

Silver and Zinc: Cardiganshire, Brittany, and Dillwyn & Co. of Swansea

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Abstract: Dillwyn & Co. were established as a smelter of silver bearing ores at Swansea in the 1850s. By 1861 they had diversified into smelting zinc ores and had developed techniques to extract silver from those ores. Their sources were diverse, primarily overseas in origin, and included the rich argentiferous blende (sphalerite) ores from Pont Péan, a mine to the south of Rennes in Brittany, but Dillwyn's business partner, Evan Matthew Richards, was closely connected with mining in mid-Wales. He made specific reference to the Cardiganshire (now Ceredigion) mines as a source of zinc ores for their new Llansamlet Spelter Works. But how successful were they in extracting silver from the Cardiganshire ores? This paper explores that question, building on research into the smelting of the Pont Péan ores.

Introduction

The silver content of zinc ores, primarily blende or sphalerite, is seldom referred to when considering the economic potential of non-ferrous metal mines. Argentiferous lead ores, on the other hand, were frequently highlighted in promotional material for new mines in mid-Wales and elsewhere in Britain and the silver returns regularly reported in returns to the Mining Records Office and its successors.

Geologists have acknowledged the potential for silver associated with zinc ores in mid-Wales but there is little mention of it in the documentary record.¹ The situation is little better in Western Europe as a whole but there is one significant exception – the mine at Pont Péan, south of Rennes in Brittany (France, Ille et Vilaine).² Lack of reference to the potential for silver in zinc ores in Wales is perhaps surprising given that the leading smelter capable of extracting it – Dillwyn & Co. – was located in Swansea.

By the mid-nineteenth century Swansea, in South Wales, was probably the world's leading centre for non-ferrous smelting. From the eighteenth century onwards it had dominated the processing of copper ores mined in Wales and south-west England, moving on to treat the majority of the ores mined in the Americas, Australia and other developing copper mining fields. By the 1860s it had responded to the demand for zinc metal, stimulated to a large extent by the introduction of galvanised iron products, with some copper smelters switching

to zinc or 'spelter'. Swansea had also become a significant centre for the smelting of silver rich ores and mattes from overseas mines.

Dillwyn & Co. and the silver-rich zinc from Pont Péan

The role of Dillwyn & Co. in processing silver-rich zinc ores is highlighted in the documentary record for the Pont Péan Mine (Fig. 2) and the shipment of ores from Brittany to Swansea in the early part of the second half of the nineteenth century regularly noted in the *Cambrian* newspaper.³ With a large relatively shallow poly-metallic ore deposit, Pont Péan produced significant amounts of lead, zinc, iron pyrites and silver between 1847 and 1907 (Fig. 3). The silver-rich lead ores dominated the deposit and were the first to be worked, going to many conventional and specialist smelters for treatment; including the Tamar Smelter at Weirquay in south-west Devon and that at Combe Martin on the north Devon coast. Dillwyn & Co. probably processed some of that ore in Swansea as they were initially set up as specialist silver smelters treating a range of ores from Britain and overseas. As such they were well placed to take advantage of the dramatic rise in world silver production in the second half of the nineteenth century. Having remained at relatively low levels with no overall increase up to 1850, it would increase six-

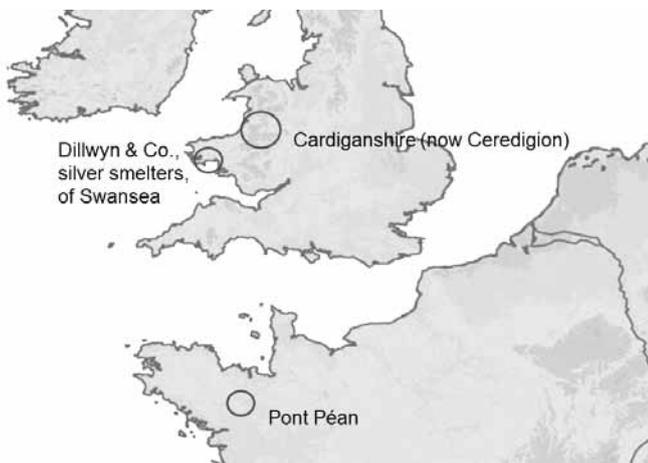


Fig. 1 Location of the principal sites referred to in the text.



Fig. 2 Little remains of the mine at Pont Péan beyond the administrative building and traces of one shaft head – most of the site has been cleared and turned to light industrial use.

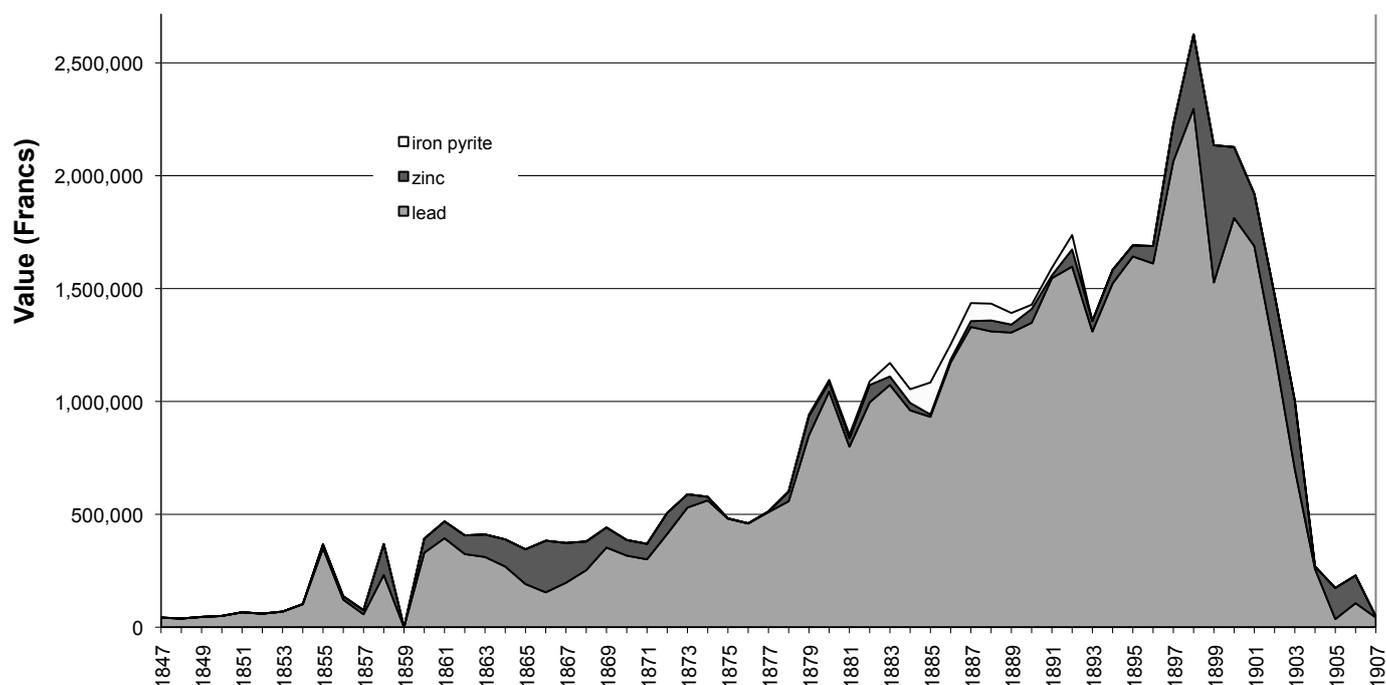


Fig. 3 Value of ore production, Ille et Vilaine (Pont Péan being the only producer in that department at the period). Source: Statistique de l'industrie minière, 1847–1907 (Paris: Ministère de l'agriculture, du commerce et des travaux publics: direction des mines, annually 1854 onwards).

fold with Mexico and the South American countries accounting for 50% of the increase.⁴ In 1853 and 1854 Dillwyn & Co. did purchase galena concentrates from various mines in mid-Wales, including Foxpath, Frongoch, Cefn Bruno, Level Newydd and Esgair Lle.⁵ Whether this was for their silver content is unclear as lead would be required to effect liquation, taking up the silver from rich but complex ores low in lead content.

Dillwyn's first 'Silver Works' was on the west bank of the Tawe, at Landore, located on the site now occupied by the Liberty Stadium. It was erected in 1853 using smelting expertise brought in from Freiberg in Saxony and was in operation by early July of that year.⁶ In anticipation of its completion the company was already buying in lead ores from mid-Wales.⁷ They were, however, probably largely reliant on ores being purchased on their behalf by Henry Bath & Son, an ore buying concern then based in Swansea.⁸ A large proportion of the silver ores shipped into Swansea was destined for Henry Bath, including numerous cargoes from Breton ports throughout the late 1850s (Fig. 4), the majority, if not all, of which would have originated from the mine at Pont Péan and much of that would have been smelted by Dillwyn & Co.

By at least 1861, perhaps as early as 1856–1858, Dillwyn & Co. had started smelting zinc ores from Brittany. A 'new works' had been established at Llansamlet, on the east bank of the Tawe, by 1858.⁹ It has been suggested that they had acquired Evan John's zinc smelter at Llansamlet and had replaced the English furnaces with the Silesian method of distillation.¹⁰ But that smelter, on the left bank of the river opposite the Landore Silver Works was a ruin in 1840 and probably of little use.¹¹ However, in December 1858, Dillwyn entered into two leases with the Earl of Jersey allowing him to erect a smelter (confusingly referred to as a copper smelter) and dump slag on a new site at Llys Newydd, subsequently shown on the maps as the Llansamlet Spelter Works (Fig. 5).¹²

In the late 1860s Dillwyn's sought to expand their zinc production enterprises. The company had an interest in a mine near Alicante in south-east Spain although the product of that mine is unclear. Its exact location is not yet known to the author but it may have been a lead/zinc producer; however the ores shipped to Dillwyn & Co. from that port in the first half of the 1860s are invariably described as 'silver ore' when listed in the 'Foreign Arrivals' section of the *Cambrian*. The company also had access to the produce from a mine at Konnerud near Drammen in Norway, producing 17,540 tons of lead and zinc ore between 1866 and 1875, and were actively looking at leasing a smelter at or near Newcastle upon Tyne in 1868.¹³ Prior to 1868 the zinc ores from Brittany and Pont Péan appear to have been a significant factor in Dillwyn's success and they were certainly significant for the success of the mine. From the early 1860s Pont Péan was increasingly dependent on the income from the zinc as its output of lead ores declined.¹⁴ The zinc ores were offered on an open market in which their silver content had little impact. In fact, with conventional smelting by distillation that silver was lost, being volatilised and exhausted to the atmosphere with no method of recovery. Dillwyn was evidently taking advantage of that situation – developing a method of extracting the silver prior to distillation and paying a little over the norm to acquire the ore, but not as much as the Pont Péan management felt it was worth.¹⁵

In 1868 Dillwyn & Co. were developing a new smelter on the Llys Newydd site at Llansamlet. They do not appear to have proceeded with the planned Newcastle smelter and the output from Konnerud was probably shipped to Swansea. Cargoes of ore continued to come across the Channel from the Breton ports but by the early 1870s production of zinc from Pont Péan was declining. The mine was also undergoing organisational re-structuring and had established links with Belgian smelting interests who treated most of the increasing output of silver-rich lead ores.

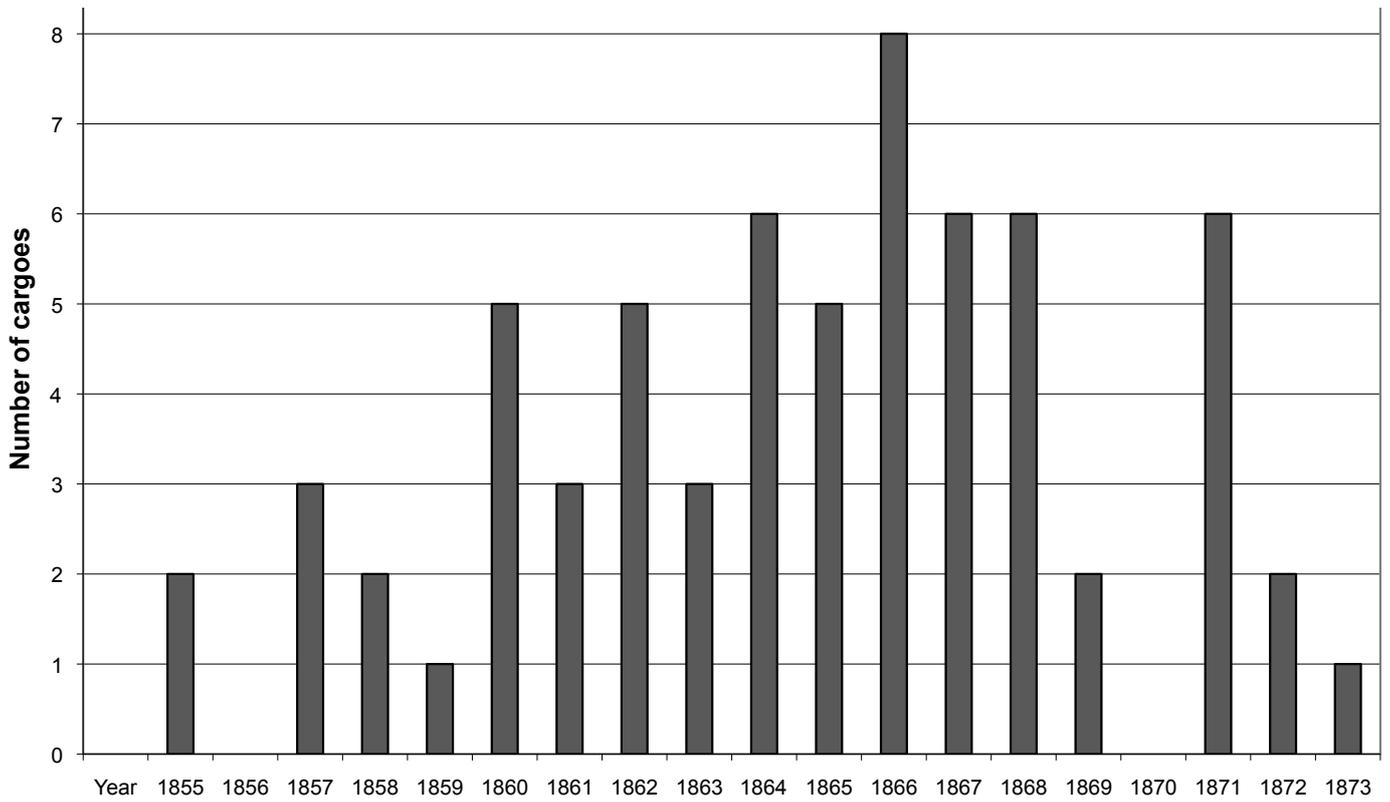


Fig. 4 Zinc ores shipped to Swansea from Breton ports (number of cargoes). Source: *Cambrian*.

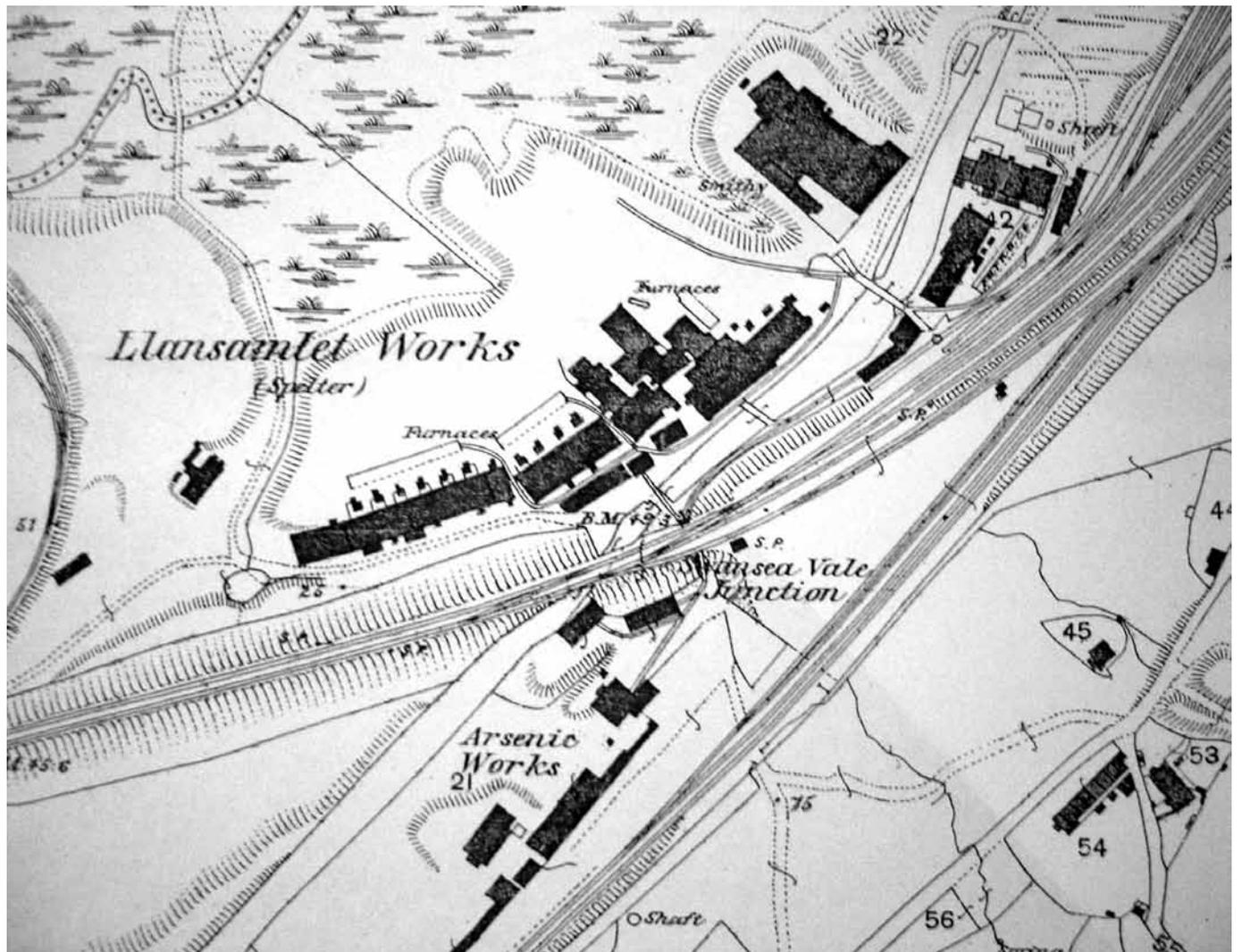


Fig. 5 The Llansamlet Works in 1881.

The processes used by Dillwyn & Co.

When Dillwyn set up business as a silver smelter in 1853 he drew in Central European expertise to set up the works on the Tawe. Unfortunately, no descriptions of the works at that period are known to the author but the employment of a Mr. O. Meissner from Freiberg to set up the first silver furnaces does suggest they were of the blast furnace type commonly used in Saxony.¹⁶ The blast furnace was, with significant modifications, used to treat the complex silver-rich ores with low lead/copper content being discovered and worked in the western parts of North America where the conventional British processes, the ore-hearth and the reverberatory furnace based ‘Welsh’ process, were not effective when dealing with low lead/copper silver-rich ores.¹⁷ We have, however, a little more information on the smelting of zinc ores.

In 1861 Percy published an account of the processes used by Dillwyn’s at their Llansamlet works where Silesian retorts were employed.¹⁸ But, as Percy stated, the ‘argentiferous blende is treated at those works, chiefly for the sake of the silver’ and straightforward distillation in retorts would result in the loss of the silver.¹⁹ The ores were first crushed to a fine powder (225/sq. inch) and then calcined for 22 hours before being subject to a ‘special process’ which William Penrose, Dillwyn’s works manager, would not disclose to Percy. The heat at which the ores were calcined was carefully controlled to avoid driving off both the zinc and the silver. There were some losses of the former but it was possible to recover them as precipitate from the flues. The ‘special process’ was in all probability a form of lixiviation, an adaptation of the Augustin process, where the roasted/calcined ore was combined with sodium sulphate in water to recover the silver as

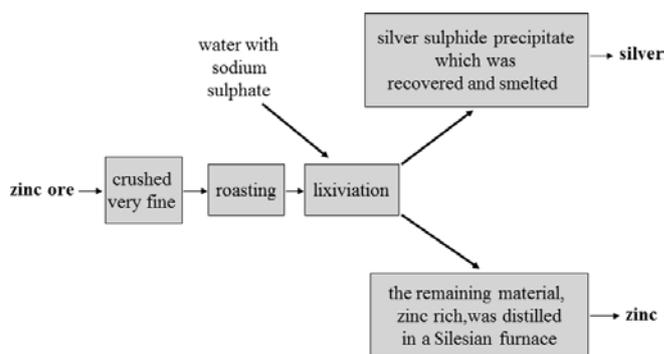


Fig. 6 A suggested flow diagram for the ‘special process’ used by Dillwyn & Co.

silver sulphide.²⁰ After drying, the zinc-rich residues were distilled in the Silesian retorts to recover the zinc metal whilst silver sulphide precipitates were treated to extract the silver (Fig. 6).

It is unlikely we will ever be able to examine the Llansamlet smelter site (Fig. 7) to find physical evidence for the process. The wholesale clearance of industrial sites in the Swansea Valley during the 1960s and 70s put paid to that option and the works, if there are any subsurface remains, now lie beneath the Enterprise Park.

E.M. Richards and the exploitation of Welsh zinc ores

Between 1868 and 1874 Evan Matthew Richards was an MP for Cardiganshire. He was also described as the managing partner in Dillwyn and Co., the specialist silver smelters in Swansea. His election as MP came at a time when Dillwyn’s



Fig. 7 The Llansamlet Works in 1946 (Welsh Assembly Government Photograph, RAF 106GUK 1625 3274).

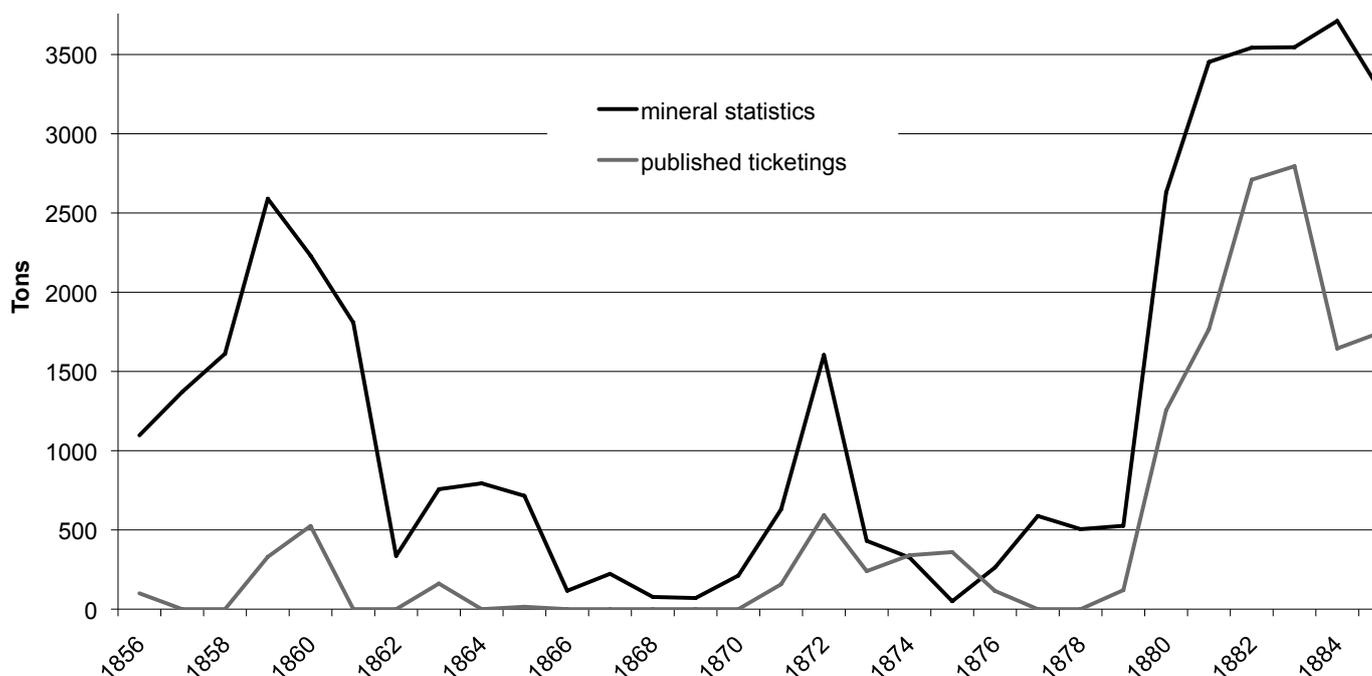


Fig. 8 Cardiganshire zinc production and published ticketings.²¹

were expanding their processing of zinc ores with the opening of their new smelter at Llansamlet. In the run up to and after the election the *Mining Journal* reported on the ‘representation of mineral interests’ amongst the candidates. In an article subsequently reprinted in the *Cambrian* it is reported that Dillwyn’s had ‘tried extensive experiments with the blende ores of Cardiganshire, which up to a few months past were considered useless. Success having attended the experiments made, large works are now being erected at Landore [sic] for the smelting and manipulation of these ores ...’²²

Dillwyn’s were purchasing the occasional batch of zinc concentrates from Cardiganshire prior to 1868 but there is little published evidence that Richards’ statement on the intention to develop that source was successful. Cardiganshire zinc production did rise after 1868 (Fig. 8) but how much of that ore went to Dillwyn & Co. in Swansea is currently unknown. Ticketing sales do not match the levels of production throughout the 1860s and ’70s but not all those sales were published in the mining periodicals of the period and there would have been many private sales, the details of which would not be published.

Richards’ exact role within the company is hazy at times. Dillwyn & Co. was evidently established at Landore using family money and there was a continuing family connection with its operations. For example, the mine at Konnerud, in Norway, was not owned or leased by the company but was apparently in the hands of a family member.²³ Although referred to as a ‘company’ in its early years Lewis Llewellyn Dillwyn was in practice the sole proprietor. It is clear from his diaries that he took a day to day interest in the works, personally taking the silver produced to dealers in London, but the operation of the Landore Silver Works was evidently in the hands of Evan Matthew Richards. Correspondence in the Bank of England Archive indicates that in 1855, when he was elected MP for Swansea, Dillwyn intended to lease the works to Richards and provide him with a supply of ores. It is not clear if that was carried out but by 1861 Richards was

describing himself as ‘a silver smelter in partnership with L.L. Dillwyn, Esq.’²⁴ In 1868 Richards was referred to as the ‘managing partner’ in the run up to the parliamentary election when he contested and won the Cardiganshire seat.²⁵

Summary and the potential for further work

The value of the silver to be found in combination with zinc ores was recognised by Dillwyn & Co., and it was exploited to good effect with the ores from Pont Péan. The ores from other mines in Norway and south-eastern Spain may also have been sources of argentiferous zinc but without detailed assays which take account of the connection between zinc and silver it is hard to come to firm conclusions. Zinc ores from Cardiganshire may also have been a source of silver. Some modern geological investigation does suggest their potential but without contemporary data is hard to be definitive on their value to Dillwyn & Co. There is much more that might be gleaned on the relationship between Dillwyn’s, and their managing partner Richards, and the Cardiganshire mines but the information is probably buried in the many company reports for the mines at that period. Short of a long and exhaustive search, we are reliant on chance discoveries and if they come to light as a result of this paper, it will have served its purpose

After Dillwyn’s death in 1892, with debts of £100,000,²⁶ his daughter Amy Dillwyn rebuilt the concern, returning it to profitability before floating it as a limited liability company. Amy Dillwyn then sold her majority holding in the company to Metallgesellschaft in 1902²⁷ and there remains the possibility that some of their records survive in German archives. This paper has therefore highlighted the possibilities that there was a connection between the exploitation of zinc ores in Cardiganshire and Dillwyn & Co., and that silver was recovered from those ores. It also highlights the potential for further research, the results of which might be reliant on chance discoveries and/or time consuming investigations in archival collections across Europe.

Acknowledgements

I am indebted to George Hall for providing me with data from ticketing sales published in the *Mining Journal* and Jake Almond for information on zinc smelting in the North-East of England. My thanks also go to Richard Morris for providing me with detailed extracts of the information contained in L.L. Dillwyn's diaries.

Notes

- 1 S.J. Hughes, 'The silver question', *Welsh Mines Preservation Trust Newsletter* (2008), pp. 10–15; John Mason, pers. comm.
- 2 Initial research was presented as P. Claughton, 'Dillwyn et le traitement du zinc argentifère de Bretagne', paper given to the Société Archéologique Française pour l'Etude des Mines et de la Métallurgie meeting at Melle (2006), <http://people.exeter.ac.uk/pfclaugh/mhinf/dillwyn.doc>
- 3 M. Simmonet, 'Résumé de quelques expériences sur le grillage des blendes argentifères', *Annales des Mines*, 6th series, 17 (Paris, 1870), pp. 27–36. *Cambrian* (Swansea), 21 June 1861 *et seq.* All the cargoes were despatched from ports in Brittany but, as Pont Péan was the only zinc producer active in the region at the period, it is safe to assume they all originated from that mine.
- 4 C.W. Merrill, *Summarized Data of Silver Production*, U.S. Department of Commerce, Economic Paper 8 (Washington, DC, 1930).
- 5 *Mining Journal* 1853, entries for 18 April, 30 May, 25 Aug. and 3 Oct., and 1854, entry for 15 Apr. – data supplied by George Hall.
- 6 Personal diaries of Lewis Llewellyn Dillwyn currently in private hands (hereafter Dillwyn Diaries), entry for 3 Jan. 1853; *Cambrian*, 14 Jan. 1853 and 10 June 1853.
- 7 Published ticketing returns in the *Mining Journal* for 1853 – data supplied by George Hall. The silver content of those ores would have been attractive to Dillwyn & Co. but they would have also needed the lead for the process of drawing out silver from difficult ores.
- 8 Dillwyn Diaries, entries for 13 and 27 Dec. 1852 and 26 Nov. 1853.
- 9 Dillwyn Diaries, entries for 14 Jan. and 6 May 1858.
- 10 E.J. Cocks and B. Walters, *A History of the Zinc Smelting Industry in Britain* (London: Harrap, 1968), p. 13; repeated in S. Hughes, *Copperopolis* (Aberystwyth: RCAHMW, 2000), p. 62.
- 11 National Library of Wales, Tithe Award, Llansamlet, 1840–44.
- 12 West Glamorgan Archives, Swansea, D/D BF 447 and 916; Ordnance Survey mapping, 1:2500, 1st edition, Glamorgan sheet XV:14 (1881).
- 13 E. Björlöw-Larsen and J. Sellaeg, *KonnerudVerket* (Drammen, 2002) p. 137, citing Norges officielle Statistik C.12. Dillwyn Diaries, entry for 8 Feb. 1868.
- 14 A. Brulé, *Mineurs de Bretagne* (Morlaix: Skol Vreizh, 1988). For an account of the mine in English, see N. Laffoley, 'Mining on Sark – the French connection', *Bull. Peak District Mines Historical Society*, 12.2 (1993), pp. 19–24.
- 15 Simmonet, 'Résumé'.
- 16 Dillwyn Diaries, 3 Jan. 1853.
- 17 J.E. Fell, *Ores to Metals: the Rocky Mountain smelting industry* (Boulder: University Press of Colorado, 2009).
- 18 J. Percy, *Metallurgy: Fuel; Fireclays; Copper; Zinc; Brass* (London: John Murray, 1861 – facsimile reproduction Eindhoven: De Archaeologische Pers Nederland, no date), pp. 558–72.
- 19 Percy, *Metallurgy*, p. 558.
- 20 See *Mining and Smelting Magazine*, V (1864), 139–41, and W. Gowland, *The Metallurgy of the Non-ferrous Metals* (London: Charles Griffin, 1921), pp. 413–15.
- 21 Sources: 'Mineral Statistics', collated production returns, from Burt *et al.*, *The Mines of Cardiganshire* (Exeter, no date) and published ticketing from the *Mining Journal*, basic data supplied by George Hall.
- 22 *Cambrian*, 11 Dec. 1868, p. 6.
- 23 Richard Morris, pers comm.
- 24 Bank of England Archive, Swansea branch letter books. *Cambrian*, 7 June 1861.
- 25 *Cambrian*, 11 Sept. 1868.
- 26 D. Painting, *Amy Dillwyn* (Cardiff: University of Wales Press, 1987), p. 82.
- 27 Painting, *Amy Dillwyn*, p. 98.