 'Comments on the meeting held on April 8th at the Woodenbridge Hotel', Letter to the Geological Survey of Ireland, 25 April 2008 <https://www.gsi.ie/NR/rdonlyres/5D462677-1F22-45C5-9954-AFCBF991D0B6/0/SubmissionNickCoy.pdf> Accessed 12 November 2015.
- DAHG, Department of the Arts, Heritage and the Gaeltacht, 'Historic Environment Viewer - Help Document', <http://webgis.archaeology.ie/historicenvironment/help.html> Accessed 13 November 2015.
- Doyle, A., Mahon, J., and Harrington, D., 'Integrated feasibility study for Avoca', letter to Eibhlin Doyle, Geological Survey of Ireland, 20 April 2008, <https://www.gsi.ie/NR/rdonlyres/2DD0B68F-854F-496B-BA58-CB004420E60C/0/SubmissionCelticCopperHeritage.pdf> Accessed 12 November 2015.
- Environment Agency, Prioritisation of abandoned non-coal mine impacts on the environment: the national picture, <http://publications.environment-agency.gov.uk/PDF/SCHO1111BUBX-E-E.pdf> Bristol, 2012.
- Farrell, L., 'Rehabilitation at Silvermines', undated EMD press release, <http://www.mineralsireland.ie/NR/rdonlyres/06497A37-028E-49E9-A094-9DED962D286C/0/Rehabilitationatsilvermines.pdf> Accessed 8 January 2015.
- Forgotten Landscapes, 'Thoughts From Blaenavon World Heritage Site Volunteers', 21 June 2013, <http://forgottenlandscapes.org.uk/> accessed 14 January 2016.
- Grosvenor Construction <http://www.grosvenorconstruction.co.uk/2012/06/22/to-infinity-and-beyond/> accessed 14 January 2016.
- Harris Blog, <http://www.simonharris.ie/#!/Harris-visits-Avoca-Mines/c1ck3/55816e740cf2c5a6c8f949bb> Accessed 15 January 2016.
- HLF Heritage Lottery Fund, 'Copper Kingdom Project

strikes gold', 24 March 2011, <https://www.hlf.org.uk/about-us/media-centre/press-releases/copper-kingdom-project-strikes-gold> Accessed 30 December 2015

HLF Heritage Lottery Fund, 'Copper Kingdom - A major new tourist attraction for Anglesey', 5 July 2012, <https://www.hlf.org.uk/about-us/media-centre/press-releases/copper-kingdom-major-new-tourist-attraction-anglesey>, Accessed 30 December 2015.

Irish Archaeology, 'Proposal to de-list archaeological and historical sites that post-date 1700', <http://irisharchaeology.ie/2011/09/proposal-to-de-list-archaeological-and-historical-sites-that-post-date-1700/> Accessed 6 August 2015.

Isle of Anglesey County Council, 'Anglesey celebrates global Geopark status', <http://www.anglesey.gov.uk/anglesey-celebrates-global-geopark-status/111200>. article accessed 30 December 2013.

Martinez, C., 'The Social Identity of Wales in Question: An Analysis of Culture, Language, and Identity in Cardiff, Bangor, and Aberystwyth', Fulbright Grantee Projects. Article. Submission 4, 2012. <http://digitalcommons.linfield.edu/fulbright/4> Accessed 30 December 2015.

Porter, S., Letter to the Geological Survey of Ireland, 30 April 2008, <https://www.gsi.ie/NR/ronlyres/CB086059-2524-447A-89BC-52C1157156E3/0/SubmissionSPCDevelopments.pdf> Accessed 12 November 2015.

RCAHMW, Royal Commission on the Ancient and Historical Mounuments of Wales, Learning History, <http://www.rcahmw.gov.uk/HI/ENG/Learning/History+Primary/Parys+Mountain/> accessed 13 March 2016.

Wales Online, 'First fracking, now open-cast mining - is Wales on its way to becoming the world's first fossil fuel free country?', 2 April 2015, <http://www.walesonline.co.uk/news/wales-news/first-fracking-now-open-cast-mining-8973640> accessed 24 November 2015.

Water Technology Research Group, <http://www.irelandswater.com/wtrg.html> Accessed 12 November 2015.

Wicklow County Council Planning Application No. 15/473, 'Engineering and Public Health & Safety works on a site at East Avoca Mines', 22 May 2015, <http://www.wicklow.ie/online-enquiries> Appendix B: Environmental Report Accessed 18 February 2016.

Younger, P., and Potter, H.A.B., 'Parys in Springtime: Hazard Management and Steps Towards Remediation of the UK's Most Polluted Acidic Mine Discharge', In: 9th International Conference on Acid Rock Drainage (ICARD), 20th-26th May 2012, Ottawa, Canada. Enlighten – Research publications by members of the University of Glasgow <http://eprints.gla.ac.uk>, 2012. Accessed 30 December 2015.

Personal Communications

Oliver Burrows email, 15 January 2016

Nick Coy email, 18 February 2016.

David Jenkins email, 12 February 2016