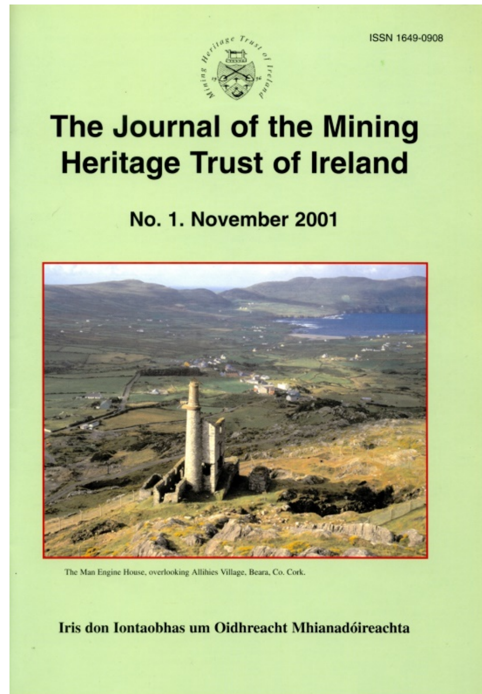


Morris, J. H, Bown, K. (2001) 'The Man Engine House, Mountain Mine, Aillihies, Co. Cork' *Journal of the Mining Heritage Trust of Ireland*, **1,** pp. 39-48

THE MAN ENGINE HOUSE, MOUNTAIN MINE, ALLIHIES, CO. CORK

John H. Morris and Kenneth Brown

John Morris, Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4. Email: johnmorris@gsi.ie
Kenneth Brown, 15 Coombe Park, Camborne, Cornwall, TR14 0JG, UK.

Abstract: The ruinous remains of Cornish Engine Houses constructed during the 19th and early 20th Centuries remain, even now, in the 21st Century, a visible and potent reminder of not only a remarkable technological achievement, but also a reminder of a truly international technological diaspora - and, now, a shared heritage. It is estimated that about 2,000 such installations were constructed in total in Cornwall-Devon, and a further 1,000 in other parts of the world, in places as far apart as Ireland, Spain and South Australia. The vast majority of these installations were applied to pumping, winding or ore crushing. In contrast, only 21 of the global total were designed as, or adapted as Cornish design Man Engine Houses, of which the Man Engine House described here is the only one ever constructed in Ireland, in 1862. It is now the most intact, and sole surviving example of a purpose built, Cornish design Man Engine House anywhere in the world. In this paper, we briefly review the history of man engine technology, before considering what is known of the history of the Mountain Mine Man Engine installation, reputedly constructed by Michael Loam, the Cornish designer of such engines. We then present an interpretation of the Engine House and its mechanical configuration, based upon a new survey undertaken in 2000. Finally, we consider the international and national heritage value of this building, not only as a local and national mine heritage icon, but also its importance as an unique component of international Cornish mine heritage. *Journal of the Mining Heritage Trust of Ireland*, 1, 2001, 39-48.

INTRODUCTION

This report, initially prepared in connection with a conservation consultancy, reviews the development of Man Engine technology, and, within that framework, summarises the history, and heritage value of the Man Engine House, Mountain Mine, Allihies, Co. Cork (Fig. 1).

MAN ENGINE TECHNOLOGY

By the early 1800s, mining technology had advanced sufficiently to permit mining to considerable depths, to 1,600 feet or more. This primarily reflected the invention of reasonably efficient water or steam driven pumps, as de-watering mines was the primary constraint upon mining at depth. Such pumps were operated by the reciprocal motion, typically in the range 6 – 10 feet, of a string of square wooden rods, which extended down the length of the shaft. The pumps were set at intervals of a few hundred feet, progressively raising water up the shaft via intermediate holding tanks.

In 1833, a miner in charge of the pumps at the Spielgelthal Mine in the Harz Mountains, invented the first man engine by

Figure 1. The Man Engine House, Mountain Mine, Allihies, Co. Cork.

adapting the reciprocal motion of the pump rods to create a mechanism to lift himself up and down the *c*. 200m deep shaft (Barton 1965, Krassmann 2000). His idea was elegantly simple. The pumps in that mine were operated by two reciprocating strings of pump rods, which acted in opposite directions, one reaching the top of its upward motion at the same time as the other reached the bottom of its stroke. At this point, the miner attached nails to both rods, along the length of both strings, such that he was able to step onto a nail, be lifted the stroke length, then, during the pause when both strings of rods were momentarily stationary, step across onto the nail on the other rod, be lifted the next stroke length, and so on. The idea spread rapidly to other parts of Germany, and, in time, to France, Belgium and Norway. Two Man Engines are still operational, both operated by wire ropes, rather than wooden rods: in the Samson Shaft, St. Andreasberg, Germany (installed in 1837 and retained for shaft maintenance purposes); and in the Kongsberg Mine, Norway (Krassmann, 2000).

Figure 2. The Man Engine, 234(1,404 feet) fathom level, Dolcoath Mine,Camborne, Cornwall. Photo by J.C.Burrows, 1893. Reproduced by permission of the Royal Cornwall Museum.

THE CORNISH MAN ENGINE

At about the same time, in 1834, a prize was offered at the first meeting of the Royal Cornwall Polytechnic Society for the development of a system to lift miners up and down from the ever increasing depths being reached in the Cornish tin and copper mines (Barton 1965, Tew, 1981). Their motive was primarily humanitarian. It would normally take miners up to an hour to descend to the working levels, there to spend a full 8 hour working shift in hot and poorly ventilated conditions, then to be followed by a *c*. 1 to 2 hour climb up steeply inclined ladder ways to the surface. Not surprisingly, there were instances of loss of life through miners falling off the ladders due to exhaustion. The man engine at least promised some degree of relief from this extremely arduous life style. Subsequently, an engineer, Michael Loam, proposed a design for installation at the Consolidated Mines in 1839, although this was not commissioned due to lease problems, and it was not until 1842 that the first trial installation was made at the Tresavean mine (Barton 1965, Tew 1981). This water wheel driven man engine operated to a depth of only 156 feet, but a permanent, steam driven installation was commissioned in October 1842, operating initially to a depth of 840 feet, and subsequently to 1,740 feet by June 1843 (Tew, 1981).

Despite the success of this installation, it was not until 1845 that the second installation was made, at the United Mines, followed by a third installation at Fowey Consols in 1851. The first two installations were of the double rod type, following the German pattern. However, the installation at Fowey Consols, and all subsequently, were of the single rod type. In this design, the single rod oscillates at about 4 strokes per minute between wooden platforms installed in the shaft at the distance of the stroke length, generally 12 feet.

A miner would step from the platform onto the rod, be lifted the distance to the next platform, where he would step off and wait for the down-stroke to bring the step above, down to the level of the platform. He would then step on again, and repeat the process (see Figs 2 and 3). In the Dolcoath Mine (Fig. 2), the platforms were placed on both sides of the rod, one to serve miners ascending, the other those descending (Barton 1965). This use pattern is evident in Figure 2, even as late as 1893, as miners may be seen standing on opposite sides of the rod on successive platforms.

The single rod system was considered safer than the double rod type, though fatalities did occur on all Cornish Man Engines, particularly in the years 1865 – 6. In the years 1865 – 1885, these averaged 2 per year (Barton 1965), and generally resulted from miners missing a step. String rods occasionally broke, twice at Dolcoath and three times at Levant, but in all but one instance, these resulted in only minor injuries. The sole exception was at Levant when, in October 1919, the rod string and safety

Figure 3. The Man Engine, 186 fathom (1,116 feet) level, Cook's Kitchen Shaft, Illogan,Cornwall. Photo by J.C.Burrows, 1893. Reproduced by permission of the Royal Cornwall Museum.

catches broke, resulting in the death of 31 miners, and 11 serious injuries. This was, at the time, the last operating Man Engine in Cornwall, and it was abandoned after the accident. In all, only 16 man engines were ever installed in Cornish Mines, the last at South Caradon, in 1872, and at two in mines in Devon (Devon Great Consols). It should, however, be noted that man engines were moved from one shaft to another, such that man engines operated at more than 16 individual shaft sites. The installations are summarized in Table 1 below.

Three other Cornish design Man Engines were constructed in other countries: in the Isle of Man, South Australia and Ireland. One, driven by an in-shaft reciprocating hydraulic engine, was installed in 1882 at the Great Laxey Mine in the Isle of Man. This engine continued in operation until the mine closed in 1930, and it is now (1999) under active conservation by the Laxey Mines Research Group. Another Man Engine was constructed in the Hughes Shaft at the Wallaroo Mine, South Australia, probably the last such installation of its type anywhere in the world. Here a 48 inch diameter Bull Engine had been installed in 1867 as a pumping engine, and continued to function as such until 1876 when it was superceded by a 60 inch pumping engine at another shaft (Drew and Connell 1993). By that time the Hughes Shaft was 840 feet deep, and it was consequently decided in 1876 to convert the Hughes engine installation into a Man Engine. However, this only operated for 4 years, when it was replaced by wire rope hauled man skips, introduced in 1880. The third and final Cornish design Man Engine installation was at the Mountain Mine, Allihies, Co. Cork, which is considered in greater detail below.

The man skip system for hauling miners up and down shafts was also introduced into Cornwall from about the 1870s onward, and grew in popularity very quickly, primarily because it was safer, and could carry up to four times as many miners in a given time (Barton 1965). This new innovation effectively brought to a close the era of the Man Engine. Even in their heyday, they were a very rare technological development. Barton (1965) estimates that by 1865, about 30 man engines were operating in Europe, mainly in Germany and Belgium, at collieries as well as metal mines, with others noted in Michigan and South Australia (Wallaroo Mine, noted above). Krassmann (2000) provides a summary listing of all known and inferred Man Engines, of all origins, throughout the world, a global total of 115: 60 in Germany; 1 in Poland; 3 in the Czech Republic; 19 in Belgium; 4 in France; 1 in Norway; 20 in the UK and the Isle of Man; 1 in Ireland; 6 in the copper mines of the Keeweenaw Peninsula, Michigan, USA; and 1 in Australia.

HISTORY OF THE MAN ENGINE HOUSE, MOUNTAIN MINE, ALLIHIES

There is, unfortunately, very little known about the history of the Mountain Mine Man Engine, the only one of its type ever constructed anywhere in Ireland. Williams (1993), summarises, in his history of the Berehaven Mines, the, so far, only known documentary information concerning this Man Engine, while contemporary sketches, reproduced in Figures 4 and 5, provide additional information.

The engine was apparently erected in 1862, reputedly by Michael Loam, the designer of Cornish Man Engines, who was known to the local miners as "Loam of ease" – an undoubted reference to the improvement in their working life afforded by the Man Engine. The engine continued in operation up to 1882, when the mine was abandoned. During its 20 years of opera-

Mine	Installation Date	Depth (max.)	Power	Designer
Tresavean	1842	1,740’	S, 36” engine	Loam
United Mines	1845	1,260’	S, 32” engine	Hocking & Loam
Fowey Consols	1851	1,680’	WW, 30 feet diameter	West
Dolcoath	1854	1,488’	S, 19” engine; 1876, S	Hocking
Great Wheal Vor	1857	1,020’	1857 S 32”; 1868 30” engine	
Levant	1857	1,596’	1857: S, 20” engine; 1874, 24” engine; 1893, horizontal compound engine	Hocking
Cook’s Kitchen	1860; 1871	1,620’	1860 WW; 1871 S, 26” horizontal engine	
Carn Brea	1861	1,020’	S, 26” engine	
Par Consols	1861	1,320’	S, 24” engine	
Wheal Reeth	1861		S, 30” engine	Eustice
Tincroft	1863	1,020’	S, 26” engine	
Wheal Josiah	1865	660’	WW	
Wheal Emma	1865	1,080’	WW	
Wheal Mary Ann	1869		S, 22” horizontal engine	West
Providence	1869	840’	S, 20” engine	Eustice
Crenver & Wheal Abraham	1872	1,200’	S, 30” engine	Hocking
South Caradon	1872	840’	S, 24” engine; 1882 S, 23” horizontal engine	West

Table 1. Summary of Man Engine installations in Cornwall and Devon. Data from Barton (1965), Tew (1981) and Kenneth Brown, unpublished. Two engines were installed at Great Wheal Vor, before and after mine closure between 1860 and 1868. Two man engines were installed at Devon Great Consols, recorded above under their separate names, Wheal Josiah and Wheal Emma. NB: all measurements are given in inches (”) and feet (’), in accord with the historic measurement system. Depths have been converted from fathoms to feet (1 fathom = 6 feet). WW = water wheel; S = steam

tion, Williams (1993) notes only one fatality related to the use of the engine, and one injury, both related to a single event in October 1865. Indeed, it was noted that up to that time, loss of life at the mine was very rare.

The contemporary sketches (Figs. 4, 5) both occur on a mine plan, dated 1869, held in the Mine Records archive of the Geological Survey of Ireland. Although neither sketch was drawn to scale, they nonetheless provide us with an extremely valuable, contemporary source of information about the appearance and configuration of the Man Engine and associated structures. Many design features, such as the Engine House, Boiler House and Chimney are fairly typical of Cornish Engine Houses. However, it is the configuration of the masonry mountings and mechanical features to the front and side of the engine house which are of most interest.

These clearly show that the Man Engine was constructed and operated as a dual function engine: as a winding engine, operated by winding drums mounted on the north side of the Engine House (Fig. 5); and as a Man Engine, operated by a rocker beam system, also on the north side of the Engine House (Figs. 4, 5). Both sketches clearly indicate that the Man Engine was of the single rod type, with platforms set at 12 foot intervals, equivalent to the in-shaft stroke of the man engine rod string (Williams 1993). Miners were hauled up to, and down from the “Adit” level in the inclined Man Engine shaft (Fig. 5). The engine operated initially to a depth of 768 feet (128 fathoms), and later perhaps to the full 1,494 feet (249 fathom) depth of the inclined shaft.

In normal operation, the engine would run in man-engine mode during shift changes, and, after a gear change, would operate as a hoist at other times, obviating the need for the engine to stand idle for long periods between shift changes.

The winding mechanism consisted of a set of drums, supported on one side by a machinery plinth to the front of the engine house, and by a column on the other side. These masonry constructed mountings are clearly visible in Figure 5, and also in

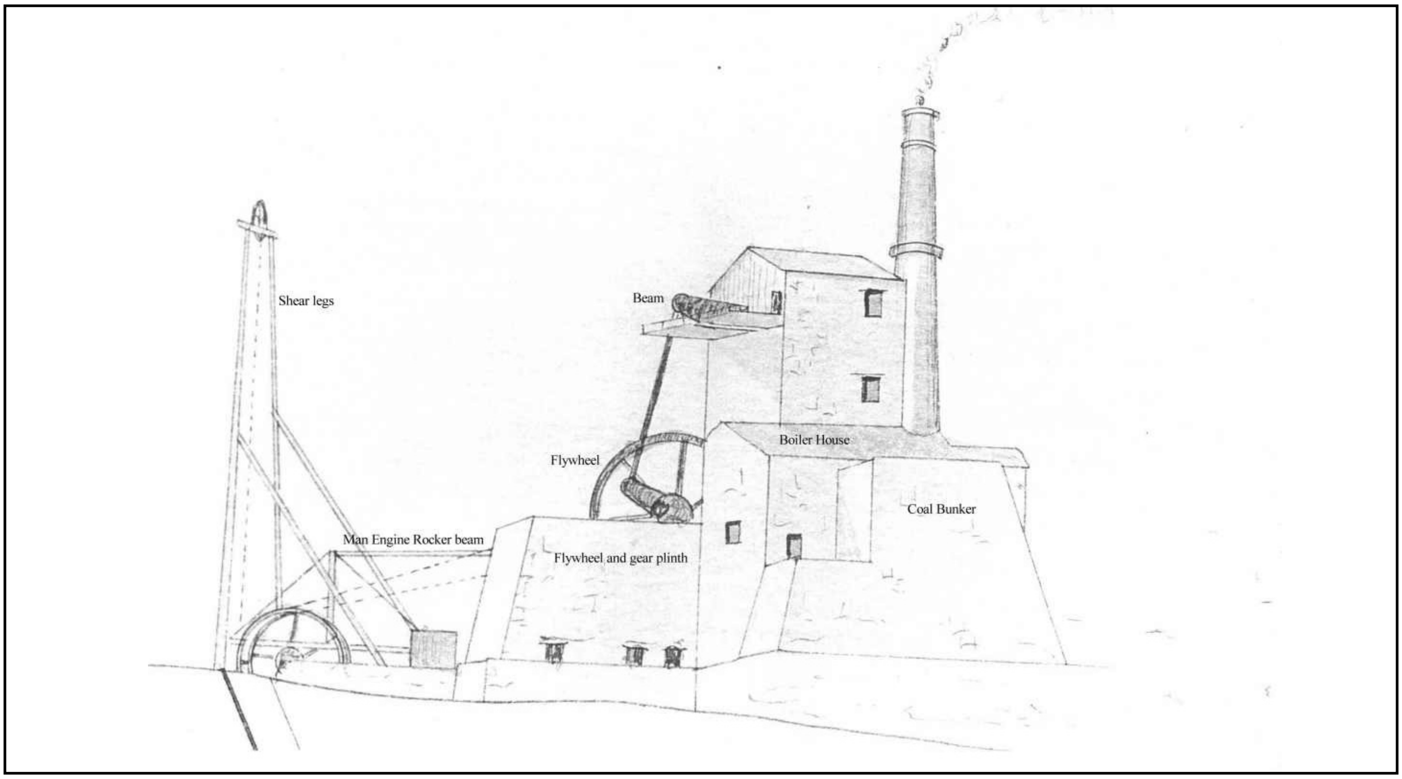


Figure 4. The Man Engine House, Mountain Mine. Reproduced from a sketch on a mine plan, dated 1869, held in the Mine Records archive of the Geological Survey of Ireland. View from the South.

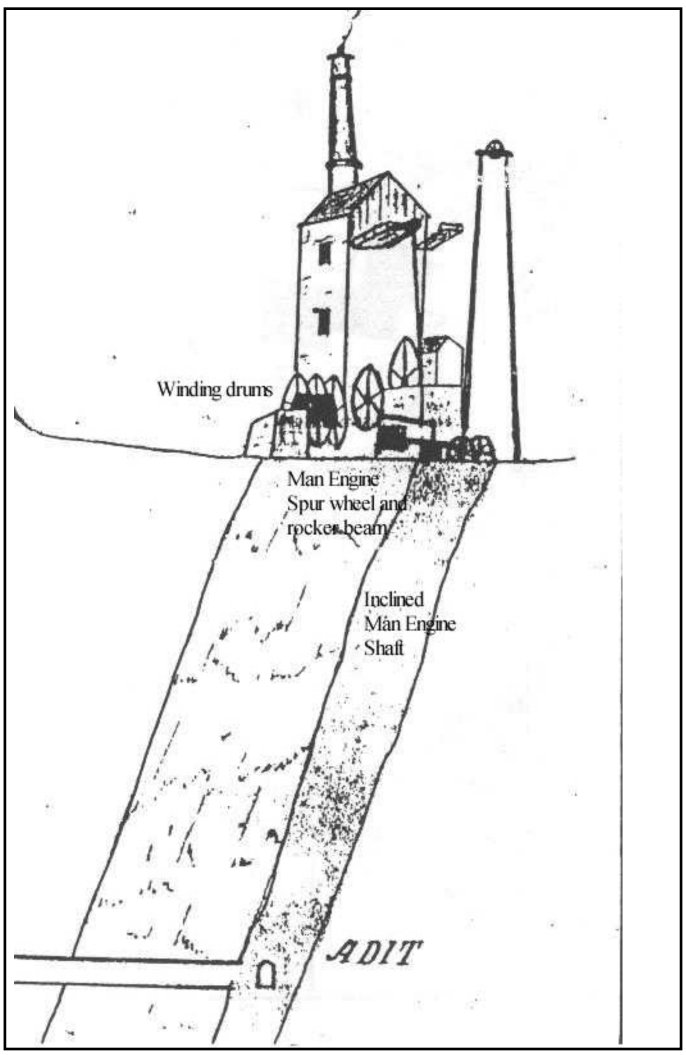


Figure 1, a view of the Man Engine House as it is today. A pair of sheave wheels are visible in Figure 5 just at the edge of the inclined shaft, and these are again shown in Figure 4, here with dashed lines angling back from the sheave wheels towards the drums. These lines represent a pair of winding cables, most probably made of wrought iron wire rope [first introduced in Cornwall in 1857]. The configuration clearly indicates a double action hoisting mechanism, in which one hoist container was wound up the shaft at the same time as the other descended the shaft. This counterbalance system may be deduced from the configuration of the cables in Figure 4: one cable is oriented in such a way that it was wound over the top of one drum, the other from the underside of the other drum. Thus, when the drums were set in motion, one cable would wind onto the drum, while the other would unwind.

Both sketches also provide valuable evidence about the configuration of the Man Engine mechanism. The drive for this is provided by a "flat rod" pinned to a spur gearwheel mounted on the side of the machinery plinth (Fig. 5), this, in turn, driven by a smaller gear pinion on the flywheel axle through a clutch mechanism. At the shaft end, the flat rod is pinned to the top of a triangular shaped "rocker beam", the configuration designed to transform the circular motion of the pin on the spur wheel into an up and down vertical motion at the end of the rocker

Figure 5. The Man Engine House, Mountain Mine. Reproduced from a sketch on a mine plan, dated 1869, held in the Mine Records archive of the Geological Survey of Ireland. View from the NW, showing winding drums, and man Engine rocker beam. Compare with extant remains visible in Fig. 1.

beam (Figs. 4, 5). Wooden rods of the type shown in Figures 2 and 3, would have been attached to the shaft end of the rocker beam, while a counterbalance weight would have been attached to the other end. The counterbalance is clearly visible in Figure 4, represented by a large square, although the wooden rods have not been depicted. The ratio of the vertical to horizontal proportions of the rocker beam would determine the in-shaft stroke length of the Man Engine rods, presumed to be the standard 12 feet.

This configuration is similar to that employed on most installations in Cornwall. An arrangement strikingly similar to Allihies may be seen at the South Tincroft, where the engine also drove a hoist. In double rod installations, such as Tresavean, the drive to the Man Engine rods was effected through rack and pinion gear wheels, connected directly to the in-shaft Man Engine rods. At the Wheal Reeth Man Engine, the rods were connected, most unusually, directly to the end of the engine beam, while in the case of the Bull engines used at the Great Wheal Vor, and also at the Wallaroo Mine, S. Australia, the rods were connected directly to the end of the steam engine piston rod.

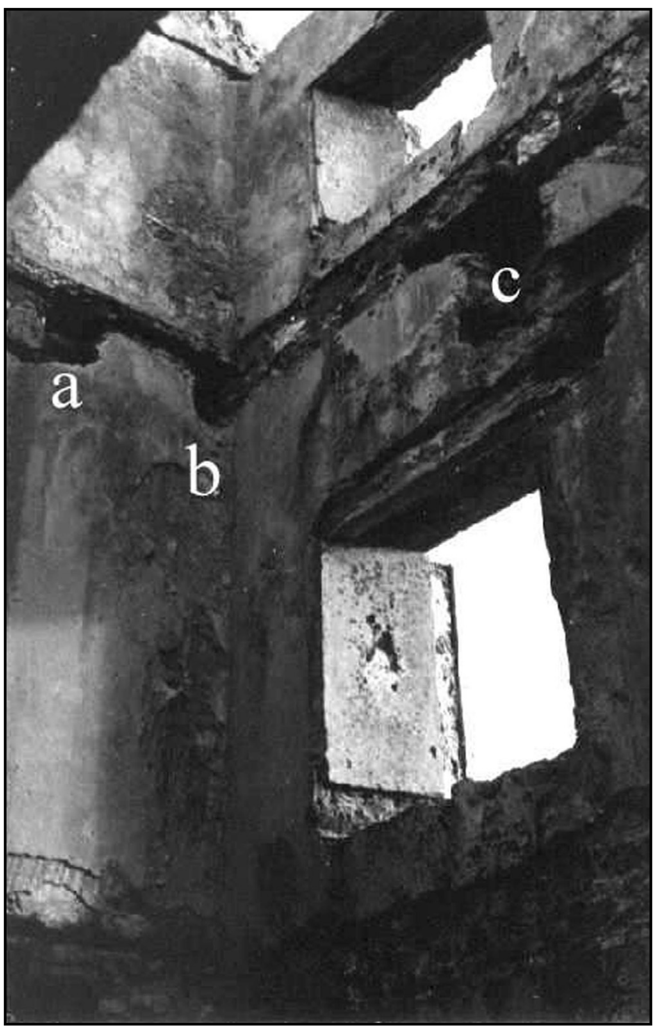


Figure 6. Interior view of NE and SE Engine House Walls, Showing spring beam (a), side beam (b) and main girder (c) openings. Interior plaster coat readily visible, and course of top floor.

MAN ENGINE SURVEY AND INTERPRETATION, 2000

An initial survey of the Man Engine was undertaken in January 2000, and again in early November, with particular attention paid to the Flywheel and gear plinth in front of the Engine House (Figs 1, 4, 5). The exterior and interior features of the Engine House, Boiler House and Chimney are all fairly standard. The courses of all floor levels and connecting staircases are readily discernible in the still relatively intact wall plastering, as are the openings for spring and side beams, and the main girder (Figs. 6, 7).

At ground floor, and cataract pit level, all 4 steam engine cylinder retaining bolts are still in position (Fig. 8), and both bolt tunnels are readily visible, albeit partially blocked with masonry (from blasting of the Condenser pit in the 1950s?). Measurements directly from these bolts indicate a cylinder diameter of 32”.

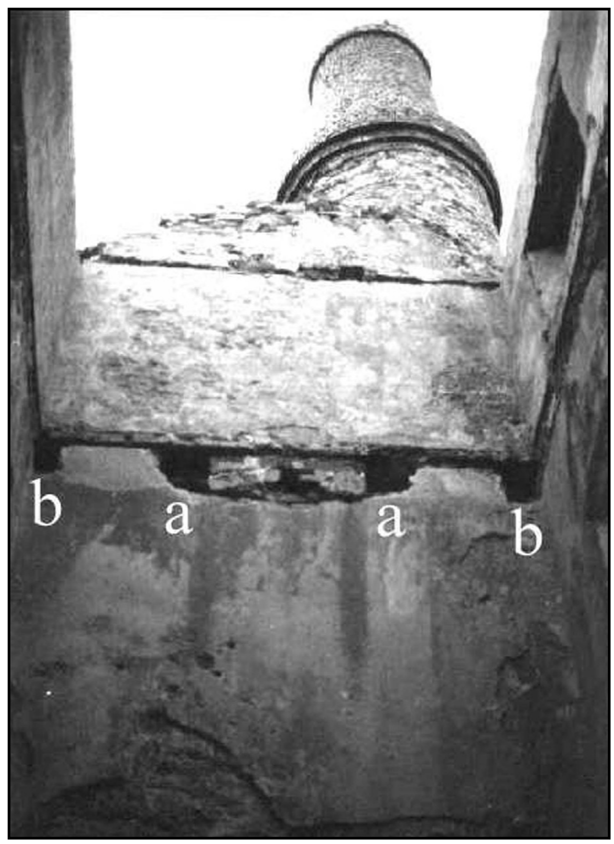


Figure 7. Interior view of NE Engine House wall, showing spring beam (a) and side beam (b) sockets. Note relatively intact line of roof pitch and chimney.

Unusually, the flywheel and gear plinth is structurally integrated with the Engine House bob wall, as is an inferred valve gear lever mechanism slot which passes through the bob wall adjacent to the condenser pit (Fig. 8). The latter has been severely damaged, apparently caused by explosives training in the 1950s, while the plinth is built upon a lattice of wooden springer beams, which acted as lintels for the hold down bolt tunnels. These beams have decayed severely, or been removed along outer edges, resulting in long sections of unsupported masonry (Figs. 1, 10, 13).

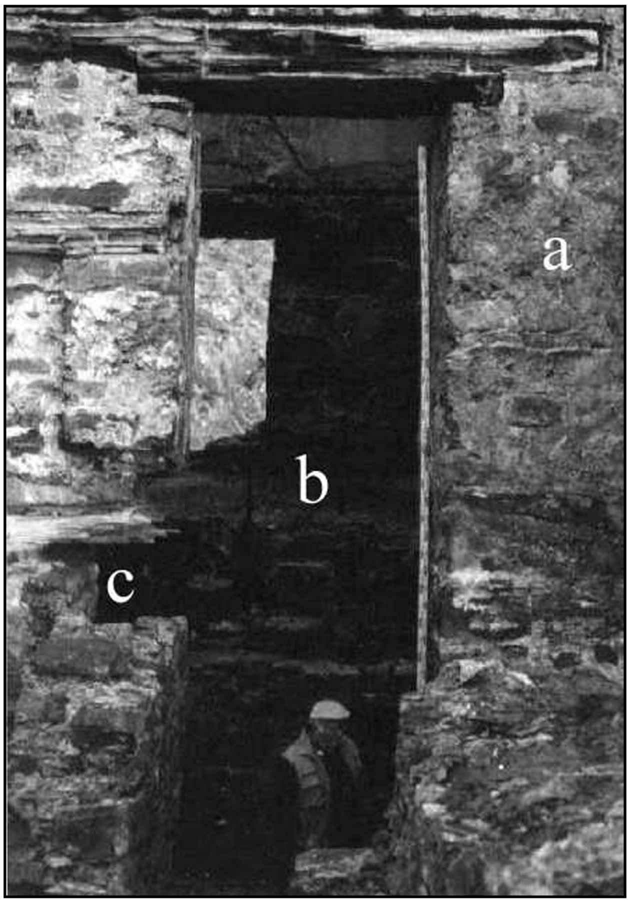


Figure 8. View of Bob wall (a) looking NE from plinth. Note cylinder bolts (b) inside the Engine House, and the valve gear mechanism slot through the bob wall (c). Scale rod held by Mr. P. Harrington.

A plan of the surface features visible on the top of the plinth is shown in Figure 9. The damaged condenser pit is shown in the lower right hand part of the diagram, while other features of note include:

A slot for the flywheel (calculated diameter = c. 19 to 20 feet) which matches with a beveled groove in the bob wall (Fig. 11);

The crank pit beside the flywheel, for the crank drive from the beam to the flywheel (this mechanism is clearly shown in Figure 4; calculated throw = 3 feet);

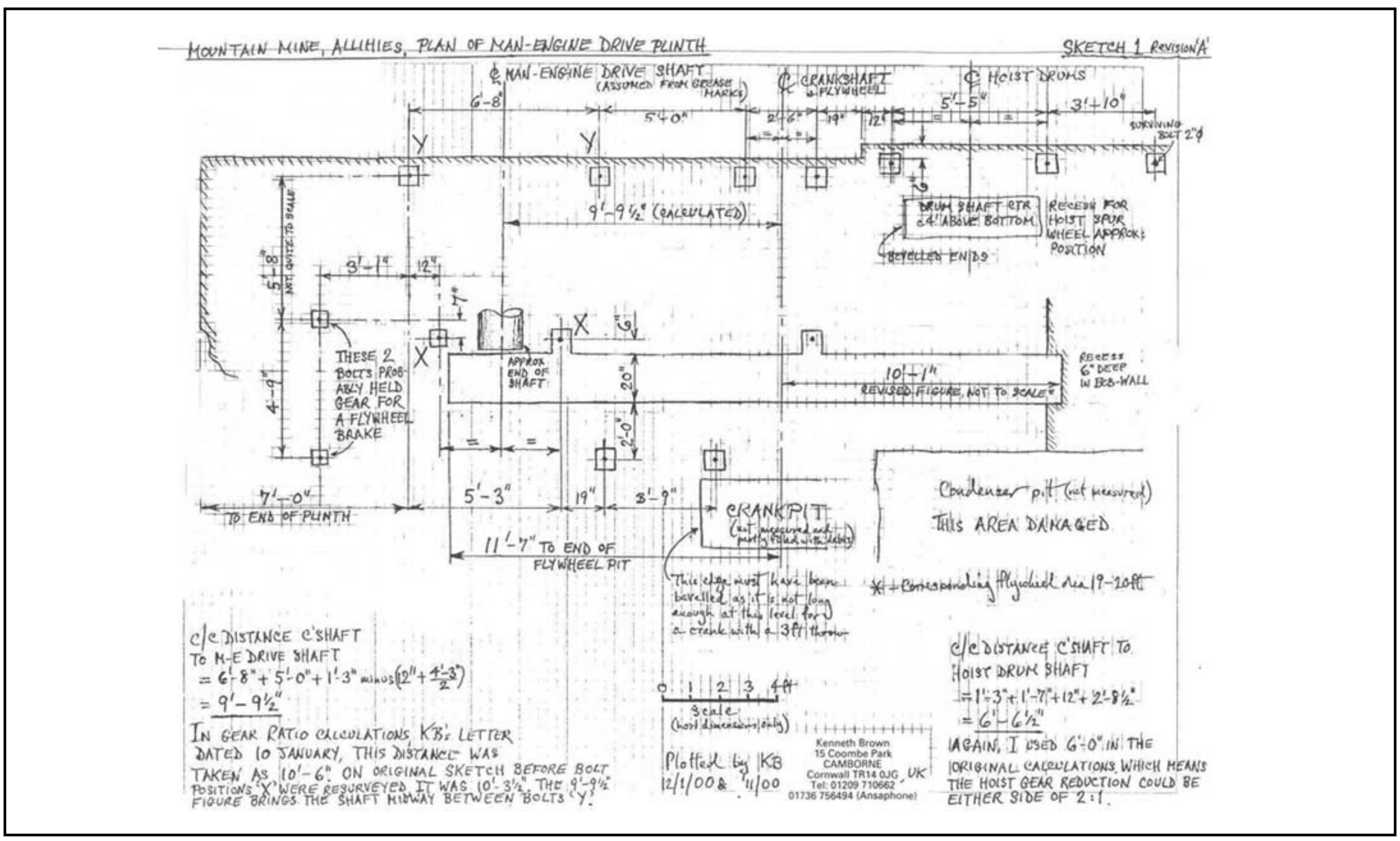
The flywheel crankshaft position, deduced from bolt-holes and congealed grease streaks on the N face of the plinth. This carried two gear pinions and clutches to provide the drive to the Man Engine gearing to the left, and the winding drums to the right (Fig. 12). Counterpart winding drum features are readily visible on the inner face of the outer winding drum axle pillar (Fig. 13);

The position of the shafts for the Man Engine drive wheel and winding drums axle, again deduced from bolt hole positions, and grease streaks (Fig. 10);

And the position of an inferred flywheel brake mounting at the front of the flywheel.

There is a noticeable recess in the north edge of the plinth, presumed to accommodate the Man Engine spur wheel (calculated diameter = 16 feet), clearly shown in Figure 5 (see also Fig. 10).

Figure 9. Survey plan of gear, crank and flywheel mountings on plinth in front of engine house bob wall. Surveyed by Kenneth Brown, Industrial Archaeologist, January and November 2000. Derived from original manuscript drawing, with only minor editing.



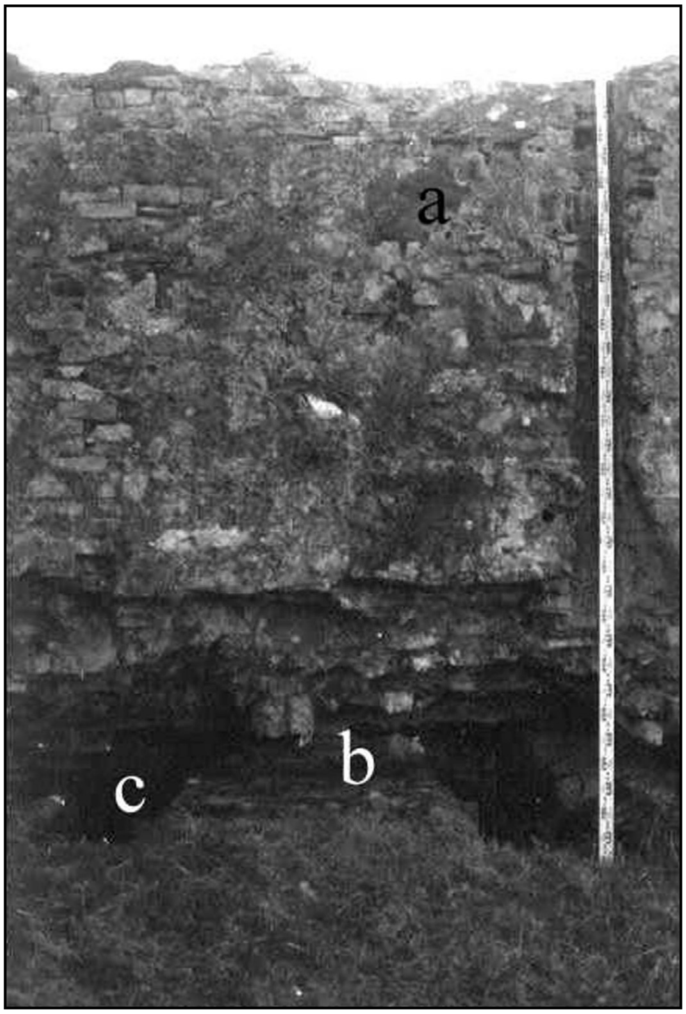
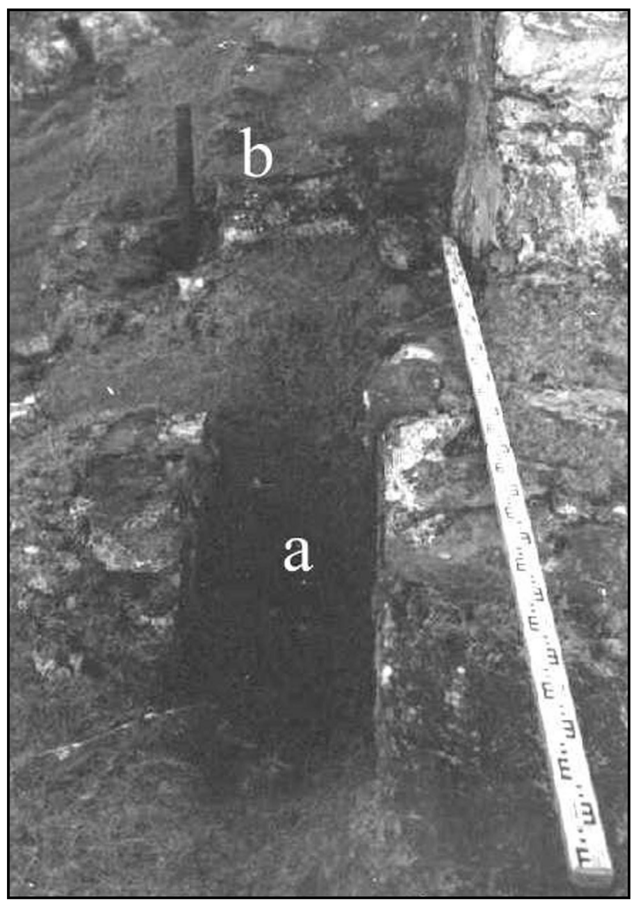


Figure 10. Above. View of NW edge of flywheel plinth. Note congealed grease drips (a) marking position of Man Engine spur wheel axle; unsupported plinth masonry (b – removal or decay of ground level wooden beams), and bolt tunnels (c). Survey pole resting in an axle bearing bolt hole.

Figure 11. Above right. View looking along NW edge of plinth showing lower part of bob wall (a), and beveled recess for flywheel (b). (KB standing in flywheel pit)

Figure 12 (right). NW edge of flywheel plinth, showing winding drum spur wheel pit(a) and timber gribbage retaining bolt (b).



A profile view interpretation of the flywheel crankshaft to winding drum and man engine gears is shown in Figure 14. Drive to both mechanisms was provided by two gear pinions of about 4 feet diameter, either of which could be clutched in (but not both), and with a neutral position enabling the engine to run idle. Since all the machinery rested on timber baulks which have rotted away, there is no evidence of the details of the clutch and brake mechanisms. However, the two pinions could either have run loose on the flywheel/crank shaft with a dog clutch in between; or the shaft could have been splined, or

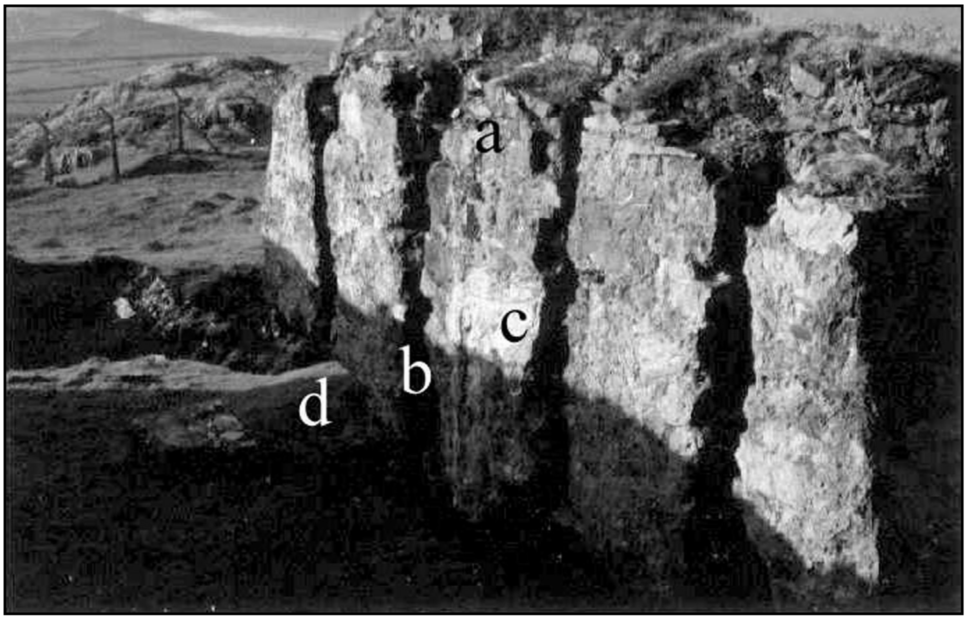


Figure 13. View of inner face of outer winding drum support pillar, showing congealed grease streaks marking position of winding drum axle (a); retaining bolt holes (b); curved groove mark in masonry caused by winding drums rubbing against the pillar (c); (d) under-mined masonry.

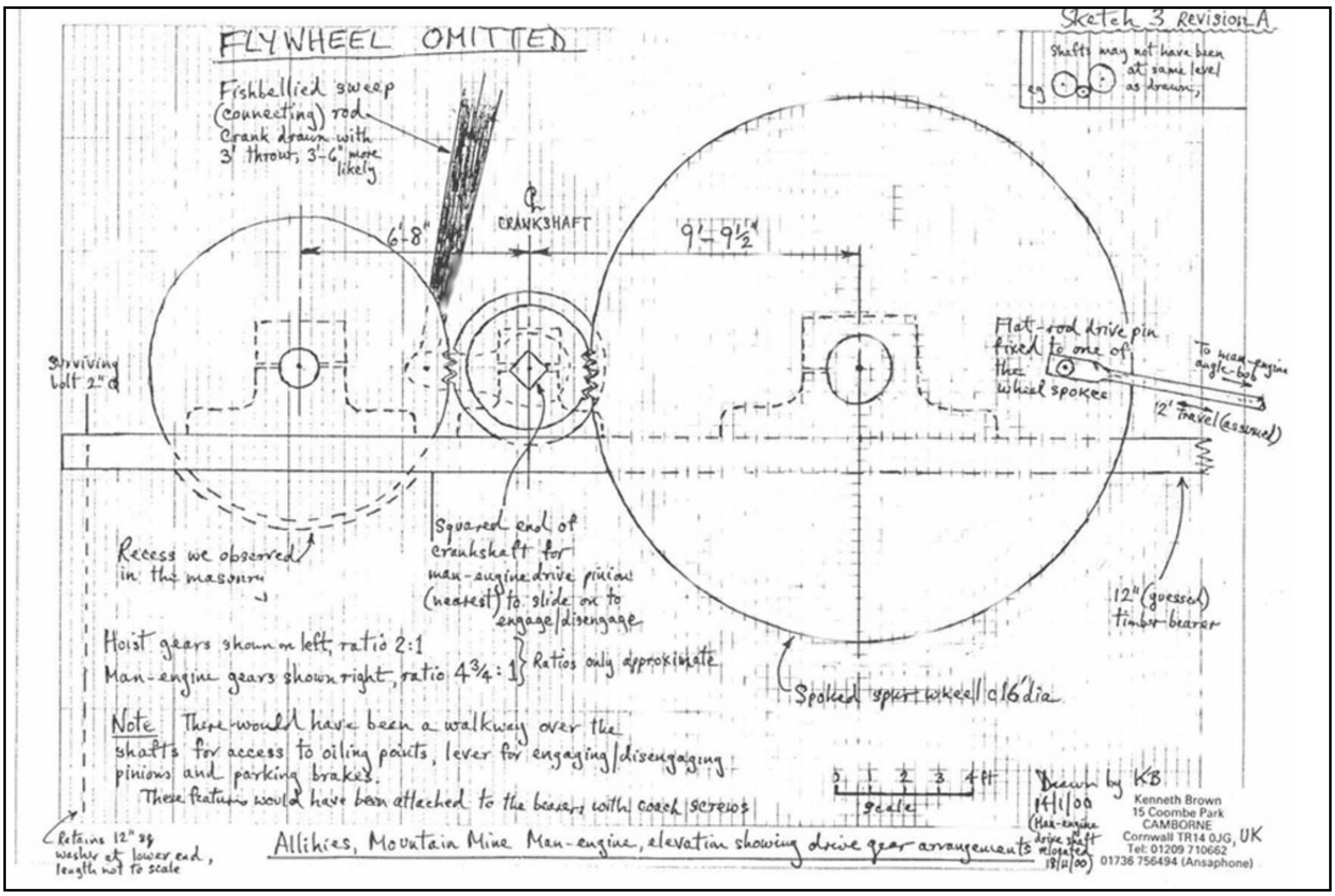


Figure 14. Reconstruction of winding drum and man engine gearing. Survey and interpretation by Kenneth Brown, Industrial Archaeologist, January and November 2000. Derived from original manuscript drawing, with only minor editing.

squared so that the pinions could have been slid in or out of mesh. In either case, operation would have been by levers from a manstand on the plinth. The neutral position would have been required for initial warming up of the engine, and for manoeuvering. The diameter of the winding drum gear wheel is about 8.5 feet, while that of the Man Engine spur wheel is calculated to be about 16 feet, resulting in gearing ratios of about 2:1 and 4.75: 1 respectively. The spoked, Man Engine spur wheel was connected to the rocker beam by a flat rod calculated to provide a 12 feet travel, which was attached, as shown in Figures 5 and 16, to a spoke on the spur wheel.

HERITAGE VALUE OF THE MAN ENGINE HOUSE

It is estimated that somewhere in the order of 2,000 Cornish Engine Houses were constructed in Cornwall and Devon during the 19th and early 20th Centuries, with perhaps a further 1,000 worldwide. The vast majority of these were constructed for pumping, while most others were used for either winding ore or materials, up and down the shaft, or for driving ore crushing machinery. In contrast, the global total of known, definitive origin Cornish Man Engines, is only 21, equivalent to 0.7% of all Cornish Engine House applications ever constructed.

The extreme rarity of this type of Cornish Mining technology immediately distinguishes and sets them apart from any other type of installation. Surviving examples are even rarer. The surface features of several such installations still remain in Cornwall, as does the hydraulic engine which drove the installation in the Isle of Man example, but even in this very select company, the Allihies Man Engine House stands apart even from these surviving examples. It does so on two grounds: intactness and, most importantly, uniqueness.

Most surviving engine house ruins now generally consist of little more than the shell of the Engine House itself, and in many instances even the walls are only partially intact. Surviving chimneys are less common, while surviving boiler houses are extremely rare, as they were generally less well constructed than the engine house, and they were very commonly partially or totally demolished to extract the boiler upon closure of the Mine. Chimney survival reflects a combination of factors, such as quality of original construction, mortar quality and strength, extent of brick and mortar erosion by acidic solutions derived from flue gases, and lightning strike.

The Allihies Man Engine House complex is, by any standard, remarkably intact, and this despite its very exposed position, and having lain derelict since mine closure in 1882 (Fig. 1). It retains virtually all of its original features, most surviving close to their original design dimensions and heights: engine house, chimney, boiler house and even a coal bunker (Figs 1, 4).

But it is the uniqueness of this building complex which sets it apart from any other Engine House complex in Ireland, or, indeed, anywhere else in the world. It is now the sole surviving, purpose built, Cornish design Man Engine House anywhere in the world [although Krassmann (2000) lists a global total of 115 Man Engines, to date, only 21 of these, listed above, are known to be of undisputed Cornish origin]. It is also the most intact of its type, only 1 in Cornwall, at South Tincroft, approaching the level of completeness of the Allihies example.

Of its type, the Mountain Mine Man Engine House is nationally and internationally unique, and consequently, the heritage value of the surviving complex is inestimable. It is arguably the most intact structure of its type still in existence, with sufficient evidence to clearly indicate, and in the future, demonstrate how the surface features of this Man Engine were constructed and operated. It consequently presents a world-class example of this extremely rare application of Cornish mining technology. This could be of immense value in the context of a current bid to register Cornish Mining Technology as an UNESCO World Heritage Site (WHS). This bid, "Cornish World Mining", led by Cornwall County Council and the Trevithick Trust, is now on the UK candidate site short list, and there is considerable confidence that the bid will be ratified in about 2 years time. In that context, this building is of immense value. Not only might it be registered as the representative example of its type, but it, and the extant remains of the 19th Century copper mining centre in Allihies, could be registered as an adjunct to the WHS, thereby contributing to the globalisation of this WHS.

Finally, and by no means least, the building is an icon in the local community. The building features in locally used signage of all types: in public houses, building construction, and in tourism products. It is a potent symbol of what was their industrial past, albeit one marked by considerable hardship and ill-will towards the mine owners. The historic legacy cannot be changed, but attitudes can, and they are changing. There is a growing awareness and appreciation in the community of the need and value of conserving what remains of that industrial past, for what it was, as well as the links it provides with the diaspora of Irish miners and their families to Michigan, Montana, Utah and various other parts of the mid-western USA in the 19th Century. This is a rich and increasingly valued heritage, one of very few of its type in Ireland – and one which fully deserves support now in order that it will be preserved for the benefit of future generations. The Man Engine House complex lies at the very heart and essence of that heritage.

REFERENCES

Barton, D. B. 1965. *The Cornish Beam Engine*. D.B.Barton, Truro. [Man Engines, pp. 207 – 218]

Krassmann, T. 2000. GAG – Projects: The international Man Engine page. http://www.untertage.com/fahr/tkfahre.htm. 8p [March 2000 update].

Tew, D.H. 1981. Man Engines in Cornwall. *Journal of the Trevithick Society*, 8, 47 – 53.

Williams, R.A. 1993. *The Berehaven Copper Mines*. A.B. O'Connor, The Bookshop, Kenmare. 228pp.