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Cegin Viaduct Assessment

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by

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CEGIN VIADUCT ASSESSMENT

Contents

Abbreviations:

CRO: Caernarfon Record Office
UWB: University of Wales, Bangor

Nomenclature:

The nomenclature of early railways is currently going through a period of re-assessment. The following document follows the most consistent and unambiguous practice, which is to refer to all system of guided and supported wheeled vehicles as *railways*. Railways making use of flangeless wheels on L-section track, often referred to as tramways or tramroads, are here referred to as *plateways*. Railways from the hybrid period (1780-1830) which make use of flanged wheels on edge rails are here referred to as *railroads*. Railways making use of some or most or all of the attributes of the modern railway – locomotive haulage, iron or steel rails, mineral, goods and passenger service, etc. – are referred to as *railways*.

References to the '2ft gauge' should be taken as meaning 'approximately 2ft', without delving into the abstruse question of the precise dimensions of the gauge of the quarry railways, which seems, at penrhyn at least, to have begun as 2ft 1in centre-to-centre and latterly has always been quoted as 1ft 10¾in on the inside faces.

The usage 'Penrhyn quarries', common in the nineteenth century, has in the main yielded in the twentieth century to 'Penrhyn Quarry'. Both phrases however, refer to the main quarrying complex.

Spelling:

The spelling Llandegai has now been officially superseded by the spelling Llandygái; however, the original spelling is retained in quotation from sources.

Summary

The present document examines the archival and historical context for the Cegin viaduct, a structure which formerly carried the Penrhyn railroad over the Cegin river. It concludes on the basis of map evidence (reproduced in Appendix 1) and documentary sources that it is likely to have been built between 1798 and 1800. On the basis of what is known of other early railway structures in Wales (identified in Appendix 2) it concludes that it is the oldest known multi-arched railway bridge to survive above ground level in Wales and possibly the world, and that it is a monument of international significance. On this basis, and on the basis of a basic survey and photographic record which constitutes Appendix 3, recommendations are made for its management.

CEGIN VIADUCT ASSESSMENT G1716

1 BACKGROUND TO THE PROJECT

Gwynedd Archaeological Trust has been grant-aided by Cadw: Welsh Historic Monuments to carry out an assessment of the structure hereinafter referred to as *the Cegin viaduct*, which formerly carried the Penrhyn railroad (see below section 3.2 for discussion of terminology) over the Afon Cegin near Port Penrhyn. The objectives of the project as agreed with Cadw are:

1. To establish the archaeological significance of the structure within the context of the other early railway structures world-wide

2. To establish the archaeological significance of the structure within the context of coeval structures within the area

3. To carry out initial photographic recording of the structure

4. To produce a basic survey of the structure

5. To establish the current condition of the structure

6. To make recommendations for the future management of the structure

The present document fulfils 1, 2, 5 and 6 of these requirements. Appendix 1 contains copies of archive maps of the structure. Appendix 3 to this document fulfils 3 and 4 of these requirements.

2 LOCATION

The viaduct is situated at SH 5926 7239; the Cegin river, which the viaduct crosses, here forms the boundary between the communities of Bangor and Llandygái in the county of Gwynedd, formerly Caernarvonshire.

3 OWNERSHIP AND PRESENT MANAGEMENT

The viaduct and the surrounding land are owned by the Penrhyn estate, whose agents are Carter Jones Property Consultants, the Estate Office, Port Penrhyn, Bangor, Gwynedd LL57 4HN (01248 362536). However, the cycle track which crosses the Cegin over the immediately adjacent former railway bridge and the lands immediately adjacent, including the Cegin viaduct, are leased to Gwynedd County Council. The responsible officer at Gwynedd is Mr Wyn Williams, Planning Department, y Pencadlys, Caernarfon Gwynedd (01286 679363 [direct line]).

4 METHODOLOGY

4.1 Historical Background

The present report has been compiled on the basis of existing research into early railways and on the Penrhyn railroad as well as the standard works on the archaeology of railways and the development of railway infrastructure, as listed in section 9, Bibliography.

Consultation was also carried out with a number of individuals who are authorities on the history and archaeology of early railways.

4.1.1 *Context for railway assessment*

The archaeology of railways has become a recognised sub-section of the discipline of industrial archaeology, but also owes much to the long-established study of engineering history. It reflects a broad-based interest in transport technology in general and in railway technology in particular that can be traced back to the very earliest days of the modern railway, and owes a great deal to the researches of interested amateur historians.

A railway may be defined as a prepared way which both guides and supports wheeled vehicles. Within this broad definition, a consensus has emerged over the last few years that railways may usefully be divided into ***early*** and ***modern***, as well as a transitional period from 1800 to 1830 sometimes referred to as the ***hybrid railway***, in which some of the features of the modern railway become apparent. Leaving aside the question of railways in Prehistory and in the Roman and the early Medieval period, the early railway may be assumed to have developed in the late Medieval period, and typically to be distinguished by the following features:

- Individual or industrial partnership ownership
- Mineral traffic only
- Unidirectional transport flow
- Locally negotiated route
- No perception of linkage to greater railway system
- Animal haulage
- Wooden or cast-iron track

The modern railway is generally assumed to have been initiated by the opening of the Liverpool and Manchester Railway in 1830, and typically to be distinguished by the following features:

- Multiple ownership
- Carriage of fare-paying passengers in dedicated rolling stock
- Provision of station facilities
- Multiplicity of goods carried
- Multi-directional transport flow
- Parliamentary sanction for route
- Possibility of through running or exchange of passengers and goods onto larger railway network.
- Locomotive haulage
- Wrought-iron or steel track

Furthermore, though modern railways have with very few exceptions made use of edge rail (a form of track where the flange which keeps rail and wheel in alignment is on the wheel, rather than the rail itself) early railways are characterised by a variety of rail- and wheel-types. The earliest attested form was an edge railway, in other words making use of flanged wheels (as on the modern railway) on a horse-drawn waggon typically run on its own, rather than in a train, but running on wooden rails (sometimes with an iron covering). This type of system, which flourished in the Newcastle coalfield from the seventeenth century to the early nineteenth, is commonly called a **waggonway**. A common form was the **plateway**, involving flange-less wheels running on flanged (L-section) track, a system which flourished in South Wales and elsewhere from the 1780s to the 1820s. Another type was an edge-railway system making use of all-iron rails, a form of technology which emerges in the South Wales valleys in the 1790s, and which gradually yielded the modern railway of today. Railways such as these were known in the early period of their evolution as **railroads**, and though the word survived in common usage in the United States, it did not in Britain. However, practice amongst railway historians increasingly uses the word **railroad** to indicate these early edge railways, and to distinguish them from waggonways and plateways, bearing in mind that all are railways of one sort or another. Ambiguous terms such as tramway or tramroad, much used in the early nineteenth century and generally identifying plateways, but increasingly used to mean any small-scale industrial railway or a public inter-urban system, are best avoided.

On this basis, the railway which made use of the Cegin viaduct falls into the category of early railway, and was built as a railroad. For the purposes of this document, it will be referred to as the Penrhyn railroad.

4.1.2 *Context for railway bridge assessment*

The very earliest systems laid in the British isles have left no remains so far identified – the colliery lines established in Nottinghamshire from 1604 and in Shropshire a little later. However, as systems grew in length and technical sophistication, and as they were required to carry ever-greater loads, civil engineering features were built on a larger scale and have bequeathed archaeological evidence. Dr Michael Lewis's study *Early Wooden Railways*, published in 1970 (effectively a history of railway engineering from the late medieval period to the late eighteenth century), observes of the Newcastle waggonways:

> Stone bridges were few. The first, as far as we know, and certainly the greatest, was Causey Arch, sometimes called Tanfield Bridge or Dawson's Bridge. It was built by Wortley and Liddell to carry the Tanfield waggonway from Thomas Dawson's Causey and Tanfield collieries, which they were leasing, over Causey Burn. The line came into operation in July 1725, and it is said that the first bridge here collapsed almost as soon as it was finished. Its successor, the present structure, was begun in August 1725 ....[1]

A two-arched railway bridge survives at Newdale in Telford, Shropshire, believed to have been built *c.* 1760. It carried a waggonway to a foundry over a small brook, and consists of two segmental brick arches.[2]

A detailed index of early railway sites in Wales was included as part of Stephen Hughes's *The Archaeology of an Early Railway System*, published by the Royal Commission on Ancient and Historic Monuments of Wales in 1990, and included here as Appendix 2 of the present document. This does not include the Cegin viaduct. It does confirm dates and engineers for a considerable number of other structures, and suggests that the earliest surviving railway bridge in Wales may be the single-arched bridge which formerly carried Kymer's Pwll y Llygod railway over the Gwendraeth Fawr, and that this may be the original structure of 1769.[3] On the basis of this document, no multi-arched railway bridge of earlier date survives largely complete in Wales, with the possible exception of the viaduct at Blaenavon, in existence by 1798 but probably built ten years earlier. A *Time Team* excavation found a tunnel over the site of the railroad where it is believed to have crossed the viaduct, suggesting that the tipping of waste had not only engulfed the structure but had risen so high that the railroad at this point, though it began life well above ground level, ended considerably below. It is possible that the fabric of this structure, almost certainly older than the Cegin viaduct, may survive.[4] Otherwise, no other multi-arched railway bridge is known to survive, either in Wales or the rest of the world.

The only detailed assessment of an early railway bridge is that carried out by Professor Roland Paxton of the Department of Civil and Offshore Engineering at Heriot-Watt University, and published in *Early Railways*. He describes the multi-arched Laigh Milton viaduct on the Kilmarnock and Troon Railway, Scotland's first public railway, completed in 1812 after having been under construction for four years. It is a four-arch viaduct, 270' long 19' wide. As Professor Paxton points out, the structure was not on a particularly large scale for its date, and its construction followed late eighteenth century practice rather than the more advanced current practices. The 'combination of frugality and skill' which distinguished the building of the Kilmarnock and Troon Railway contained sufficient of the latter to enable the structure to be conserved in the mid-1990s.[5]

4.1.3 *Context for coeval structures within Gwynedd*

As yet no assessment has examined related or comparable structures of the late eighteenth and early nineteenth century within the region. Studies of technology transfer to and within the area in the period 1750-1850 have identified a vigorous technical culture capable of assimilating, and learning from, the

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[1] M.J.T. Lewis, *Early Wooden Railways* (London, 1970) p. 155.
[2] Richard Morriss, *The Archaeology of Railways* (Tempus, 1999) p. 80.
[3] Stephen Hughes, *The Archaeology of an Early Railway System* (Royal Commission on Ancient and Historic Monuments of Wales: Aberystwyth, 1990) p. 258.
[4] Dr Peter Wakelin, Cadw: Welsh Historic Monuments, pers. comm.
[5] Roland Paxton: 'An Engineering Assessment of the Kilmarnock & Troon Railway (1807-1846)', *Early Railways* (London, 2001) pp 82-102.

skills of newcomers, and enjoying the active patronage of the local élites.[6] Bridge building was an established craft, and, from the evidence of bonds and plans preserved in the county archives, presented no problems to local masons. Polite influence in the context of such structures, however, is comparatively rare. Eighteenth century bridges in the area are functional, and the only concession made to the spirit is the occasional *englyn* carved into the fabric by the mason.

However, particularly given the role of newcomers to the area and to the activities of the wealthy, the appropriate context for the Cegin viaduct is not only long-established local skill-culture of Gwynedd but also the work of architects and engineers associated with the Penrhyn estate. No detailed archaeological assessment of their work has yet been carried out, but it is clear that the Wyatt family, whose connection with the estate dates to 1786, introduced a markedly polite form of architecture to the area. James Wyatt had been commissioned by Richard Pennant to work on his English estate, whilst his brother Samuel rebuilt the medieval hall at Penrhyn, and constructed the original dwelling at Lime Grove, adjacent to which the railroad runs. This building, which was demolished *c.* 1860, bore his hallmarks in the form of office wings on either side of a main block and tripartite arched windows. This style is apparent in his farm buildings on the estate as well as industrial structures such as Incline Cottage (the former winding house on the lowest incline on the Penrhyn railroad), where the pattern of a ceremonial gateway to a high-status dwelling is adapted to the mechanics of operating an inclined plane.[7] The presence of other individuals within the area who identified themselves as 'architect' leaves open the possibility that persons other than the Wyatts were also involved.[8]

4.1.4 *Existing studies of the Penrhyn railroad*

The history and surviving assets of the Penrhyn railroad, as well as of its successors systems, are described by Mr James Boyd (see *9 Bibliography*).

4.2 Basic Survey and Photographic Recording

The viaduct was recorded in late March 2002 when the water level in the river was reasonably low. Heavy rain in the preceding months had resulted in high water levels, making access to the bridge hazardous. The viaduct was photographed using a leveled 35mm camera with the film plane parallel to the masonry face where possible. The southern end of the structure was obscured by trees and oblique photographs were taken of this part. Selected record photographs are included in this report and all further photographs and negatives are stored under archive conditions at Gwynedd Archaeological Trust. A taped survey was also carried out in order to produce a plan of the structure (Appendix 3 Fig.1).

5 EXISTING MANAGEMENT INITIATIVES

5.1 Statutory Protection

No statutory protection has been afforded the bridge. One feature associated with the Penrhyn railroad has, however, been listed; this is the winding house identified in **4.4** above, on the incline to the south of the Cegin viaduct:

1.	Incline cottage	SH 5930 7192	Grade II	593/719

[6] D.Rh. Gwyn, '"Ignorant of all science": Technology transfer and peripheral culture; the case of Gwynedd, 1750-1850', *From Industrial Revolution to Consumer Revolution: TICCIH 2000 Transactions* (Association for Industrial Archaeology 2001) pp. 39-45, Dafydd Glyn Jones, *Un o Wyr y Medra* (Dinbych: Gwasg Gee, 1999).

[7] Richard Haslam, pers. comm., P.E. Jones, 'The Wyatts of Lime Grove, Llandygai', *Transactions of the Caernarvonshire Historical Society* 42 (1981) pp. 81-116, esp. pp. 82-92.

[8] By Mr Eric Foulkes, pers. comm.

6 HISTORICAL BACKGROUND

6.1 Topography

The Cegin viaduct crosses the lower reaches of the Afon Cegin, the more westerly of the two rivers which flow northwards into the Menai Strait and define the ridge of land on which Penrhyn Castle is built.

6.2 Historical and Archaeological Background

Until the twentieth century the Afon Cegin formed the boundary between the estate whose focus lay on the *penrhyn* (promontory) on its eastern bank, where Penrhyn Castle now stands, and the lands under episcopal control to the west, on which the city of Bangor was founded. It is likely that this boundary reflects territorial divisions of long standing. Whilst there have been suggestions that Penrhyn is the site of a Roman fort, the first sure indication of settlement dates from the thirteenth century when it was in the ownership of Ednyfed Fychan. His descendants, the Griffith family, sold the estate to Dr John Williams, the royalist Archbishop of York, who left it to his nephew. It was divided into two on the death of his sister. In 1765 Anna Susannah Warburton, heiress of General Hugh Warburton, owner of the moiety of the estate, married Richard Pennant, whose fortune derived from his Jamiacan sugar estates and was for a while member of parliament for Petersfield in Hampshire and for Liverpool. In 1785 he finally completed the purchase of the other moiety, and re-united the estate.

6.3 Industrial development and pre-railway transport links

The slate veins in the parishes of Llandygái and Llanllechid have been exploited since at least the fifteenth century, but it was Richard Pennant's capital and the strongly managerial tradition that he brought to the estate which transformed the industry. From 1768 leases were granted containing the right to work in the quarry at Cae Braich y Cafn, replacing the old system of a farm of one eighth of the produce, and in 1782 the estate effectively took over the working of what was now increasingly being referred to as 'the Penrhyn Quarries.' The new arrangements not only affected the winning of the rock but also the means by which it was transported to the sea. Hitherto, all carriage had been by pack-horse to loading points at Aber Ogwen and Aber Cegin. Amongst the new arrangements were a cart road ('ffordd Lord') from the quarry, and the building of new shipping facilities at Aber Cegin (which underwent a similar change of name, becoming 'Port Penrhyn') in order to concentrate export from this one location.[9]

Aber Cegin was a long-established landing place, forming a sheltered haven where not only could slate be exported but fish from the fish traps could also be loaded into vessels. An early plan (Appendix 1, Map 1) shows no dedicated facilities of any sort, only a beaching spot for vessels. But by 1783 we hear of payments towards 'Repairing Aber Cegin Store House' and towards work on the road, probably at this point, on the alignment of the existing road which entered the port from the east, as shown on the map.[10] It is clear from map evidence that the earliest focus of shipping was the area of the ford itself and the heavily silted pool between it and the viaduct which forms the subject of the present assessment. The building of the bridge at Port Penrhyn itself, adjacent to the site of the ford, has had the effective of creating an artificial throat over the mouth of the Cegin, causing the silting of what was effectively the late-Medieval creek.

6.4 Penrhyn estate railway systems – history

6.4.1 Introduction

The Penrhyn estate and the Penrhyn Quarry made extensive use of railways from the late eighteenth or early nineteenth century until 1965. At its height, these together formed one of the largest industrial narrow gauge systems in Britain, making use of steam and internal combustion locomotives, and running workmen's trains along the main line between the quarry and Port Penrhyn.

Three of these railways are germane to the present document: the Llandygái railway, the Penrhyn railroad, and the Penrhyn Quarry Railway.

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[9] Jean Lindsay, *A History of the North Wales Slate Industry* (Newton Abbot, 1974) pp. 27-47.
[10] It is also shown on UWB Penrhyn 1971, fol. 15v and Penrhyn 1972 of 1765.

6.4.2 *The Llandygái railway*

The first railway on the Penrhyn estate may date from the late eighteenth century. It has been suggested that this ran from Port Penrhyn for about a mile inland to a flint mill, known as Melin Penlan, to transport flint landed by sea to a place where it could be crushed, then taken back down to the port for shipment to Liverpool. Melin Penlan, according to one local historian writing in the early twentieth century, was opened *c.* 1795, and was managed by one John Cape on behalf of Samuel Worthington.[11] James Boyd, drawing on information passed on to him by Eric Foulkes, who has been researching the history of Penrhyn Quarry for many years, suggests that the railway opened in 1798 or 1799.

There is no unequivocal evidence for the existence of this railway. The plan of the proposed new post road dated 1817 shows what appears to be a branch from the Penrhyn railroad to the mill at Penlan.[12] Clearly the Penlan mill did have rail access – which would have to have been an incline, given the topography of the area – but whether this reflects a pre-1800 system is not clear.

Perhaps more telling is that in 1798 James Deffard ('of Llandegai ... Architect'), John Roberts of Bangor, turner and Evan Jones of Bangor, mason, signed a bridging bond for the widening and repairing of Pont Marchogion, an existing road bridge on the Conwy to Bangor road, situated at SH 5933 7219, which this putative railway would have had to share with the road, and which the 1801 railroad certainly did use. The suggestion has been made that the repair of the bridge was necessitated by the imminence of a railway crossing it.[13] This is possible, but there is no reference in the bond to this, simply that the bridge was ordered to be widened by the Trinity Quarter Session of 1798.[14]

If this railway did exist, and were to have been built in 1798 or 1799, then the Cegin viaduct is likely to date to one or other of these two years.

The gauge and rail type of this railway are uncertain. In view of the fact that the Penrhyn railroad of 1800-01 was originally proposed as a plateway, it is possible that the Llandygái railway was a plateway.

6.4.3 *The Penrhyn railroad*

In 1800 Thomas Dadford reported on the practicality of a canal or a railway to serve Penrhyn quarries. The map he produced to accompany the report does not survive, but modern transcriptions of the original report are preserved at the Caernarfon Record Office. Dadford was decidedly in favour of a railway, and suggested that it should be a plateway.[15] When work began, in October 1800, it was on a different arrangement, a railroad (edge railway) made up of oval-section cast-iron rails, for double-flanged wheels, to an approximate gauge of 2' to a design which Benjamin Wyatt claimed as his own.[16] In fact, bar iron edge rails had been used in the South Wales valleys for a few years, though the oval section was new to Penrhyn (and predictably found few imitators), and the Penrhyn railroad was a longer and more ambitious system that the others. As such, it marks an important stage in the evolution of the modern railway system.

Summary accounts for the construction of the railroad survive, but do not confirm or deny that the bridge was already in existence. On this basis, if it had not been constructed in 1798-9, it was almost certainly constructed in 1800. Payments are recorded to Charles Shone, a surveyor who some years before designed a bridge over the Conwy, and to James Greenfield, the quarry agent.[17] It has been suggested that the bridge is typical of the work of John Foulkes (*c.* 1765-1850) a local architect-builder.[18]

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[11] UWB Bangor ms 9754, John Morris Ciltwllan, 'Hanes a gwahanol weithfeydd gychwynwyd o bryd i bryd ym Mhlwyfi Llanllechid a Llandegai', fol. 10r.
[12] CRO X/Plans/RD/2.
[13] By Mr Eric Foulkes, pers. comm.
[14] CRO X/Plans/B/181.
[15] CRO XD/40/20/1.
[16] CRO XM/5171/1, fol. 60r-61r.
[17] Greenfield's background appears to have been in surveying; CRO X/Poole/5198 confirms that Greenfield took the levels for the abortive Anglesey colliery railway proposal of 1810-11.
[18] By Eric Foulkes in a letter to the author of the present report.

The first certain indication of the bridge's existence is an estate map of 1803, which shows the railroad crossing the Cegin on the site of the present bridge. Already, the gardens of the agent's house, Lime Grove, come down to the banks of the river, and it is possible that the bridge and the alignment of the railway were deliberately calculated to form an element in the view of the garden, a combination of the *dulce* and the *utile* (Appendix 1, Map 2).[19] A map of 1828 shows that further woodlands had been planted along the course of the railway by 1828 (Appendix 1, Map 3).

6.4.4 Later history

Estate and railway surveys made over the following decades confirm that the bridge remained in use for as long as the railroad remained the main transport artery of the quarry.[20] Hyde Hall curiously states 'Over the Keggin and its mouth are two bridges built for the conveyance of the railway to Port Penrhyn, and Pont Marchogion ... over which the turnpike road goes into Bangor.'[21] An account of 1812 refers to a payment of £42 6s 'for repairing the Bridge on the Rail Road' which may be the Cegin viaduct or may equally be a bridge elsewhere on the railroad or in the quarry itself.[22] It continued to serve, as plans for an alternative route drawn up in 1844 show that the proposed new railway would have made use of the bridge (Appendix 1, Map 4). In 1851 a standard gauge branch line was laid from the Chester to Holyhead main line to Port Penrhyn, which crossed the Cegin alongside the railroad. Little is known about the early history of this line, which appears to have been built without statutory authority as a private siding by the Penrhyn estate. Subsequently it was operated by the London and North Western Railway and its successors, the London, Midland and Scottish Railway and British Railways. It is not clear what type of bridge carried this branch over the river, apart from a plan of 1873, and a similar plan dated 5 March 1878 for a new viaduct, presumably on its site, which would carry not only the standard gauge siding but also the Penrhyn Quarry Railway, then under construction (Appendix 1, Map 5). This was a new locomotive-worked 2' gauge railway from Port Penrhyn to the quarry, which superseded the railroad, and which ran on a different alignment. The viaduct is a wrought-iron three-span girder construction where it crosses the Cegin, and includes a shorter fourth span where it crosses the 'tramway'. The elevation of this proposed structure shows dotted lines indicating a timber support, possible parts of the earlier bridge of 1851.

The Cegin viaduct carried its last train in 1879, as did the 1851 bridge, when the new bridge was brought into operation. This marked the final abandonment of the last working section of the Penrhyn railroad in favour of the Penrhyn Quarry Railway. This railway remained in use until the end of regular traffic in 1962 and the passage of the last scrap train in 1965. The pillars of the 1879 bridge now carry the spans of a cycle and footpath bridge.

7 CURRENT CONDITION

The Cegin Viaduct is a stone-built, three-arch viaduct with a slate-roofed sluice at the northern end.
The Viaduct spans the Afon Cegin at the point where the waterway formerly widened into Cegin Pool which was in 1790 'a commodious harbour capable of admitting vessels of 300 tons burden' (Boyd 1985). Cegin pool was superseded by Port Penrhyn and silted up after the construction of the bridge at the mouth of the pool. The river still widens from 11m to 27m at the point where the viaduct crosses.

The three arches have a span of between 5.0m and 5.5m and a rise of about 1.8m. The rectangular sluice at the north of the structure is 1.2m wide and almost 2m high. The level of the river bed drops by up to 0.5m as it passes through the arches. At normal levels the river currently passes through arches 2 and 3 along with the sluice (see Appendix 3, Fig. 1). Initial impressions suggest that a 3.0m wide pitched stone ford crosses the river just to the south of the viaduct but closer examination shows that the sloping river bed between the arches is similarly constructed. It seems likely that this carefully constructed stonework was laid at the time of the construction of the bridge in order to prevent erosion of the river bed and the undermining of the piers. The pitched stone does not continue across and through the sluice. It could not, however, be determined if the pitched stone originally continued through this feature and had subsequently been lost as a result of erosion or

[19] UWB Penrhyn Castle Further Additional '1803 A Map of the Manor or Demesne land of Penrhyn Mawr'.
[20] UWB Penrhyn Castle Further Additional '1829 Map of Penrhyn Park', '1829 Map and Survey of the Rail Road', '1844 Penrhyn Slate Railway',
[21] Edmund Hyde Hall, *A Description of Caernarvonshire 1809-1811* (Caernarfon, 1952), p. 97.
[22] UWB Penrhyn Castle 2913 fol. 14r.

other factors. It is possible that the sluice was inserted at some time during the history of the viaduct and that the pitched stone was removed at this time. There is, however, no definite structural evidence to suggest this.

The lack of protection for the river bed has resulted in the undermining of the base of the sluice walls resulting in the collapse of a large part of the western end. The northern side has collapsed as far as a straight joint in the masonry leaving a 2.5m wide exit for the sluice. The resulting erosion of the soil and stones infilling the abutment has created a substantial void (2m deep and 3m x 2m wide) beneath the bed of the railroad. The roof of the void has broken through to the surface at one point leaving a hazardous 3m drop into the river.

The continuing erosion of this part of the viaduct clearly threatens the stability of the northern end of the structure and will presumably lead to its collapse if allowed to go unchecked.

The rest of the structure is in reasonably good condition but is showing signs of ongoing deterioration. This is mainly due to the growth of several mature and semi-mature trees on the top of the viaduct. The roots have penetrated much of the masonry and can be seen to have reached the river in arch 2, causing the formation of a small mud bank. Several stones have also been lost from the facing of the western side of the viaduct just above the top of arch 2, probably as a result of root action.

The continued growth of the trees and other vegetation clearly present a threat to the overall stability of the viaduct both as a result of root action and the threat posed by wind-blown trees.

8 CONCLUSIONS

Archival research and a study of the available secondary literature on railway archaeology and on the evolution of bridge design, suggests that the Cegin viaduct is likely to have been constructed between 1798 and 1800. It is on this basis the oldest known multi-arched railway bridge in Wales to survive above ground level, quite possibly also in Britain and the world. It forms an important element within an industrial-transport-park landscape of outstanding archaeological potential, comprising a late-Medieval creek where silting offers the possibility for the survival of timbers in water-logged conditions, Port Penrhyn itself, the other roads and railways associated with it as well as their individual features, the Penrhyn demesne parkland and the gardens and ornamental waters of Lime Grove. The Cegin viaduct is of international significance as an industrial monument.

The present study also underlines the potential value of further archaeological assessment of similar type- and landscapes-classes elsewhere in Wales.

The erosion to the western side of the sluice clearly threatens the stability of the viaduct in the short term. The growth of trees along the top of the viaduct poses a longer-term threat. The possibility of serious damage by wind-blown trees will increase with time and root action is an ongoing source of damage.

9. RECOMMENDATIONS

9.1 Conservation works

A site visit was arranged and this was attended by representatives from the owners (Penryhn Estate), the leaseholders (Gwynedd Council), Gwynedd Archaeological Trust and Cadw. The following programme of conservation work was agreed to be appropriate.

Phase 1. Clearance of the trees and vegetation growing on the viaduct including the application of herbicide to prevent regrowth.
Phase 2. A full structural survey, along with appropriate archaeological recording of any features and masonry revealed by the clearance of vegetation.
Phase 3. Stabilisation works based on the results of the structural survey.
Phase 4. Erection of interpretation boards

The single span masonry bridge that carried the railroad over the Cegin a short distance to the SSE was also inspected. It was recommended that this structure should be included in the work programmme.

It is also recommended that consideration be given to statutory protection for the Cegin Viaduct.

9.2 Further research

The following research objectives were identified during the assessment:

- That consideration be given to further archaeological assessment of the port and inland transport features associated with the viaduct

- That consideration be given to a survey of the garden associated with Lime Grove

In the light of the broader themes that have emerged as part of the present assessment, it is clear that understanding the significance of the Cegin viaduct and associated features, and of similar structures elsewhere, is hampered by the lack of any detailed knowledge of port and inland transport features as an archaeological resource within Wales It is therefore recommended:

- That consideration be given to a comprehensive programme of archaeological assessment of port landscapes throughout Wales

- That consideration be given to a comprehensive programme of archaeological assessment of inland transport features throughout Wales

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10.2.1 UWB

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Penrhyn Castle 1971 (William Williams Llandygâi's notebook of expenses, 1783)
Penrhyn Castle 1972 (Letter from William Williams Llandygâi to Richard Pennant, referring *inter alia* to the road and to shipping slate from Abercegin)
Penrhyn Castle 2913-4 (Quarry accounts, 1812)
Penrhyn Castle S812 (lease of land from Bishop of Bangor for the erection of a wharf at Abercegin)

10.2.2 CRO

XM/5171/1 (Capel Curig Inn, visitors' book – contains [fol. 60r-61r] a description of the Penrhyn railroad 'by the Inventor, M[r] Benjamin Wyatt')
XM/3156/9 ('Payments made during the construction of the Railroad from Quarry')
XD/40/20/1 (Copy [recent] of Dadford's recommendations re a canal or railway from Penrhyn quarries to Port Penrhyn, 1800)
X/Plans/B/181 (bridging bond [no plan] for Pont Marchogion, 1798)

10.3 Maps and plans

10.3.1 UWB

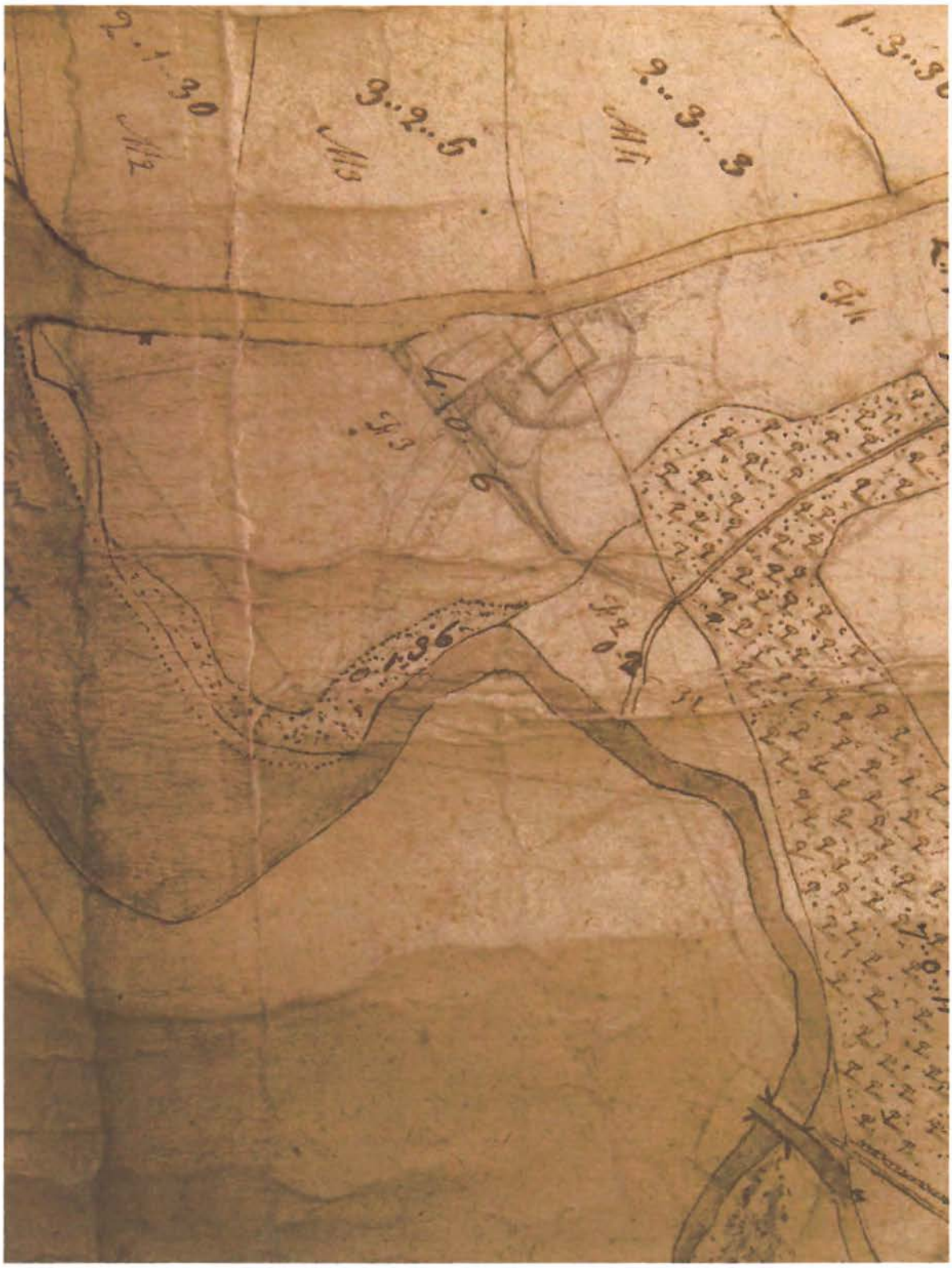
Penrhyn 1971, fol. 15v, '1765 Map of Penrhyn Estate'
Penrhyn 1972, '1765 Map of Penrhyn estate'
Penrhyn Castle Further Additional '1803 A Map of the Manor or Demesne land of Penrhyn Mawr'
Penrhyn Castle Further Additional '1829 Map of Penrhyn Park'
Penrhyn Castle Further Additional '1829 Map and Survey of the Rail Road'
Penrhyn Castle Further Additional '1844 Penrhyn Slate Railway'

Penrhyn Castle Further Additional '1873 Plan and section of a proposed railway line'

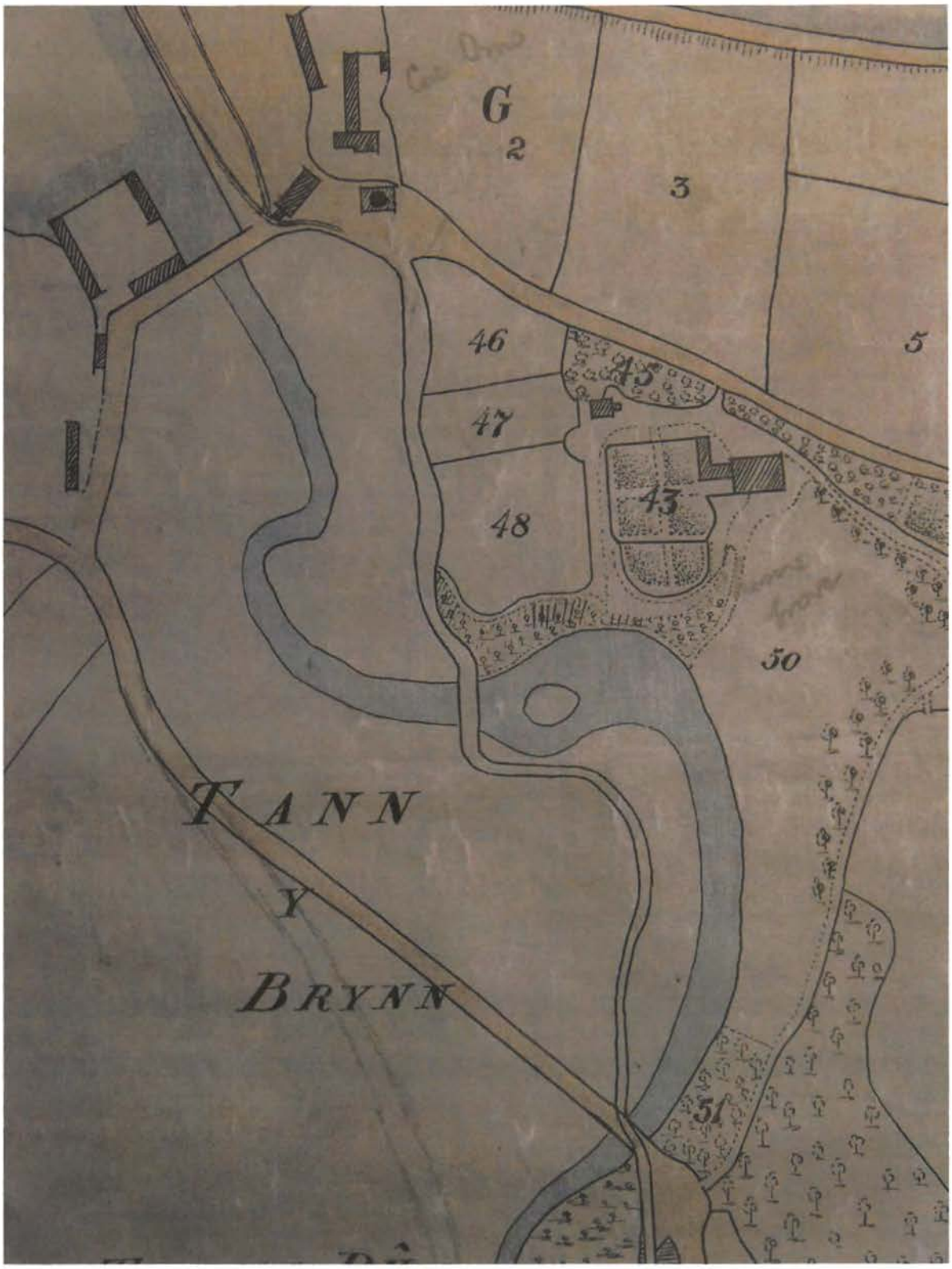
10.3.2 CRO

X/Plans/RD/2 (map of post road, 1817)
XPQ/103/2b (Plans signed by Arthur Wyatt and R.A. Parry contractor for a viaduct over the Cegin, dated 5 March 1878)
X/Plans/B/181

Appendix 1, Map 1. UWB mss: Penrhyn 1768 – map of demesne and surrounding area, 1768 (detail).

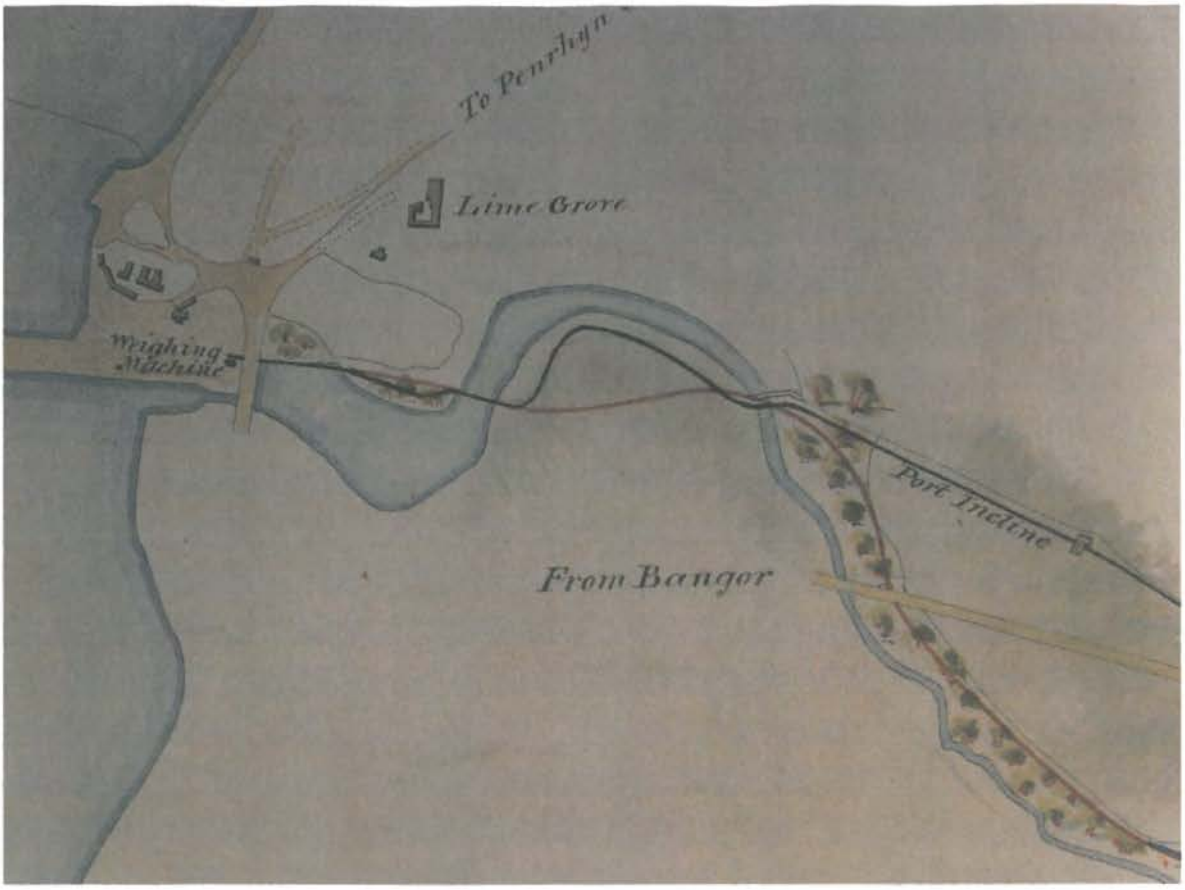


Map 2. UWB mss: Penrhyn 1803 – map of demesne and surrounding area, 1803 (detail).



Map 3. UWB mss: Penrhyn 1828 – map of demesne and surrounding area, 1828 (detail).

Map 4. UWB mss: Penrhyn 1844 – plan of existing and proposed rail systems, 1844 (detail).



Map 5. UWB mss: Penrhyn 1873 – plan of existing and proposed rail systems, 1873 (detail).

Appendix 2

The following document is drawn from the 'bridges' section of the gazetteer of 'Significant early railway remains in Wales', published in Stephen Hughes, *The Archaeology of an Early Railway System: The Brecon Forest Tramroads* (Royal Commission on Ancient and Historic Monuments in Wales: Aberystwyth, 1990), pp. 311-339, pp. 320-29.

The gazetteer grades sites thus:

****	sites or remains of international importance
***	sites or remains of British importance
**	sites having particular importance to Wales
*	sites or remains of local importance

Sites that are scheduled are so indicated by (**sch**). The existence of illustrations (**I**), notes (**N**) or full or partial survey (**S** or **PS**) at RCAHMW is also indicated.

Stone bridges

In civil engineering terms perhaps there was little significance in applying to railways the road-building technology used previously in the construction of masonry bridges. Yet it was a significant development in the transition from short-lived lines serving single points of mineral exploitation to longer lines serving more substantial and more heavily capitalized collieries and quarries. The earliest recorded and still-extant railway arch in the world was built by the stonemason Ralph Wood in 1727. The span of this 'Causey Arch' on the Tanfield Waggonway in County Durham is an astonishing l03ft (31.4m) and the bridge is some 60ft (18.3m) high. Pwll y Llygod Bridge in Wales is the second or third oldest known surviving early railway bridge.

There were other eighteenth-century masonry railway bridges in the United Kingdom. The Tyneside lines had stone-built bridges, some supporting upper works of timber. The low stone-built causeway at Newdale (SJ 676095. now Telford). Shropshire, was supported on two brick arches. The neighbouring industrial complex of casting-houses. moulding-shops and warehouses were built by Abraham Darby II and Thomas Goldney II in 1759-6L the remains of which have now been removed by open-casting.

Afon Cegin, bridge, Port Penrhyn, Bangor, Gwynedd **

(SH 5932 7218)

A bridge carrying the successive Llandegai and Penrhyn railways in the period 1798-1879. This masonry arch is situated at the foot of the incline leading to Port Penrhyn. The bridge also carried a roadway and may pre-date the railways.

Afon Gwyrfai, bridge, Bontnewydd, Gwynedd ***

(SH 4800 5994)

Bridge built for the Nantlle Railway in 1827-28. Robert Williams, of Bangor. was the resident engineer for most of the line with William Owen of Gwaenfynydd, Anglesey as contractor for one section; and Robert Stephenson Senior and Gillespie (acting in consultation with the famous George Stephenson) laying the track.

Beaufort, bridge, Gwent *

(SO 1604 1154)

Bridge on the 'Rassa Railroad'. There has been a bridge on this site since 1794, when Thomas Dadford Junior was probably the engineer responsible. The original (timber?) bridge was in a dangerous state by August 1804 and John Hodgkinson was ordered to rebuild it in stone in November 1806.

Clydach, bridge, Gwent *

(SO 2329 1372)

This bridge carried the tramroad from Clydach Ironworks to the Brecknock and Abergavenny Canal at Gilwern. In use as a footpath and in need of some consolidation.

Clydach. Llan-march tramroad bridge, Gwent *

(SO 2252 1766)

A tramroad bridge over the Sychnant, at the foot of the incline to Darren Felen. The tramroad was completed in 1811. It is probable that the leat from the River Clydach to the Clydach Ironworks rolling mill was carried over

the Sychnant beneath the tramroad.

Gelli-felen bridge, Clydach, Gwent *
(SO 2184 1212)
A small masonry arch spanning a precipitous stream. This section of Bailey's Tramroad survived when superseded by the adjacent railway. The completion of the tramroad was recorded on the 19 December 1821. The line is stated to have been engineered by Thomas Hill of Blaenafon (probably the son). The bridge is now in need of some consolidation.

Gelli-isaf Bridge, Llwydcoed, Aberdare, Mid Glamorgan ** Sch.
(SN 990 044) **I,N,S.**
A fine stone arch of 1803-5 carrying the Abernant Tramroad over the Afon Cynon. A typical example of a tramroad bridge.

Gilwern, Maesgwartha, Clydach Railroad, Gwent *
(SO 2302 1379)
Bridge built for the railroad in c1790.

Govilon, bridge, Gwent ** Sch.
(S0 2597 1335)
High arch spanning Cwm Llanwenarth. Bailey's Tramroad ran from Govilon up the southern slope of the Clvdach Valley to Brynmawr and Nant-y-glo (5½ miles—8.85km). Built by Crawshay Bailey in 1822. In need of some consolidation and to have the tree growing out of it removed.

Greenfield bridge, Edwardsville, Quakers Yard, Merthyr Tydfil, Mid Glamorgan ** Sch.**
(ST 0904 9655) **I,N,S.**
Large span masonry tramroad bridge carrying the former course of the Penydarren Tramroad over the River Taff, incorporating the abutments of the earlier wooden bridge, which had collapsed on 15 February 1815 while a train was passing over it. This and its 'sister-bridge' (see below) are two of the largest early railway bridges constructed, having a span of 63ft (19.2m) at a height of 27ft 6ins (8.4m) above the water. Now used as a road bridge.

Neath Abbey Ironworks, forge tramroad Bridge, West Glamorgan ***
(SS 7381 9795) I,N,S.
A fairly small early nineteenth-century stone-arched bridge with integral weir. It has a parapet of ogee-moulded copper-slag blocks and is particularly important for its group value in the middle of the Neath Abbey Ironworks, one of the most important industrial archaeological sites in south Wales.

Nine Mile Point, bridge and embankment, Wattsville, Gwent *
(ST 2034 9108)
This fine masonry arch carried the Penllwyn Tramroad over the Sirhowy River. It achieved sufficient height to connect with the Sirhowy Tramroad by means of an embankment. Both bridge and embankment carry a footpath to the site of the former railway station for Wattsville. The tramroad was opened in 1824 and was five miles (8km) long.

Pont Gain, Gelli-groes, Gwent *
(ST 179 942)
A masonry arch carried the Penllwyn Tramroad over the Ebbw River below Gelli-groes. The tramroad ran to Blackwood and was opened in 1824.

Pont Hemley. Afon Llynli, Llandyfaelog Tre'r-graig, Powys *
(SO 1289 2907)
Bridge and embankment built by John Hodgkinson for the Hay Railway in 1816-18. Part of the face of the bridge has collapsed and dammed the Afon Llynfi.

Ponthir, bridge, Gwent *
(ST 3338 9204)
A stone-arched bridge that carried the Pontypool Turnpike over the Caerleon Tramroad and the Caerleon Tinplate Works leat.

Pont-y-gwaith, bridge, Merthyr Tvdfil, Mid Glamorgan ** Sch.**
(ST 0808 9775) **I,N,S.**

Small-span but high arch carrying a road over a secondary diversion straightening the line of the Penydarren Tramroad.

Pont yr yard, Aber-eraf, Powys *** Sch.
(SN 8154 1248) **I,N,S**
A large stone arch with pierced spandrels that carried a colliery tramroad over the gorge of the River Tawe. Built by the colliery owner Daniel Harper c.1824.

Pwll y Llygod Bridge. Dyfed ****
(SN 4461 0681)
A fine single-arched bridge of c. 1770 which carried a railway from coal-pits near Pwll y Llygod farm over the Gwendraeth Fawr to Kymer's Canal. The collieries, and presumably the bridge, were still in use in the 1860s. It is a monument of considerable importance, as the oldest railway bridge in Wales and the second or third oldest in the world.

Redbrook. bridge. Gwent * Sch.
(SO 5367 1026)
Overbridge on the Redbrook Incline.

Skewen, Mines Royal Copperworks, tramroad bridge, West Glamorgan ** Sch.
(SS 7314 9691) I,N,S.
A stone-arched bridge over the Tennant Canal constructed by the engineer William Kirkhouse in 1821.

Victoria bridge. Quakers Yard, Merthyr Tydfil ** Sch.**
(ST 0943 9627) **I,N,S.**
Large span masonry tramroad bridge carrying the former course of the Penydarren Tramroad over the River Taf. Now used as a footpath bridge. Built in 1815 to dimensions similar to those used on the Edwardsville bridge.

Stone viaducts

A large number of long multi-span railway viaducts were constructed along the lines of horse-drawn railways. The steeper gradient profiles tolerated on these early railways and the lesser capital available to finance large-scale engineering, compared to the later joint-stock companies, resulted in many of these structures being fairly low in height and largely indistinguishable from the road bridges that had proceeded them.

There were, however, some high viaducts which had a secondary use of considerable social interest. It was common practice for workers to build dwellings using whatever existing shelter or walling was available for cheap and easy conversion: for example the bridge-houses of the furnaces at Dowlais Ironworks and the ruins of the vaults of Neath Abbey were used for such purposes. The few high viaducts on early railways offered similar opportunities and in 1799 at a site adjacent to Blaenafon Ironworks 'the want of habitations for the increasing number of families had occasioned an ingenious contrivance: a bridge being drawn across a steep dingle for the support of a railroad leading into a mine, the arches which are ten in number, have been walled up and formed into dwellings.' This 'contrivance' would not have been applicable, of course. to those viaducts solely crossing substantial rivers. The great thirty-two arch Risca Viaduct on the Sirhowy Tramroad was planned with the consideration that houses could be built under some of its land arches. However, this practice seems to have been discontinued in more favourable times due to the seepage of water through the flat decks of the railway viaducts (although viaducts at Blaenafon and Moira had gabled roofs).

Some of the early locomotive railway viaducts also sheltered accommodation and at least one instance is particularly well documented. Three and three-quarter miles (6km) of viaduct, comprising no less than 878 arches mostly of 18ft (5.5m) span, 28ft (8.5m) wide and 22ft (6.7m) high, were built in 1834-38 on the London and Greenwich Railway. On the 7 June 1834 the board of that railway resolved to provide accommodation for the houses of families whose houses had been demolished to make way for the railway. Gas light, heating and cookers were to be provided so that railway passengers would not be inconvenienced by the smoke expelled from countless chimneys along the railway. A consideration that had not applied to the nine chimneys protruding above the track at Blaenafon. In 1835 two demonstration houses had been completed in the viaduct at Deptford with six rooms each, described as small, but neat and comfortable. On 12 March 1836 one of the Deptford cottages was let for £20 a year but in February 1837 it was noted that 'the speculation has failed, for it was found that no sooner does a heavy shower fall than the water filters through the crown of the arches. This was an early lesson in the impracticality of flat roofs in the British climate. By February 1839 no house dwellers remained in the arches. Like many early locomotive lines this railway was set on stone (granite) sleeper-blocks that

transmitted the vibration of passing locomotive trains directly into the arches below and this probably does much to explain why such housing was largely a phenomenon of the age of the horse-drawn railway.

However, there were other early instances of the use of viaducts for housing; in 1845 a number of arches under the London & Blackwall Railway were used for housing and also for an infants' school. There are also the remains of some houses still extant beneath a London. Brighton & South Coast Railway viaduct at Coldblow Lane, Newcross, in London.

Basaleg viaduct, Gwent ****
(ST 2883 8720)
Viaduct bearing a plaque reading 'RUMNEY RAILWAY CO. 1826'. An impressive ashlar masonry structure with four semicircular arches with 26ft (7.9m) spans set on short piers with pointed breakwaters. Reused and widened by the succeeding Brecon and Merthyr locomotive railway in 1863 and latterly used by British Rail. George Overton was surveyor to the original company. Recommended for listing Grade 2 in a Welsh Office list of 1970. The modern usefulness of the bridge has been based on the rail-borne trade from Machen Quarries and the future of this important viaduct deserves some consideration.

Bont Fawr aqueduct and viaduct, Pontrhydyfen, West Glamorgan ** Sch.**
(SS 7954 9415) **I,N,S**
Built by the ironmaster John Reynolds in 1824-27 in order to convey water at a suitable height to provide the waterwheel-driven blast at the Oakwood Ironworks. There is a local tradition that small boats used the structure and after 1841 a railway was also laid across the bridge. It is 459ft (140m) long and 75ft (23m) high. The four 7Oft (21m) span elliptical arches now carry a minor road.

Fforchdwm viaduct, Tonmawr, West Glamorgan *
(SS 8157 9692) **I,N,S.**
The piers of a fine three-span stone viaduct built in 1842 for the Glyncorrwg Mineral Railway. The arches were demolished in 1979. The road from Tonmawr to this point is built on the railway formation.

Pont y Doctor or Machine Bridge viaduct, Glyn-taf, Pontypridd, Mid Glamorgan **
(ST 0839 8928)
A large stone-built three-arch bridge built over the River Taf, latterly used to carry the A4058 with modern accretions on the original superstructure. The structure was originally part of the tramroad that opened up the Rhondda Valley for colliery development, and was built for the entrepreneur Dr. Richard Griffiths in 1809. The line was eventually 5½ miles (8.9km) long. The second name of the bridge was derived from a weighing-machine of the tramroad that stood at one end of the viaduct.

3 Ogmore River-viaduct, Glan-rhyd, Aberkenfig, Mid Glamorgan **
(SS 8989 8278)
Bridge of three stone-built arches over the River Ogmore designed by the engineer John Hodgkinson as part of the Bridgend Railway in 1829, part of the 20¾ miles (33.4km) leading to the harbour at Porthcawl. Now used as a minor-road bridge, the structure bears the inscription: 'Erected in the year 1829 by Morgan Thomas, Laleston, Mason'. It has some importance as the last structure remaining from the general-purpose Bridgend Railway.

Risca viaduct, Gwent ***
(ST 2358 9079—ST 2388 9068)
This was possibly the largest structure built specifically to serve the purposes of a horse-worked railway. It formed part of the 25 miles (40km) of line built from the Sirhowy Ironworks to Newport. This tramroad was built in two sections in 1802-05 by the engineer John Hodgkinson who had formerly worked with Benjamin Outram. The viaduct seems to have been 48ft (14.6m) high with 32 arches, and to have been built of extremely fine masonry'. The western stub of the approach to this splendid structure survives at Dan-y-graig Road, Dan-y-graig, Risca and the eastern abutment of the bridge alongside Tredegar Road, just below Risca Station. It was planned so that dwellings could be built beneath some of the arches, as indeed was done elsewhere.

Ynysafan viaduct, Cwmafan, West Glamorgan **
(SS 7870 9231)
Three-arched bridge carrying the Bryn Railroad of 1839-41 over the River Afan. This fairly short line took coal from collieries at Bryn westwards to the copper- and ironworks of the English Copper Company at Cwmafan.

Ynysygeinon viaduct, Ystalyfera, West Glamorgan *
(SN 7608 0708) **I,N.PS.**
This five-arch viaduct across the River Tawe was on a 400m long line leading from Ynysygeinon Colliery to the

Swansea Canal. In 1824 the Rev. Edward Thomas of Ynysygeinon applied to the Swansea Canal Company to build a railway to carry 'coal, culm and other goods, wares and merchandise to and from the said canal'. The eastern abutment and the most easterly of the piers survive.

Timber bridges

The great majority of bridges built on early horse-worked railways were built of timber The network of railways in the area of the Swansea Valley alone had about 26 major river-crossings and no less than 22 were constructed of timber.

Nant-y-cae ('Red Gill') timber-bridge site, nr. Crai, Powys **
(SN 8898 2064) **I.N.S.**
Some structural timber beams remain *in situ* on intermediate supports and these rare survivals and the small adjacent construction quarries on varying levels make this site of interest. Designed by Joseph Jones *c.* 1822.

Resolfen, bridge across the River Neath, West Glamorgan *
(SN 8270 0310) **N.**
The timber supports are still visible in the bed of the River Neath for a timber trestle that carried the 1,500m long Resolfen colliery tramroad, built to convey coal to the Neath Canal for J.W. Lyon in 1839-40.

Waun-y-coed, bridge across the River Tawe, Pontardawe, West Glamorgan * Sch.
(SN 7377 0494) **I,N.**
The base of the central timber supports are still visible in the river-bed and the stone abutments remain of this bridge built by the engineer William Brunton Senior in 1828 for the ironmaster George Crane.

Iron bridges

Iron girder-bridges had been built by the Chinese as long ago as *c.* 1000 AD. and the first known such bridge constructed in Europe was built over the Glamorganshire Canal by the local engineer Watkin George *c.* 1790. George then seems to have built Pontycafnau and a second iron railway bridge in 1793. Many iron railway bridges were subsequently produced in the iron-making centres of south Wales before George Stephenson built his Gaunless Bridge on the Stockton & Darlington Railway in 1823-25, often claimed to be the first iron railway bridge.

The construction of a 72ft (22m) span wrought-iron bridge at Kirklees in West Yorkshire in 1769 had preceded the construction of the famous cast-iron arch at Ironbridge in Shropshire, built in 1779. The date of the construction of the first wrought-iron railway bridge is unclear, although a lattice wrought-iron span was constructed to carry the Penydarren Tramroad over the Morlais Brook at Penydarren End in Merthyr Tydfil at an indeterminate date. The tramroad had originally been constructed by George Overton in 1799-1802. Only the stone abutments and a fragment of girder remain of this bridge which collapsed while the process of listing it as an historic structure was under way.

Llanelli, 'The Ironbridge', Dyfed ****
(SN 4988 0054)
The ironmaster Alexander Raby carried his main railway line over the original course of the Lleidi River by the 'ironbridge' constructed between 1798 and June 1802. This presumably may have been the world's third iron railway bridge after the two constructed at the Cyfarthfa Ironworks. No details of the bridge are known. The Lleidi River was later diverted and the bridge or its remains lie under the succeeding locomotive railway immediately to the south of the Pembrey Road overbridge. A large fish-bellied cast-iron girder carries a works siding over the later course of the Lleidi River to the south, on the western side of a main railway bridge (SS 5001 9998). This seems more likely to be a localized survival of archaic practice rather than a reuse of the earlier bridge. The latter was probably left in place over the settling infill of the old river course.

Llanelli, Wiselboom Bridge ***
(SN 4993 0042)
The ironmaster Alexander Raby carried his branch railway to Cae-maen colliery over the old course of the Lleidi River 150m upstream of the 'ironbridge' *c.* 1801. It seems likely that this was also made of iron, possibly cast from the same patterns as the presumably earlier 'ironbridge'. The remains may lie under the site of railway sidings at the end of Parkview Terrace.

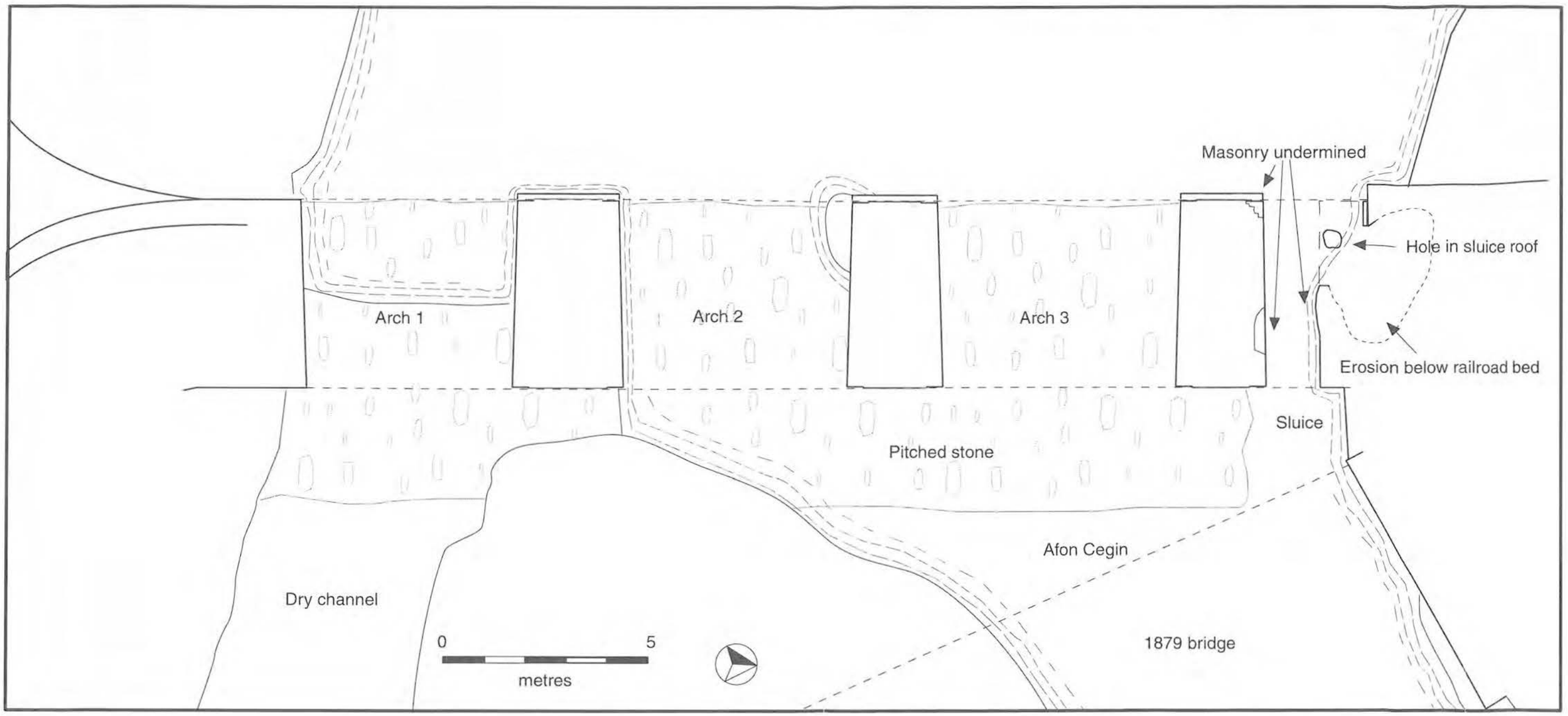
Llanfoist, bridge, Gwent **
(S0 2850 1300)
The continuation of Hill's Tramroad to the coal and lime wharves at Llanfoist Village was achieved by a bridge over the Brecknock and Abergavenny Canal. This has a deck of cast-iron plates laid on cast-iron 'T'-section girders. Hill's Tramroad was opened in 1822. The bridge is still used for vehicular access to the adjacent Canal House.

Pontycafnau, Cyfarthfa, Merthyr Tydfil, Mid Glamorgan ** Sch.**
(SO 0376 0713) **I,N,S**
A cast-iron tramroad bridge and aqueduct, originally part of the sub-structure for the high-level water-feed to the massive *Æolus* water-wheel driving the blast to the Cyfarthfa Furnaces. Authorized in January 1793 and almost certainly designed by the local engineering prodigy Watkin George. This was probably the world's first iron railway bridge and is also significant in the way that it can be shown to have influenced the design of the iron canal aqueducts at Longdon-upon-Tern and Pontcysyllte. The abutments of a bridge probably cast from the same patterns remain just to the south in front of the Cyfarthfa furnaces.

Robertstown, bridge, Aberdare, Mid Glamorgan ** Sch.**
SN 997 056) **I,N,S.**
A cast-iron bridge with its 1811 date cast in. It was cast at the nearby Abernant Ironworks, as the name cast into the same hand-rail support as the date shows. The decking has been renewed: care needs to be taken that the integrity of such internationally significant structures is not destroyed

Stradey Level bridge, Pwll, Llanelli, Dyfed (*)
(SN 4871 0118)
The Stradey Level had an access railway leading southwards over the Afon Dulais and the latter is still bridged by a small cast-iron arch bearing the (upside-down) wording 'Waddle 1845 Lanmore'. The Llanmore/Lanmore iron foundry at the Wern was owned by J.R. Waddle. This line was still in use for horse-drawn rail traffic in 1964.

Waterloo Bridge, Penydarren, Merthyr Tydfil, Mid Glamorgan **
(ST 0555 0700)
A works access to the Penydarren Ironworks was facilitated in 1815 by the construction of an iron bridge over the Morlais Brook. This was named the Waterloo Bridge. An arched-beam of a cast-iron bridge is visible in a vertical shaft leading to the Morlais Brook culverts. The tramroad to the south ran through a tunnel on its way to the charging bank of the adjacent iron-furnaces.



Appendix 3, Fig 1. Plan of the Cegin Viaduct.

Plate 1 Cegin Viaduct, western side, oblique view

Plate 2 Cegin Viaduct, western side of sluice gate

Plate 3 Cegin Viaduct, damage to facing on western side

Plate 4 Cegin Viaduct, Eastern side, oblique view

Plate 5 Cegin Viaduct, pitched stone on river bed