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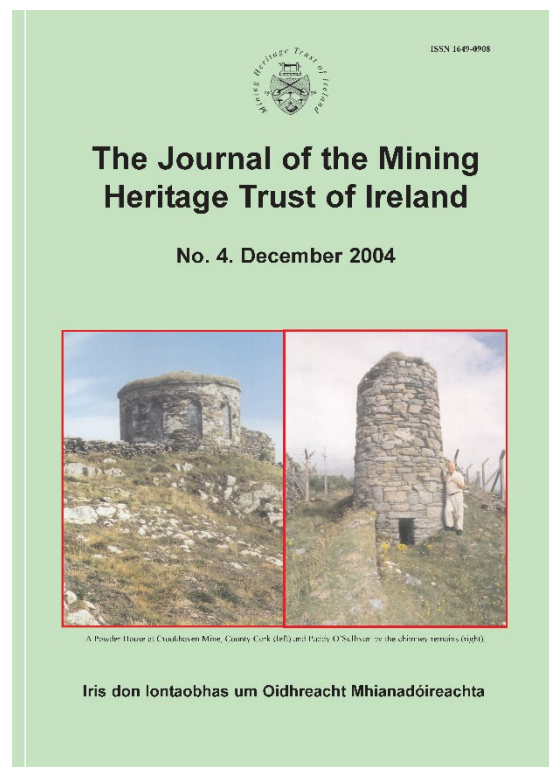
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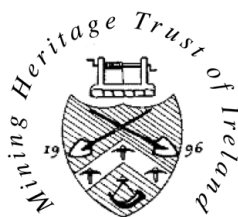
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THE AVOCA MINERAL TRAMWAY - A FURTHER LOOK INTO AN EARLY COUNTY WICKLOW MINERAL TRAMWAY

By Andrew Waldron, Danny Sheehan and Andrew Wilson

Abstract: In Journal No 3 December 2003, Mr Ewan Duffy presented a paper titled IN SEARCH OF HODGSON'S TRAMWAY which gave an account of the scant remains today, of the tramway. In this paper we aim to provide some of the answers to Ewan's many questions and provide an insight into what was a most enterprising early industrial line of communication. *Journal of the Mining Heritage Trust of Ireland*, 4, 2004, 31-40.

The Vale of Avoca was once a hive of industrial activity and from the various paintings and sketches we have seen of it to date, it really must have been on a very similar scale to the Ironbridge Gorge in Shropshire. Ironbridge enjoyed excellent communications with the outside world by means of the river Severn and numerous tub boat canals and tramroads were built in the 18th century between the industries and the river Severn.

The Vale of Avoca does indeed have a river but this is not usefully navigable, and the roads of the area were primitive. But the Avoca valley provided an easily graded route to the port of Arklow. Prior to the period 1845 to 1848, the years of the great famine, all of the local mining companies sent their output to Arklow by way of either carters' or pack trains of which there were some 2,000.

EARLY HISTORY

After the great famine enormous numbers of people left Ireland for better prospects overseas. Henry Hodgson probably saw this coming and decided that he needed a more efficient form of transport for his ores at a time when output was rising. Thus the mineral railway was born. The exact date is not clear but the Board of Works advanced a substantial loan to the Wicklow Copper Mine Company in 1848. This was the company that worked Ballymurtagh hill, west of the Avoca river. The amount of this loan or its purpose is not available but we suspect it would have been for the tramway. The Wicklow Copper Mine Company (WCM Co) had been granted two previous B.O.W loans in 1832 when new machinery of considerable power was being erected to the un-watering of the mine and the managers were expecting to give employment to upwards of 400 persons and in 1837 £550-00 was loaned in aid of machinery at Ballymurtagh copper mines.

The Avoca Heritage Society have supplied information that shows that the tramway was being planned in 1846 with construction commencing in 1847 but we do not know when the line actually opened to traffic. Early railway construction was a very labour intensive affair and we can only assume that even with a start being made in 1847 it would have taken at least a year to complete and possibly longer.

Our earliest reference found to the tramway being in operation is from the 1854 prospectus of the Wicklow Mineral Railway that anticipated that Mr Hodgson's mineral railway which was

then in use would connect with it. The company failed to get its bill through parliament. Hodgson directly mined Ballygahan, which formed a U-shape around Ballymurtagh to its east, south and west. He was also a major shareholder in Ballymurtagh and the same lodes went through the two townlands..

Our next piece of documentary evidence comes from an 1856 map. It shows the tramway as commencing at Ballygahan Lower. The late Kevin Murray produced the first account of this tramway in 1947 for the journal of The Irish Railway Record Society. Kevin had walked the route in 1945 following information he had gained from a period of earlier research and an article that covered the line in a railway periodical of 1944/45. Murray said that in tracing the route of the tramway that he had discovered that a line or the track bed at least, of a mineral tramway had been cut into a shelf in the hillside and this in turn ran past the great Bell Rock. It then approached the road and ran level with it and in turn reached the Red Road. At this point the branch made a connection and this connected with the marshalling yard and the incline.

In the past it looked like the branch which connected with the incline was in fact the first line as laid and that the line of route cut into the shelf was in fact the branch. However with the aid of the 1856 map it looks as if the mineral line did in fact terminate at the two loading platforms of the latter as referred to by Murray and the incline railway was added at a latter date.

A map dated 1840 of the Ballygahan and Ballymurtagh mines (Figure 1) showed what is believed to be the Red road or at least a part of that road as it was then and prior to it being extended. It shows the course of the two tramways along with the double track inclines. There is a reference to the winding engine as being installed in the year 1864. This is taken from the writings on Irish Railways concerning that year by G.R Mahon and he probably extracted the original information from the Dublin, Wicklow and Wexford Railway (DW&WR) minute books or from the newspapers of the time. Mr Mahon produced a whole series of articles concerning Irish railways for the period 1853 to 1879 and it is from his notes that appeared in the IRRS journals of the 1950s & 60s that we are indebted for information concerning this tramway. In 1864 the WCM Co was given as having erected a steam driven winding engine on the Ballymurtagh wagon incline. Again in the same year they asked the DW&WR if it would be possible to double the track on the horse worked mineral railway to Arklow and provide a dispos-

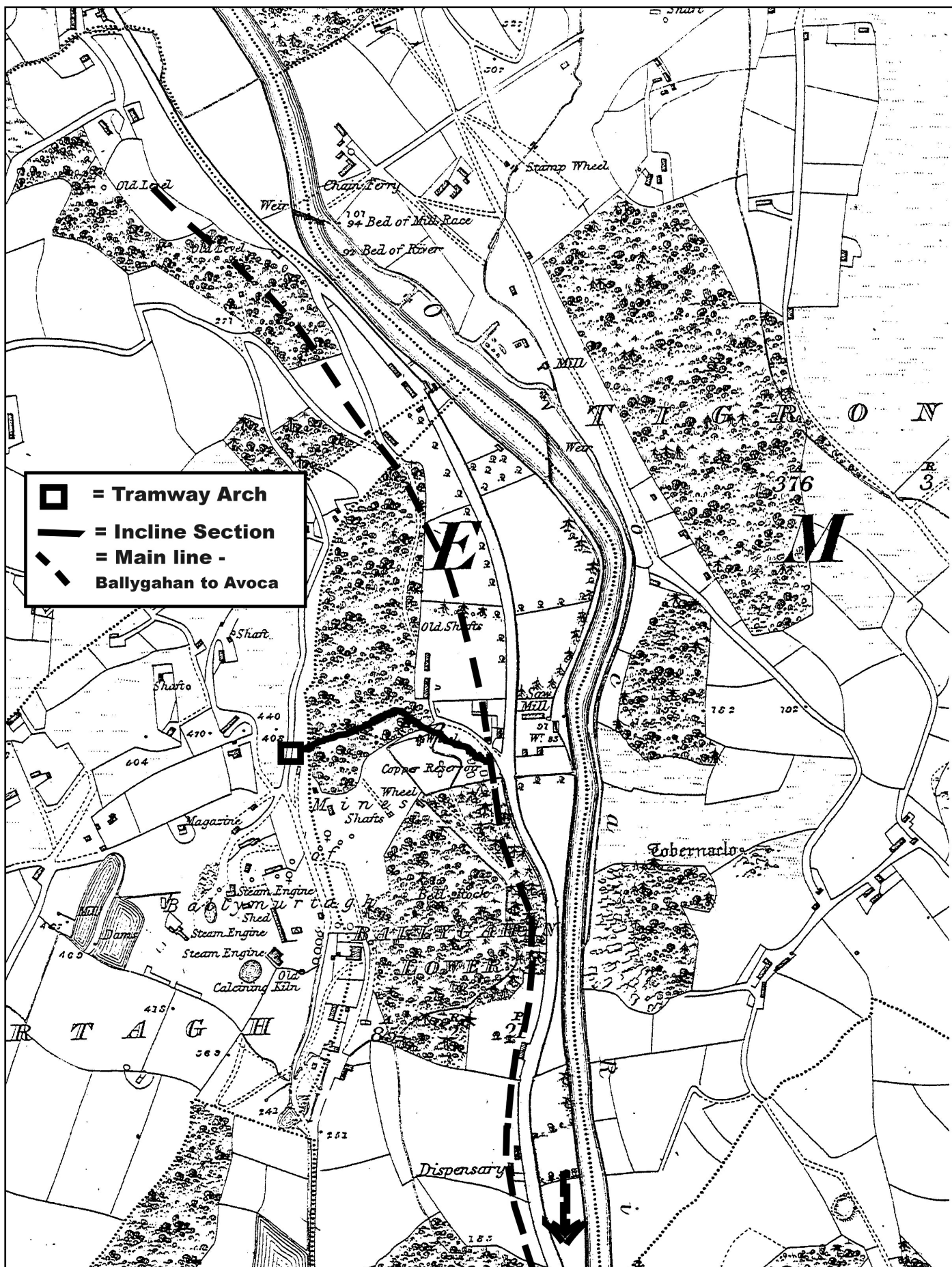


Figure 1. First edition 1840 Ordnance Survey six inch map of Ballymurtagh and Tigroney mines at Avoca, with approximate route of tramway and main rail line to Avoca highlighted.

al ground for the storage of ore at Avoca. Therefore we can assume that the tramway as laid was originally horse worked throughout and that the tramway running to Arklow was of single track.

THE INCLINES

Evidence by examination of the surviving stretches of this incline along with the arch by the Avoca heritage society would suggest that the Arch was built in the 1850s and strengthened latter in the 1870s. Ballymurtagh mine was producing 30,763 tons of sulphur in 1852 and moving such tonnages suggests that the incline had been built by then although it must be pointed out, that this is not shown on the 1856 map.

Research by the Wicklow Historical Society gives a slightly different view and they say that a double line of rails was laid down and on which an incline tramway was laid. It operated on a pulley system with the loaded wagons descending which in turn allowed the empty wagons to ascend towards the mine. Further power was supplied by steam from an engine of which the chimney stack is all that survives. This reads to some extent that a self acting incline and a steam operated incline were in operation simultaneously. We already have a date [as per above] that the steam engine was installed to power up the incline re 1864. It would seem that the DW&WR had in effect erected the steam engine on behalf of the WCM Co. who were probably the owners.

Most self acting inclines were built on the principle of using double track, either as two separate lines of rails running in parallel or using a three rail system with a passing loop midway. An examination of the said incline remains by the three of us and by Duffy has discovered that the incline had an acute curve at the halfway point. Again in the same vicinity is the chimney of the probable steam winding engine which it would seem replaced an earlier "Drum" engine sited at the same place. Thus the inclines were originally operated using two of these engines with one each operating the two separate incline sections and the steam engine would most likely have replaced these.

A NOTE, ON EARLY SELF ACTING INCLINE ENGINES

The Drum engine principle was widely adopted for double track self acting inclines in many parts of Britain and Ireland. The term "Drum" comes from the use of these engines which utilised a large wooden drum on which a continuous rope was wound. These engines were mainly confined to the North of Ireland, especially in the quarrying and mining tracts of County Antrim. The operation of these early Drum engines involved no mechanical power at all, but they had their limitations. The Avoca incline was in effect two separate double tracked lines that were either side of the acute left hand curve of the said route. Operation would have consisted of an engine house at or near to the very top of the incline and which consisted of a large wooden drum which was mounted on an iron spindle in either the vertical or horizontal position between two adjacent walls. Some of them had an overall roof as an added protection for the rope and drum against the elements. The whole structure was of an immense size and was either sited over or alongside the two

sets of railway lines at a point very close to where the actual descent was to commence.

Around this large wooden drum was wound the haulage rope. The rope having two ends of which one was attached to the empty rake of trucks usually ascending with the other end attached to the full wagons as going down and each rake had to be of equal proportions. In practice the rope was attached to the wagon nearest to the drum re the full rake going down while the leading wagon of the rake to ascend had the other end of the rope so affixed. As the rope was paid out to lower the full wagons it was being re-wound on to the drum by the ascending empties, in all a simple but effective system. Iron rollers were then arranged between the rails of the two separate lines and which resembled those of the old-fashioned clothes mangles, these were mainly to keep the rope in check as it travelled along and acted as a weight that kept the rope taut.

Slip lines were usually put in at the bottom of each line, which fed to a catch pit and acted in case of a run-away such as the rope breaking when wagons were on the incline slope. These slips usually had a one-way point blade that was operated either automatically or by the ganger who attached the empties at the bottom of the run. Thus if a runaway occurred then the wagons were diverted onto the slip line and allowed to crash before they reached the bottom of the line. The rope then passed between these rollers before passing through a capstan, which acted as a brake. The brake itself was located between the two lines of rails at the very start of the descent of the incline or in some cases it was mounted inside the engine house and was activated by the engine driver. As the full rake descended on one track the empty rake ascended on the other and the brake controlled the speed.

The engine man had to be able to visually see both rakes at all times and because the incline in question is curved this indicates that two such Drum engines may have been used for each separate section. Full wagons could be lowered down without the need to bring up empties but empties could only ascend if a full rake was to go down. The steam engine, which was installed in 1864, would most likely have replaced these two earlier engines and was sited at the midway point [as illustrated in Duffy 2003]. A return roller would have been required at the top of the first incline to enable the rope coming from the steam winder to return to same. In principle the operation was broadly similar to that of the earlier non-mechanical Drum engines but it allowed for both inclines to be in use using the one powered steam engine. Research into the steam engine as used shows that this was built by the Lincoln firm of Robey. Just what this resembled in its built form is not known but there would have been a power house either along side or mounted over the two adjacent lines and this would have had two winding drums operated by a steam brake with the steam engine sited alongside (Figures 2, 3). Again the engine man would need to see both inclines and this is amply illustrated by the remains of the engine house chimney at the mid way or curvature of the line. The steam engine would have greatly speeded up the operation of the trucks to and from the mines and would have allowed for a greater degree of flexibility.

While sulphur formed the vast bulk of what was transported,

there was also copper and some iron. One reference dated December 1861 shows that Hodgson commenced sending lead ore by rail from Avoca over the DW&WR line to Carrickmines for smelting at the Ballycorus lead works; the latter was served by a private mineral siding and which was worked by horse power. Apparently, the lead ore (possibly from his mine at Glenmalure) was transported to Rathdrum by road because the Avoca terminus only came into operation in 1864. Iron ore traffic commenced in 1864 and was shipped from Arklow. Of interest is that in the interim period between the DW&WR actually taking over as operators and the re-signing of the operations to the company's accountant following the agreed sale, ore was

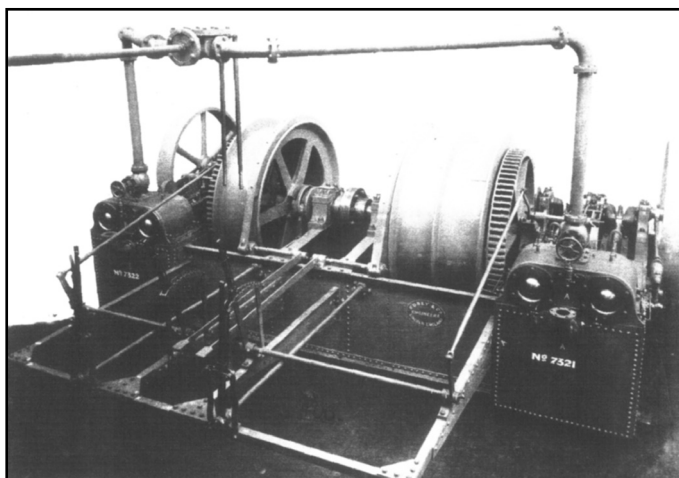
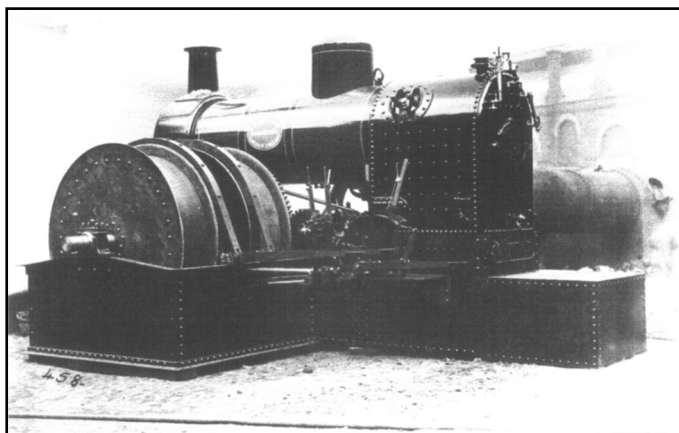


Figure 2. One of Robey's standard semi-portable engines geared to winding drums and mounted onto deep wrought iron foundation tanks. These units were shipped abroad using the tanks as packing cases for the component parts. They were assembled on flat ground then waste material from the shaft was piled up around the tanks.

Figure 3. Photos from Mr P.J.M. Southworth.

being transported over the tramway for other mines on the east side of the river.

HODGSON SELLS THE TRAMWAY

In 1859 Hodgson decided to sell up his privately operated railway to the ever expanding DW&WR. The act of incorporation for the DW&WR company's extension from Wicklow to Gorey

had allowed for the take-over of a part of Hodgson's mineral railway. Kevin Murray states that a sum of £30,000 was to be paid for the section of tramway the DW&WR required. However this was not the amount that actually changed hands. It could possibly be that the company were to offer up to that amount or that they had allocated that amount in respect of purchase of same following a land valuation. Either way when the time came the figure was down to £16,000 pounds. In the year 1861 the DW&WR lodged a bill for clauses to be inserted to alter the course of the tramway in part only on the section between Avoca and Arklow.

The new route of the DW&WR was to occupy the course of the mineral line and the mineral tramway was to be reconstructed to run parallel with that line. In fact the mineral line was to be moved away from the river. This part of the valley was extremely narrow and it was this reason alone that led the railway company to acquire its smaller neighbour. It would seem that the tramway alignment occupied more land than it really required and the DW&WR wanted to have hold of the alignment for its own line. It may be that the company really wanted to do away with the mineral tramway altogether and strove to provide an alternative point of transfer between the tramway and the railway for the output from the mines. To this end a transshipment siding at Avoca was laid down and a larger portion of the ores raised were indeed moved from there to Kingstown Harbour. Ore still went via Arklow probably because the end customer had a preference to send its ships to Arklow or that the ships in general were calling there with other imported goods and the sulphur was their backload. Arklow was once a very important coal port and this remained so even after its larger neighbour, Kingstown [now Dun Laoghaire] became the main coal port for Ireland. Coal was almost certainly moved along the tramway to the mines for use in the steam pumping engines.

The tramway was to be taken over in its entirety from the mines at Avoca all the way to Arklow to be operated by the railway company with Hodgson paying dues for the tonnage of ores moved. The whole transfer and reconstruction was extremely complex. That DW&WR were to lease a forge from Hodgson and have twelve horses to operate the section running between the marshalling yard and the Avoca loading siding. The main line of the DW&WR was to be laid at a lower level than the tramway and from this we can deduce that the tramway was probably built on a raised embankment. This may have had more to do with alleviating flooding of the line should the river Ovoca, burst its banks. The works allowed for a transfer siding at Avoca to facilitate ore that was to be shipped through Kingstown harbour. When the tramway was originally laid it ran from the marshalling yard and connected with the short spur line to Ballygahan and from there as a single line running alongside the Western side of the county or valley road. At approximately 350 yards from Avoca the line crossed the road by way of a level crossing. This section had to be altered by several hundred yards so that the tramway would run into the goods yard on the same level as the main line railway. To do this the level crossing was abandoned and a tunnel was bored under the County road and thus the tramway ran in on the level into the new Avoca goods yard and mineral transfer siding. From there to Ballyraine the DW&WR operated the line using the

tramway locomotives that had been taken over from Hodgson. The section from Ballyraine to Arklow was to be operated with the use of horses.

The new main line railway had reached Avoca by the end of 1862. However, it was the 16th of November 1863 before the entire section from Wicklow to Enniscorthy was ready for opening. The first train of ore from the Avoca siding to Kingstown was moved on 27th January 1864.

The DW&WR were to have taken over the operation of the tramway to Arklow on the 1st May 1861. However it was not convenient for them to be able to operate it until its course had been altered in accordance with their own main line railway. The DW&WR decided that they were under an obligation to work the said tramway without an interruption in the service and issued adverts for a temporary lease of the line. Two offers to work same were received; one from the contractor, Thomas Edwards, who was building the line for the DW&WR, while the other was the Ringsend Foundry Company of Dublin. In the end an agreement with Hodgson could not be reached and as a compromise Thomas Hone who was the WCM Co's accountant stepped in to take over for the interim period.

An agreement was then drawn up between Hodgson, the WCM Co and Thomas Edwards the contractor and that would allow for the alterations necessary to the tramway and at the same time for accommodation of the Wicklow and Wexford railway to occupy the original tramway route. This allowed for a 5-mile stretch of the tramway to be re-laid towards Arklow.

The alteration of the tramway involved the diverting of the river Avoca near to the village itself and the tramway being diverted to run on a new alignment on the West side of the new course of main line railway and to the lowering of the tramway on its approach to the proposed DW&WR goods yard with the provision of a tunnel under the valley road and a new track bed to suit the new railway works. What actually took place was that this work was carried out first, with the original route as unaltered and after completion of the various sections of new tramway the old route was slewed in to connect with that of the new. Working of the tramway was therefore only interrupted upon the latter slewing of the two sections of track-work.

The new alignment for the tramway utilised 170 tons of second hand rails and 8,000 new wooden sleepers each of 7 feet in length along with a new embankment that allowed for both lines of tramway and railway to parallel each other. At Ballyraine the tramway passed from the west side of the route under the main line railway and resumed its old course into Arklow. When the DW&WR built its extension to Shillelagh from Woodenbridge junction in the period 1863 to 1865 it crossed the tramway on the level by way of an intricate flat crossing controlled by signals and the basic remains of the crossing are still to be seen today.

On the 29th of April 1861 the DW&WR company's engineer, S.W Haughton, and William Dargan, then a director of the railway, visited the tramway to inspect the rolling stock and locomotives. The transfer of the sum totalling £19,850-00 to Henry

Hodgson was paid on the 1st of May 1861 for the tramway inclusive of equipment and was handed over the next day at Ballygahan. At that time Mr S.W Haughton was in attendance and he then marked and numbered the 100 wagons as acquired along with the two locomotive engines which were handed over to the WCM Co's representative Mr Thomas Hone. The WCM Co then continued to operate the tramway much as before.

By the spring of 1863 the new alignment of the tramway was completed in full and the hand over from the WCM Co to the railway company took place on the 3rd May 1863. At the same time a further locomotive engine and 12 wagons were transferred to the DW&WR from the WCM Co for £576-00. The source of locomotive and wagons is apparently not recorded.

THE DW&WR'S OPERATION

Although this company took over the operation of the tramway in 1863 it was not until 1864 that we are furnished with any more news on it. In that year a steam engine was installed on the Ballymurtagh wagon incline as already mentioned. The only other mention in 1864 is that at Avoca a shed was provided for the tramway locomotives.

Again in 1865 there is a mention in the surviving railway records to the tramway and the WCM Co in particular as being displeased with the charges for the movement of ores from Avoca to Kingstown. The DW&WR stated that they collected the ore from the Ballymurtagh mine and moved it over the tramway to Avoca using horse traction and there it was re-loaded into the company wagons and taken to Kingstown, a distance of 38 miles and that they made out the shipping documents and shipped the ore. The amount charged for this was 4/3d (4 shillings and three pence) per ton and their profit was only ¾d (0.75 pence) per ton per mile. The tramway was also operating using the old agricultural engines on the section from Avoca to Ballyraine and from there to Arklow using horses. The DW&WR attempted to re-lease the line on this latter section to the WCM Co but failed after their offer of £1,500 per year was turned down. Quantities of mine stone were brought over the tramway to Arklow in connection with the building of a chemical & manure works at the North Quay in 1865 (which Hodgson also had a large interest in).

During 1866 the dispute between the WCM CO and the DW&WR about service and charges continued, with an additional complaint about a road crossing at Avoca. However agreement was reached in November for the WCM CO to take over operation of the tramway to the north of Avoca station and that all the ore raised would be loaded at Avoca for onward movement via the main line railway. The mention of the road crossing probably refers to the road leading into Avoca via the river bridge, as this was originally a level crossing for the DW&WR main line. The present bridge over the railway at that location was installed at a later date after the tramway had closed.

In 1867 it was reported that sulphur ore was being shipped through Kingstown Mineral Wharf which had originated at Avoca station. Some ore was still being sent over the tramway

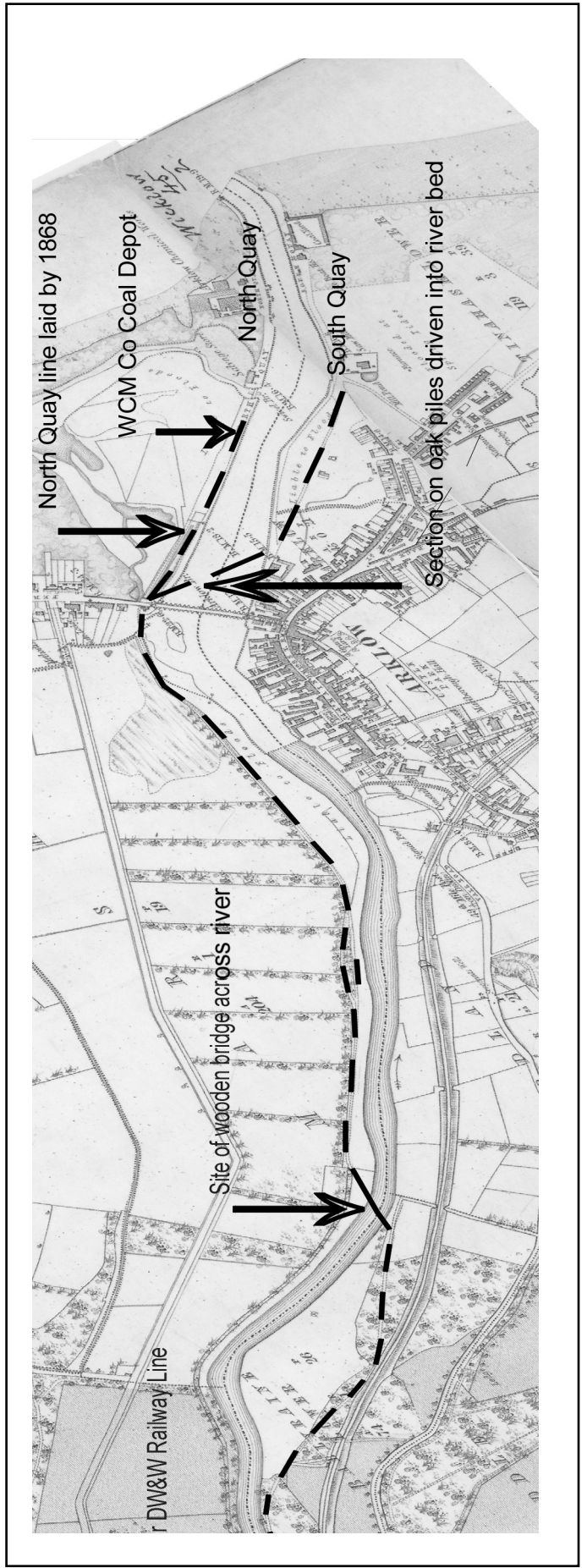
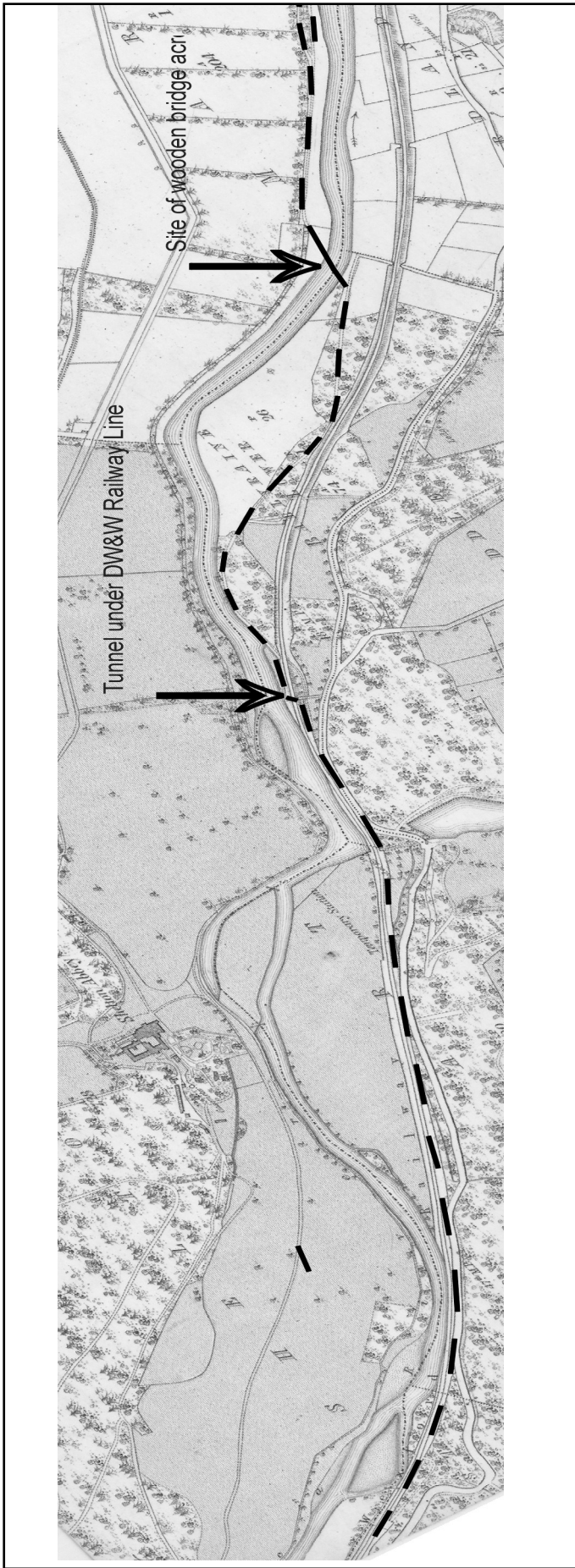


Figure 4. Figure 5. 1868 1:10,560 maps with line and details of mineral tramway approaching Arklow superimposed.

to Arklow but this was of a lesser amount. In the same year the DW&WR were having a lot of trouble with the tramway locomotives and it was reported that the tramway to Arklow was out of order because the only available locomotive had broken down. Mr William Murphy the DW&WR engineer was to report with the capital expenditure needed to make the tramway operable with locomotive power to the bridge at Arklow. The only other note from 1867 is that the wooden tramway bridge over the river Ovoca was damaged by floods; presumably this refers to the crossing of the river nearer to Arklow. The DW&WR drew attention to the fact that locomotive power should operate up to the bridge at Arklow. We can only speculate whether this ever took place. The DW&WR also had suggested using a main line loco to haul wagons on the tramway using the slip rope system. This involved hauling the wagons by use of parallel running.

In 1868 & 1869 there was a great reduction in the quantity of sulphur ore being shipped and 15,000 tons were stockpiled at Avoca station yard. In 1869 it was reported that the WCM Co had paid out to the DW&WR the sum of £6,300 for ore moved from Avoca.

THE 1870S AND THE BEGINNING OF THE END

An 1870 newspaper report says the Wicklow Copper Mines Co. Ltd. had installed a tramway of 3ft-6in gauge at the 60 fathom level and connected with the DW&WR companies' mineral tramway running to Arklow via Avoca station permitting ore drawn out of the mine to be transported without the need for transshipment. It would be interesting to know how the 60 fathom level of this mine related to the tramway level.

Further to the above, a print of 1945 showing a section of the lower portion of the incline is reproduced here (Figure 6). It indicates that by this date the lower section of the tramway had been put into order in connection with the state owned "Mianrai Teoranta". It also shows that the lower section of the second incline was being used to transport the ore from a drift or level situated near to or at the top of this line, possibly from the 60 fathom level. If so then this tramway would have connected with the head of the second incline. In addition, about halfway along the incline two twin walls are shown either side of the tramway. These are not readily explainable but they could possibly be the support walls of either the steam winding engine or that of the Drum engine.

Our next reference is dated 1873 when a derailment of a tramway train hauled by locomotive No 3 and inbound for Arklow. It obstructed the adjacent main line about 2 miles south of Woodenbridge. The directors requested their engineer to put the tramway into good order which was done by relaying with old rails from the adjacent main line. When the work was completed trains were able to attain an average speed of between 6&7 mph.

1873 may have been the final year for traffic going to Arklow, as in 1875 the tramway was lying out of service and unused. The DW&WR minutes stated that the loading platform at Avoca serving the line to Kingstown was out of action and the



Figure 6. The incline in about 1945 (see text for explanation). Permission to reproduce photograph from the Geological Survey of Ireland Archives.

tramway was likewise disused. The directors then had legal enquiries made to see if they were still liable for the upkeep of the tramway. Further evidence that a slump in the market had set in was recorded in 1876 when the Dundalk Harbour commissioners and a Mr Wardrop both made enquiries to the DW&WR over the purchase of the excess mineral wagons as used by that railway in conjunction with the WCM Co traffic to Kingstown Harbour. The prices as offered were insufficient and no sale took place.

The tramway or at least the section towards Arklow was still not in use by 1876 and the chief engineer to the DW&WR recommended that two of the three locomotives be disposed of, as they were unlikely to see use again. The No 3 loco was to be retained in case some traffic made a restart and the other two locomotives were to be sold. One of these was sold to a Mr William Wardrop of Wexford who had previously enquired about wagons. He was a small-time builder and contractor but we have yet to discover to what purpose he made of the locomotive.

Although the Avoca loading platform had been reported out of use in 1875 there was a small revival of the traffic the next year when the Dublin Wicklow & Wexford Railways income here amounted to £40 per week instead of the £500 enjoyed in the past. In 1877 Mr Hodgson unsuccessfully made a request to the company regarding a new contract for his ore to travel over the tramway to Arklow. Possibly the track required a lot of atten-

tion to put it into good order or perhaps Hodgson's anticipated level of traffic was too small. However, Hodgson had acquired a substantial interest in the Arklow Chemical Manure Company and his intention was to send his sulphur there over the tramway. A legal dispute over the continued use of the tramway then ensued, possibly over whether or not it was a public carrier and obliged to carry all traffic; but whatever the details, the court ruled in the railway company's favour and the tramway never came into use again.

By 1878 it was finally acknowledged that the mineral tramway between Avoca and Arklow had ceased operations. The DW&WR went on to help the WCM Co to maintain their tramway running from the Ballymurtagh mine via the incline, the Red road and the Bell Rock to the loading bank at Avoca. Horses were being used on the last stretch to reach the ore siding. By then one of the locomotives was still lying in its shed at Avoca and the other had been removed to the DW&WR companies Grand Canal Street works and later that same year an order in house was issued to dispose of it to a Mr Scott for the sum of £65. The tramway wagons were all scrapped early in 1881 but not before someone had tried in vain to buy them. The DW&WR were concerned that these wagons were for use on a railway construction contract and as a result would not let them be sold. Probably the contractor was building a rival line. Afterwards the tramway slumbered on in an intact but unused state until the Great War when in 1917 the rails were mostly removed for use at a number of Scottish collieries. How much longer the section of tramway north of Avoca station operated is not on record, but the last firm notes of ore going from Avoca station (by way of the DW&WR) was in 1900 for the Chemical works at Arklow.

SOME NOTES ON THE EARLY TRAMWAY ENGINES

By all accounts these were the earliest steam locomotives to have operated in Ireland for a private company other than that of a main line railway or contractors building them. We have traced one earlier loco reported to have seen use in Ulster on a land reclamation scheme from around 1838, but it is to Henry Hodgson that the real credit must be given for Ireland's first industrial steam worked line.

The locomotives that were used have been variously described as converted agricultural engines and while this may be quite true it must be remembered that at this early period purpose built industrial locomotives had hardly reached the development stage. Contractors were the main users of steam traction and most of the locomotives in their use were adapted ex-main line engines. Whether Hodgson actually converted the engines himself is not known. By about 1860 portable steam engines mounted on road wheels were being produced but these were moved around using horses. The self-propelled traction engine was in its early experimental stage. Certainly the DW&WR were of the opinion that the Avoca tramway engines had been converted from agricultural engines and not originally built as rail locomotives. Two firms which certainly built locomotives based on agricultural components in the early 1860s were Robey & Co of Lincoln and Aveling and Porter of Rochester in

Kent. There were other makers who were building agricultural type engines and could have had the capability to adapt them as locomotives but we have no evidence of their doing so at this period.

The traction engine or road locomotive only came on the scene in the mid 1860s and very few are known to have been used in Ireland. Effectively they can be discounted as being the basis of the Avoca tramway engines.

The agricultural or portable engine was much more widely used around 1860 and could realistically have been adapted to form the Avoca locomotives. Essentially these machines consisted of a locomotive pattern boiler, surmounted by a single cylinder steam engine, driving a crankshaft, with a flywheel on one end, which doubled as a belt pulley for the power output. The whole thing would have been mounted on simple axles and wheels to facilitate movement by horse power. To form a rail locomotive, a chassis on railway wheels would have to be provided instead of the simple road running gear. It would also be necessary to connect the steam engine crankshaft to the rail wheels by some means. Finally it would be necessary to arrange some means of carrying supplies of fuel and water; ideally, the chassis should incorporate some sort of suspension, a braking system, a means of coupling and buffering to the train being hauled and a safe place for the driver and his assistant to stand while in motion.

None of these are particularly difficult to achieve with 21st century technology but they did present some problems for the 1860s engineer, particularly one who was not familiar with locomotive construction. The most difficult point is probably the drive connection from the crankshaft to the rail wheels and the potential methods could include gears, belt and pulleys, or chain and sprockets. Gears need axles on fixed centres; suspension of gear driven axles is troublesome. Belt drives need large pulleys to transmit a reasonable power; leather belts would need quite large amounts of tension adjustment, and slipping could be a problem in some weather conditions. Chain drive looks most promising, although the quality of mid-Victorian chains was doubtful and rapid wear is likely to have been experienced. In the event we know that the Avoca locomotives had chain drive but we do not know how the other factors were addressed.

As noted previously, there were two British firms who in the 1860's did build locomotives which could be described as based on agricultural engines, Aveling and Porter of Rochester was the most productive, and records of their locomotives do exist but the first one was not completed until 1864, after the Avoca tramway locomotives were in use. The other candidate Robey, of Lincoln made far fewer locomotives and their early production records have not survived. They did however; supply a ten horse-power locomotive to Charles Hodgson, brother of Henry, for use at a peat works at Derrylea, Co. Kildare set up in 1860. It is not clear whether the Avoca or Derrylea locomotives came first, but the Hodgson brothers did work together on ropeway projects in later years and it is unlikely that they would not exchange news about their respective business ventures around the time that locomotives were being considered for Avoca and Derrylea. The balance of probabilities must be that Robey supplied the Avoca locomotives.

Quite by chance, we discovered a photograph, reproduced here, (Figure 7) of a very early Robey locomotive which closely fits the description of the Avoca machines. We must stress that it is complete speculation that it could be an Avoca tramway locomotive, but such descriptions as we do have point that way. The picture is obviously a Robey official record portrait although no details are available of what it shows, and there are no surviving production records as early as 1860. It is just a picture, make of it what you will. Prominently shown is the chain drive, which the Avoca engines had. There is no means of carrying fuel and water, but we know the Avoca engines had tenders. The wheels look quite small and DW&WR information says they were only 1'- 6" diameter originally. The chassis looks very crude, without brakes - perhaps brakes were provided on the wagons. It may be mentioned that the tender which was permanently coupled to the locomotive would almost certainly have had a screw-down handbrake in common with their main line locomotive counterparts. The only other means of slowing down would be by reversing the engine. Even main line engines of this period lacked brakes and worked to the same principles. There is no obvious springing on the chassis, which would make the locomotive very likely to derailment.

The locomotives were quite troublesome, particularly with their liability to break drive-chains, and in 1863 the DW&WR carried out modifications to one of the first two to improve its reliability and it was intended to make the same modifications to the other original locomotive if the first conversion was successful, which it was. The third locomotive is not reported as having been modified so it may well have been to an improved design, although it too is thought to be a converted agricultural engine. The modifications were quite major - abolition of the chain-drive and provision of inclined outside cylinders driving directly on the rear wheels which were of enlarged diameter. The cylinders would have been new because the original single cylinder was quite unsuitable for the modified arrangement. Figure 8 shows a locomotive and tender built for use on the Stockton and Darlington railway in England but both the four-wheel wooden tender and the vertical connecting rod to the wheels go some way to illustrate the above.

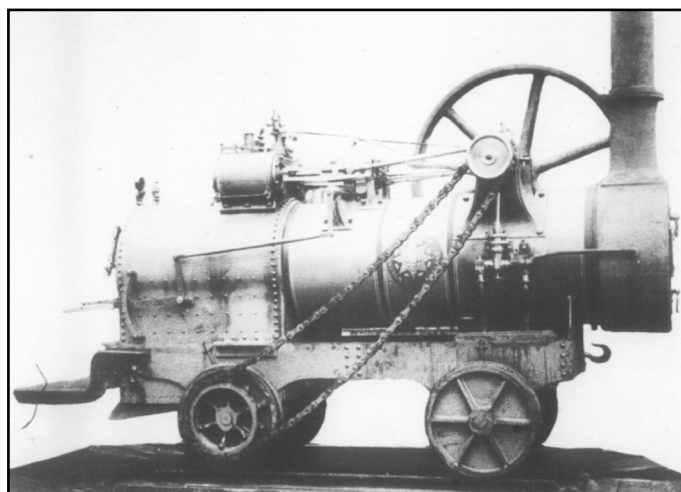


Figure 7. *Is this a Robey locomotive as used on the Avoca mineral tramway? Photo from Mr P.J.M. Southworth.*

We are ever hopeful that one day either the original DW&WR general arrangement drawing for the conversion of the locomotives from chain drive will turn up or that a photograph of one of said examples will come to light.

ADDITIONAL NOTES

The following extracts are taken from a number of contemporary sources including the company minutes and these should provide a small insight into the operations of the tramway.

On the 21st May 1863 one of the locomotives was taken up to the DW&WR Grand Canal Street works for conversion as given above. We then learn that on the 17th of December 1863 that the same locomotive had been operating over the tramway for a period of two weeks and was performing with the most satisfactory of results. As already said the second of the original locomotives would be so treated providing the first conversion was a success. This appears to have been carried out because on the 29th August 1867 we are told that the No 2 locomotive broke its crankshaft which was a feature of the conversion.

The tramway must have been very busy in 1867 because the three engines were referred to quite often regarding various breakdowns. On the 24th October all three engines were laid up either under repair or having broken parts replaced and as a result a tramway stoppage occurred lasting three days.

The third tramway engine, which was briefly referred to earlier, may have been purchased as a new locomotive either in 1862 or 1863. The price of £576 including the twelve wagons would seem to reflect this because the price of a new traction engine locomotive built by Aveling and Porter in 1865 would have cost £530, delivered. If we are to assume that the twelve wagons were purchased with the locomotive these would have cost around £2-10shillings each so that the cost of the locomotive alone would have been around £540 as delivered on site, bearing in mind that it had to be shipped over from Great Britain.

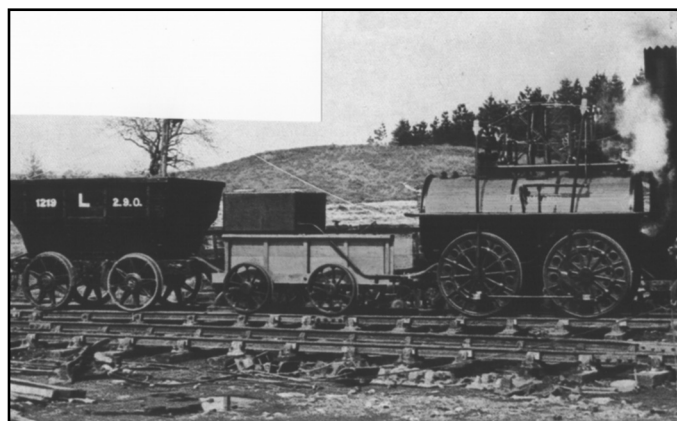


Figure 8. *A Stockton and Darlington loco image from P.J.M. Southworth to illustrate the wooden tender as used with the locomotives at Avoca. We acknowledge permission to reuse photo from Railway World Magazine of September 1975.*

In his article for the Irish Railway Record Society, published in 1947, Kevin Murray mentions that he had discovered the only surviving piece of tramway track as laid inside the abandoned tunnel near to Avoca village. Since then it has been discovered that this section of track was laid onto stone sleeper blocks. The rail was held to each block by a spike driven into the stone. It would seem that the rail was of the flat bottom type and it will be recalled that Ewan Duffy had also located a piece of similar rail on the incline section. A further survey by the three of us in 2003, also established another piece of rail of this type and this strengthens our belief that the tramway as originally laid was supported by stone block sleepers. When the tramway was partially rebuilt between 1861 and 1863 most of the stone-type sleepers were replaced with wooden ones having the rails spiked directly to them.

Although the main line of the tramway was of a single track there would have been some kind of a passing loop both at Ballyraine and at the transfer site at Avoca. These would have been necessary to allow the locomotives to detach from the loaded/empty wagons and for horse haulage to have been substituted for the next leg of the journey. In Murray's paper of 1947 he says that the chemical works of the artificial manure company was built on mine-stone from Avoca. These works were situated at the south end of the north quay at Arklow and had come into operation around 1868. An O.S map of this date shows the works as complete (Figure 5). The map also shows what appears to be the line of a tramway laid along the North quay and terminating just short of these works. Murray mentions that the sulphur ore was conveyed almost to the furnace mouth with the greatest of ease and this infers that a branch tramway which was horse operated ran from near the Arklow Bridge in connection with this..

A coal yard was established on this quay along with a stone built shed and both were still standing in 1945. The 1868 map shows some kind of a building within an enclosed area and at the point where the branch tramway terminates. Thus it is again possible that the coal for the mines was bought up from the North quay from at least 1868 by way of the tramway. We are informed that the shed was used for the black powder and it was bought by ship from Cork; this possibly implies that the gunpowder may have come from Ballincollig.

MIANRAI TEORANTA

This state owned minerals firm had established a small manufacturing plant near Avoca village in 1945 for the manufacture of synthetic fertiliser. The raw material consisted of sulphur ore and this was extracted from a drift mine situated at the head of the lower incline (Figure 6). A tramway of 2ft gauge was laid down within the drift mine and was operated using a small battery electric locomotive which hauled the U type mine tubs from the drift. These were then let down the tramway incline using an electric hauler at the bottom of which the ore was transferred to a lorry for onward movement to the production plant which was in operation to around 1955.

The compilers would welcome further comments or information to any of the above subjects covered by this article. Names and addresses supplied.

Andrew Waldron	Daniel Sheehan	Andrew Wilson
54, Middlebrook drive	19 Landen Road	35 Holt Park Road
Lostock, Bolton	Dublin	Leeds
BL6 4RH	Ireland	LS16 7QS
Lancashire		West Yorkshire
England		England

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