Tinworking in south-west England in the 16th century

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The period of Georgius Agricola's life, falling more or less within the first half of the sixteenth century, corresponds to a remarkable expansion of the English tin industry.[1] Of the two tinproducing counties of south-west England, Cornwall was the major producer, but it was Devon that witnessed the greatest relative increase in productivity, rearching a peak in 1521, followed by a gradual decline.[2] In a nice coincidence, a Great Court of Devon tinners was held in 1494 to make laws to organise their distinctive and prosperous industry[3], and its anniversary is being celebrated this year by local communities. I have elsewhere outlined the key archaeological and historical features of the Devon tin industry, including some of the characteristic artefacts such as mortarstones and mouldstones.[4] In this short paper I want to draw attention to recent archaeological work on tinworks and tin mills (where ore was processed and smelted) of the sixteenth century. The working conditions of the tinners themselves will not be covered.[5]

Most of my examples are taken from Devon, where systematic field survey and excavation is in progress by the Dartmoor Tinworking Research Group, though significant work has also taken place in Cornwall.

1. The tinworks

Altbough underground mining by means of deep shafts was certainly well-established by AD 1500[6], scope for fieldwork, analysis and dating is relatively limited, and will not be discussed here. Far more important on account of the richness of the archaeological evidence are alluvial *streamworks*, and *openworks* where lodes or veins of tin were exploited by opencast techniques. Of great significance for both these types of working was the use of water for washing away waste material and for sorting ore. Water was often stored in small *reservoirs* which were themselves supplied by many kilometres of water channels known as leats. These leats tapped both surface rainwater and flowing rivers (often small). Reservoirs and leats have now been recognised extensively in both Cornwall[7] and in Devon[8]. No contemporary account of the storage of water has yet been found, but in 1586 Thomas Beare of Cornwall stated that ‹the tynwork which they call a StreameWork otherwise a Hatchwork being without water is even as a windmill without wind›... (British Library, Harleian 6380/The maner of bounding of theire tynworks).

1.1. Streamworks

In mid Corrnwall in the sixteenth century alluvial workings for tin were known as streamworks, hatchworks (British Library, Harleian 6380/Of myne tyn and moor tynne als streame worke tynne), The element *stream* is probably connected with the dialect word for rinsing, i.e. washing, clothes[9]; the element *hatch* probably refers to small shafts sunk into the tin-bearing sands and gravels; and the element *moor* relates to the low lying valley bottoms which were locally known as *moors*.

As field evidence, streamworks are found in valleys wherever the ground is relatively wide and flat.They are most recognisable by the characteristic scarp, usually 1 m – 4 m high, at

their edges, which represents the lateral limit to which the tinners worked. These scarps are also indicators of the quantity of ground (mostly waste) that has been removed. The same type of working can also be found in dry valleys on hillslopes where the top surface of a tin lode has weathered in situ and has been exploited by a streamworking technique. There is now considerable evidence for systematic exploitation of streamworks, and several different types of waste dump have been recognised[10],whitch are likely to date to the seventeenth century or earlier:

1. Parallel or concentric banks of spoil, without walling and with a symmetrical profile. They range in height from 0.2 m – 3 m, These have almost certainly been created by the piling up of material (presumably lacking large stones) with shovels.
2. Parallel or concentric banks of spoil, with retaining drystone walls giving a vertical face on the upstream side. This type is common on Dartmoor.
3. Wheelbarrow dumps, having a steep scarp downstream and a gentle slope on the upstream side. These are otherwise known in published literature as *cuestaworks*. So far, this type has only been recognised in Cornwall.

All three types desmonstrate that the movement of work was in an upstream direction, with waste being dumped on lower areas previously worked. Recent detailed survey has been carried out by the Dartmoor Tinworking Research Group on a streamwork at Beckamoor Combe in west Devon (Figure 1). This has revealed many different phases of exploitation, most of which are likely to date to the sixteenth or seventeenth century. This streamworh was supplied by several reservoirs with associated leats.

1.2. Openworks

Where the tinners found an unweathered lode or vein in situ at surface, they worked it as a linear gully, perhaps as much as 30 m deep. These form some of the most impressive tinworking features. In the sixteenth century, when many are documented, they were known as *beamworks*, the origin of the term being unknown. A system of reservoirs and leats seems to have been commonly used for the exploitation of this type of working.Newman has documented many examples in a small area of west Devon.[11] Here he recorded sixteen reservoirs of crescentic or linear earth banks up to about 1 m in height, and ranging in length from 13 m – 70 m. The reservoirs have one or more openings, sometimes lined with stone, for sluice gates to control the flow of water. The water seems to have been used primarily for washing away soft waste material, though it has been suggested that it may also have been used for firesetting.[12] The openwork at Colliford in east Cornwall, is one of very few to have been surveyed in detai1 (Figure 2).

2. The Mills

In the sixteenth century waterwheels were used to create the energy required to crush tin ore mechanically by raising and then releasing hammers known as stamps, falling onto fine-grained stones which became worn with cup-shaped hollows. These stones are known as mortarstones. Waterwheels were also used to power bellows for creating a forced draught in tin-smelting furnaces.

Mills were generally known as tin mills. Where tin ore was crushed the structure was called a stamping or knocking mill; where it was smelted it was called a blowing mill or

blowing house. A tin mill with horizontally placed millstones, as in a corn mill, was known as a crazing mill.Out of about 100 known tin mills dating to before about AD 1750 in Devon, from both field and documentary evidence, about half are blowing mills[13],and many survive as structures. In Cornwall, more sites are known from documentary sources, but very few survive in the field.[14]

2.l. Stamping mills and crazing mills

Stamping mills were certainly operating in the English tinfields in the fifteenth century[15], and possibly ear1ier.[16] The process seems originally to have been a dry one, and combined with a crazing mill. The latter operated more or less on the same principle as a corn mill, and diagnostic slotted stones for supporting the mechanism can be found at tin mills where this practice occurred. Some crazing mills survived at least until the end of the seventeenth century[17] for crushing a particular type of ore.

The excavated tin mill at Collifard on Bodmin Moor in east Cornwall was abandoned in the early seventeenth century but, on the evidence of associated pottery, had seen the introduction of wet stamping in the early sixteenth century.[18] Richard Carew, writing in 1602 of Cornish practice, stated, *...of late times they mostly use wet stampers.* He is also the earliest writer to note the stamping machinery which be describes as, *three, and in some places six great logs of timber, bound at the ends with iron, and lifted up and down by a wheel driven with the water*.[19] The excavation at Colliford in 1979–80 was the first to be carried out on a tin mill, and revealed much useful data on the use of channels, settling pits (buddles) etc.[20] The earliest known illustration of a Cornish tin stamping mill dates to 1746.[21]

2.2. Blowing mills

In 1991 a research excavation was begun by the Dartmoor Tinworking Research Group at a tin mill at Upper Merrivale on Dartmoor. This is the first Devon tin mill to be exravated, and work is still in progress, a total of nine weeks of investigation having been completed so far. This mill, situated at a height of 335 m, actually consists of two mill structures each with its own waterwheel. In their final phase, around AD 1700, one mill was crushing tin ore and the other had a furnace for smelting it (Figure 3).

The earliest detailed description of tin smelting in south-west England is provided by Thomas Beare, writing of mid-Cornish pratice in 1586 (British Library, Harleian 6380), In a passage titled *The making of the hearth of the blowing howse* he emphasizes the need of there to be a particular depth between the entry point of the nozzles of the bellows and the tap hole of the furnace itself. The example he gives states that if the bellows themselves are two feet (0,60 m) deep, then the tap hole (the *tynhole*) must be set 14 inches (0.36 m) lower. This fits well with the evidence from Devon blowing mills which have surviving furnace structures, which suggests that raised areas behind furnaces (e.g. at Week Ford lower mill) were for supporting the bellows mechanism. The excavated evidence from Upper Merrivale mill is clearly consistent with this too.

In another passage, titled *Off the blowing of whit tyn*, Thomas Beare gives details about the preparation of ore for the furnace. Stream tin needed to be treated separately from lode tin, which required dampening in the furnace. Both sorts had to be given a final wash on arrival at the blowing mill. The furnace itself had to be thoroughly heated before any tin ore was placed

within it. The order in which black tin (i.e. concentrate prepared for smelting) should be placed in the furnace was as follows:

1. coarse stream tin
2. fine stream tin
3 fine lode tin
4. *waste*

A smelting *tide* of twelve hours should produce 300 pounds weight (136 kg) of tin metal. In the seventeenth century the fuel used in the furnaces was primarily peat charcoal which was best suited to stream tin. Lode tin was best smelted with an equal proportion of peat charcoal and wood charcoal. Slags were resmelted with wood charcoa1.[22] It is likely that this applied in the sixteenth century as well.

Conclusion

As a tailpiece to this brief summary of aspects of tinworking in Agricola's day, I illustrate a reconstruction drawing of the last phase of the Upper Merrivale tin mill: (Figure 4). This is based on tbe preliminary interpretation of excavated evidence, and although this phase is likely to date to the yearr around AD 1700, it is instructive when reflecting on Agricola's mills of 150 years before. The drawing does not show any of the important ancillary features of a mill, such as settling pits.

The tin industry was very conservative, even up to the twentieth century, and it is reasonable, in the absence of other evidence, to assume that much of what is shown here would have been largely familiar to Agricola. However, our detailed understanding of the south-west English tin industry is still in its infancy and much exciting work remains to be done.

Footnotes

1 Hatcher, J.: English Tin Production and Trade Before 1550. Oxford 1973.

2 Greeves, T.: Four Devon Stannaries: A Comparative Study of Tinworking in the Sixteenth Century. In: Gray, T et al (eds): Tudor and Stuart Devon – The Common Estate and Government (Exeter). 1992, p. 39–74.

3 Greeves, T A P: The Great Courts or Parliaments of Devon Tinners 1474–1786. In: Trans. Devonshire Association 119(1987), p.145–167.

4 Greeves, T A P: An Outline Archgeological and Historical Survey of Tin Mining in Devon, England, 1500–1920. In: ICOHTEC Internationales Symposium zur Geschichte des Bergbaus und Hüttenwesens in Freiberg. I, 1980, p. 73–89.; Greeves, T A P: The Archaeological Potential of the Devon Tin Industry, in Crossley, D (ed). In: Medieval Industry (Council for British Archaeology Research Report 40). 1981, S. 85–95.; Greeves, T.: Four Devon Stannaries: A Comparative Study of Tinworking ... (footnote 2), p. 39–74.

5 See Greeves, T.: The Good Life? – The Westcountry Tinner AD c.1500 – c.1700. In: Journal of the Trevithick Society 20(1993), p. 39–47.

6 Greeves, T A P: The Archaeological Potential of the Devon Tin Industry ... (footnote 4),

S. 85–95.

7 Gerrard, S.: Streamworking in Medieval Cornwall. In: Journa1 of the Trevithick Society

14(1987), p. 7–31.

8 Newman, P.: The Moorland Meavy – A Tinners' Landscape. In: Trans. Devonshire Association, 119(1987), p. 223-240.

9 Upton, C et al: Word Maps: A Dialect Atlas of England. 1987, p. 153.

10 Austin, D. Gerrard; G A M & Greeves, T A P: Tin and agriculture in the middle ages and beyond: landscape archaeology in St.Neot Parish, Cornwall. Cornish archaeology 28(1989),

p. 44–52.

11 Newman, P.: The Moorland Meavy ... (footnote 8).

12 Austin, D. Gerrard; G A M & Greeves, T A P: Tin and agriculture in the middle ages ... (footnote 10), p. 65–66.

13 Greeves, T.: Four Devon Stannaries: A Comparative Study of Tinworking ... (footnote 2), p. 46–51.

14 Gerrard, S.: The medieval and early modern Cornish stamping mill. In: Industrial Archaeology Review 12(1989), p.13.

15 Buckley, J. A.: Tudor Tin Bounds – West Penwith. Redruth 1987, p. 20 and 66.; Greeves, T A P: The Archaeological Potential of the Devon Tin Industry ... (footnote 4), p. 212–4.

16 Gerrard, S.: The medieval and early modern Cornish stamping mill ... (footnote 14), p. 9–10.

17 Anon: An Accompt of some Mineral Observations touching the mines of Cornwal and Devon ... . In: Philsophical Transactions, 5(1671), p. 2111.

18 Austin, D. Gerrard; G A M & Greeves, T A P: Tin and agriculture in the middle ages ... (footnote 10), p. 228.

19 Carew, R.: Survey of Cornwall (1811 edn). 1602, p. 39.

20 Austin, D. Gerrard; G A M & Greeves, T A P: Tin and agriculture in the middle ages ... (footnote 10).

21 Borlase, W.: Natural History of Cornwall. Oxford 1758, plate 19.

22 Anon: An Accompt of some Mineral Observations ... (footnote 17), p. 2113.

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