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THE WIREWORKS AT TINTERN AND WHITEBROOK

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Introduction

Tintern, a village on the tidal part of the River Wye, in Monmouthshire, is famous for the ruins of its Abbey and attracts thousands of visitors each year. The casual visitor could be excused for not noticing or knowing that Tintern was for nearly three and a half centuries an important industrial centre. It was at Tintern that Britain's first water-powered wire-drawing works were set up in 1566. A blast furnace and three forges were also in operation by the second half of the seventeenth century, and by the mid-eighteenth century there was a very large complex of iron and wire works spreading from the banks of the River Wye up the valley of the small Angidy river for nearly two miles. It was entirely water-powered, and in 1821 there were 18 waterwheels used by the works, together with some others in corn-mills in different parts of the Angidy river system. There were eventually twelve dams (or dammed ponds), and some extensive leats. The iron and wire works (which had become by then a tinplate works) finally closed in 1901. Now there are very few remains of the buildings but most of the ponds remain and add considerably to the charm and beauty of this steep-sided, well-wooded little valley.

The general layout of the Angidy river system and of the ponds, leats and mills is shown in Fig.1. This includes corn mills as well as the wireworks and ironworks. The caption lists the twelve mill sites in terms of their nineteenth-century designations. Where a pond was specifically associated with a mill or works, its name was probably that of the mill or works - e.g. P8 which supplied power to the blast furnace (M6) was known as Furnace Pond. Of the ponds where this is not applicable, P3 is probably a modern ornamental pond, P4 is known as Fedw Pool (i.e. Birch Pool) and P5 as Fairoak Pond. The original purpose of the last two ponds is not known; they may have been built as fish ponds, but they were certainly used as storage ponds to help regulate the flow in the main stream[1]. Fedw Pool was shown as Vedw Pool on the Tithe Map for Newchurch (East), so it must be at least 130 years old.

The history of the works during the sixteenth and seventeenth centuries, in the sense of an account of the business transactions and techniques used, has been very fully presented by William Rees[2], and in a much more readable form by Schubert[3]. Some of the sixteenth-century documents have been transcribed and discussed by Donald[4]. There is very little coverage of the eighteenth and nineteenth centuries in the literature. For these matters the main sources of information are the various collections of papers from the Badminton Estate, housed at the National Library of Wales but not generally accessible. These are the papers relating to the estates in Wales of the Dukes of Beaufort and their predecessors the Earls of Worcester, on whose land the Tintern works were built.

The early history of wire- and iron-making at Tintern

General aspects

In centuries past, one of the largest, and probably the most important, of uses for wire was in the making of "cards" for the preparation of wool for spinning. Other uses were in the making of bird-cages, knitting needles, curtain rings, small chains, etc. In the mid-sixteenth century the British product was inferior to that produced on the Continent. It was, however, official Government policy to make Britain less dependent on imports. Thus William Humfrey, Assay Master of the Royal Mint in London, was able to get support for a new development, namely the establishment of a wire-making industry at Tintern, in 1566. It was at first intended to make brass and brass wire at Tintern, and Humfrey went to Saxony to obtain the services of Christopher Schutz (written in some English documents as Shutes) who was expert in this matter; Schutz came to Tintern in 1566. However, he was unable to obtain the necessary equipment and so started to draw iron wire instead. At first this was not very successful, as much experimenting was necessary and it proved difficult to get suitable iron as exceptional ductility and tenacity were required. What was known as Osmond iron was really necessary (see later). Further foreign experts had to be obtained and all this caused about two and a half years of delay.

Eventually iron wire drawing proved lucrative, and much wire was sold. It was said that by 1597 there were 5000 workers employed in different parts of the country making goods from Tintern wire.

In 1568 the works had been taken over by the Company or Society of the Mineral and Battery Works, who held the lease until 1631.

Such was the demand for wire that the Company built a second wireworks (in 1607-8 according to Schubert but as early as 1595 according to Rees) at Whitebrook, a few miles to the north of Tintern. This site will be discussed later.

For a long time the Company had a legally-enforced complete monopoly of wire-making in Britain, although several attempts were made to break it. Rees gives a very detailed account of this subject, which we shall not pursue here.

The most interesting feature of the new wire-making process was the use of water-power. We shall now proceed to discuss how it was applied.

Wire-drawing at Tintern

Although the use of water power for wire-drawing had reputedly been developed in Nuremburg in the fifteenth century, it was not adopted in Britain until used at Tintern in the second half of the sixteenth century. The method was described in detail by John Ray in 1691[5] and from this description a sketch has been prepared by P.A. Burgoyne and displayed in the Chepstow Museum. A rough copy of this sketch is given in Fig.2. Schubert reproduces Ray's account of the process.

Before any drawing of the iron could be done, it was of course necessary to reduce the iron bars supplied by the forge to a coarse wire. In the early days the bars were first beaten into flat plates by the water-driven hammer, then slit into small rods which were rounded in a rolling-machine. Rees says that such a machine existed at Tintern in 1569. Later, as Osmond iron came into use, the bars from the forge were elongated into rods, or "strained", by a light water-powered hammer, the "straining hammer". The rods were then heated and annealed for about 12 hours and then laid in water for some weeks. The object of the watering is not clear; Rees and Donald say that it was to form a surface rust which was said to assist in the drawing, as a kind of lubricant, but Grey-Davies[6], quoting Rogers[7], calls it a "desulphuretting" process. It was after this process that the "rippers" cut the rods into smaller sizes and rounded them with hand hammers.

The rods were then drawn through a draw-plate with two or three tapering holes in it. The plate was double; one layer of iron, and one of steel for the narrow end of the holes.

Fig.2 shows the drawing machine. The ripper fastened the pincers or tongs to the end of the wire in the draw-plate, and the movement (under water power, as shown) of the "swingle" rotated the eccentric barrel and pulled the tongs forward by means of the hook-and-eye fastening. As the swingle disengaged from the cogs on the driving wheel, the weight of the barrel swung it back, thus loosening the tongs. The ripper moved the tongs back along the wire ready for the next pull - and so on. Train oil and tallow were used to lubricate the wire in the draw-plate.

There was then further annealing, watering and drawing, followed by a third annealing and watering. The wire then went to the small-wire drawers, who produced fine wire of five sizes: clavant, bastard, fine,

fine-fine, and northern — the last-mentioned being for wool-cards.

The wire mills were of three storeys, the small-wire drawers working on the top floor and thus being called "overhousemen". In 1747 the term "blockmen" was applied to the fine-wire drawers, and the drawing engines used rotating drums or "blocks" in a machine which was a development of the simple machine of Fig.2. We shall later see that some of the nineteenth-century buildings were called "block-mills".

English Osmond Iron

Schubert states: "The prosperity of the wireworks depended essentially upon the quality of the iron used as raw material. It was the tenacity and ductility of the special Osmond iron which made it possible to draw the wire finer and smaller than ever before, and started a new era in the English wire industry."

Humfrey realized that it was vital to find a way of making Osmond iron, and imported a Westphalian expert, Corslett Tinkhaus, who worked first at Rhyd-y-Gwern in Glamorgan, then in Sussex to try the Sussex iron, returning to Monmouthshire in 1568 when a forge near Tintern was set up to make Osmond iron. Schubert thinks it was at Monkswood, near Usk. The new wire made from this iron was highly successful.

There was a lot of difficulty and considerable litigation in the last decade of the 16th century because after Richard Hanbury ceased his interest in the wireworks, he retained control of the ironworks which supplied the Osmond iron and would not supply a good quality product to the wireworks, preferring to sell it to other users. Eventually the wireworks obtained their iron from Lydbrook as well, and by 1672 were obtaining it from their own Upper Forge at Tintern[8]. The accounts[9] for the Upper Forge for the year 20 August 1694 to 31 July 1695 show 61 tons 12 cwt 2 qr of Osmond iron made, "whereof Delivered To the Use of his Graces Wyr Works 60: 09: 0: 0:".

The process of making Osmond iron was described in some detail by Schubert. The finery hearth was narrower than normal, and deeper. The iron was melted down from the pig in liquefied drops which passed through the blast and congealed at the bottom into small lumps, which were raised with a small bar into the fire and exposed to the oxidising blast. Then "When they melted down they were intercepted and collected drop by drop at the end of a large staff held in the fire, or, if necessary, pressed against the staff with the small bar. During the process of collecting the melting particles of iron, the staff was turned round quickly, so that the particles were coiled or twisted round the end of the staff, until a regular mass or ball was formed." It was this which mainly distinguished the process from the ordinary one. When the ball had reached about 25 lb it was taken to the hammer and worked while still very warm.

The consumption of charcoal in the Osmond process was higher than in the usual process - about 12% higher at Tintern according to Johnson[10].

Iron-making at Tintern

It does not seem possible at present to determine exactly when the iron furnace and forges at Tintern were first built. In the early days of the wireworks the Osmond iron was made at Monkswood, as already mentioned, where for a time the forge belonged to the wireworks. The raw iron used was then made by the bloomery process[11]. When blast-furnace iron came to be used as the raw material is not clear. There were charcoal blast furnaces around Pontypool in the last two or three decades of the sixteenth century[12], but it is unlikely that their product was used for making Osmond iron.

There is some uncertainty about the site of the early furnace at Tintern. Wherever it was, it was a large and efficient one, producing in 1672-3 no less than 1142 tons of pig iron in 62 working weeks, and in 1675-6, 1034 tons in 61 weeks, using a mixed charge of cinders and myne (i.e. ore) in the ratio of two to one[13]. In the accounts[14] for the year 4 Aug. 1694 to 31 July 1695, the amount of pig iron "made this Blast" was 943 tons, and it appears that about 2000 loads of charcoal were used for this, with 1374 doz. bushels of "Iron Oar". Stocks of ore were held at "Brockwear, Redbrook and Abby Back", and stocks of cinders at "Monmouth, Abby Back, Brockwear" and at the furnaces.

The date and location of the first forge at Tintern is equally uncertain. It is, however, quite certain that there were two (and possibly three) forges by 1690, for account books[15] refer to the Upper and Lower Forges and to Bont Seyson Forge. Indeed, the forge at Pont-y-Saeson must have been built by 1675, for it is shown in John Ogilby's map of that date[16]. The accounts previously quoted[14] for the furnace also give some details of production at the Upper and Lower Forges. For example, the Upper Forge produced over 61 tons of Osmond iron, and the Lower Forge produced over 81 tons of merchant and bar iron. That the Upper Forge and Bont Seyson (i.e. Pont-y-Saeson) Forge were separate forges is not absolutely certain, as sites have not been found for three forges.

The development of the Angidy valley sites in the eighteenth and nineteenth centuries.

There must have been some continuing development of the works along the Angidy river between the Wye and Pont-y-Saeson during the early part of the eighteenth century, but little definite information seems to be available for the period before John Aram's survey of 1763, to which we shall soon give attention.

In 1707 there is an interesting reference[17] to "a place called ye wirepool" which was higher up the valley than the oil mill (which was at site M8 in Fig.1). This was presumably one of the ponds in which wire was "watered".

The first really definite information regarding the location and extent of the works sites appears in the very fine volume of maps[18] produced in the survey of the Duke of Beaufort's estates by John Aram in 1763. These maps, on the scale of 4 chains to 1 inch, give considerable detail. Referring to our Fig.1, we find the following shown as in existence in 1763:-

"Pontsaison Mill" (M3) with a leat (L2) about 300 yards long, but no pond (i.e. P6 not in existence)

"The Forge Pound" (P7) with "The Forge" (M4)

"The Furnace Pound" (P8) with a leat (L4) to "The Furnace" (M6) (Just to the west of the Furnace, between the leat and the road which ran to the south of it, is a "Garden for the use of the people at the Furnace".)

"The Pound belonging to the Wire Works" (P9) with "The Water Course to the Oyl Mill" (L5) and "The Oyl Mill" (M8), together with a short branch leat which fed "The Upper Wire Works" (M9)

"The Hammer Houses" and "The Block House" (M10).

"The Lower Wire Works " (M11) with a leat (L6) but no pond (i.e. P11 not in existence)

"The Forge Pound" (P12) and "The Forge" (M12)

It will be clear from what follows that the Tintern industrial complex in the Angidy valley was, by the mid-eighteenth century, already developed to within about 90% of its ultimate development.

During the nineteenth century the sites were mapped in great detail, on the scale of 25 inches to 1 mile, in successive indentures of lease. The most important of these was that of 1821[19], because not only did it include a fine map, but also gave a schedule of all the equipment in all the works and mills. Figs. 3,4,5 and 6 show the layout of the different parts of the Angidy complex approximately as given in the map. Everything shown in Fig.1 is now present except the pond P 11. (N.B. the map of the lease does not extend above Pont-y-Saeson).

We may note here that the Oil Mill of 1763 (which was before that a corn-mill) is now the Chapel Wire Mill, and that the Abbey Corn Mill is part of the wireworks organization! The New Tongs Mill (M5) with its long leat including an aqueduct over the Angidy Fechan, had been built about 1803[20]. The "Tilting Mill" (M7) just below the dam of pond P9 was evidently also built between 1763 and 1821. A count of the waterwheels indicated in the schedules gives a total of 18 for the works and mills between Pont-y-Saeson and the Wye. The "river" (only a small stream) was evidently fairly fully utilized. As the furnace was "without a hearth",

it is probable that it was out-of-use by 1821.

It is a very great pity that the 1821 map (and also its successors in the leases of 1866[21] and 1878[22], did not show the actual names or purposes of the individual buildings, particularly at the Wye-side site of Fig.6. It would be most useful to know which building was the forge, which the corn-mill, etc.

The maps of 1866 and 1878 show how the works changed during the middle half of the century. From the 1866 map we learn that the small pondP11 had been inserted in the leat to the Lower Wire Works since 1821, and that the tilting mill and the furnace had become disused, being marked only as "Site of Tilting Mill" and "Site of Old Furnace". Indeed this wording confirms that the furnace had gone out of use very much earlier in the century. By 1878 the Upper Wire Works (M5) had gone out of use, being marked "Site of Wire Mill, etc"; this mill had thus existed for less than 75 years.

The business of the wireworks was sadly declining by this time, but nevertheléss, when the Wye Valley Railway was being planned in 1872 it was agreed[23] that a branch to the wireworks should be constructed partly along the route of an earlier tramway, the branch to include a fine girder bridge across the River Wye. This branch was opened in 1876. It was hoped that the improved transport would in some magic way resuscitate the wireworks. "It was decided to manufacture tin plate as well as wire, and on Monday, 9th February, 1880 the works formally opened ..... The works employed 200 in 1883.

"Finally, the Tin and Black plate works were put up for auction on 10th January, 1901; unable to sell as a going concern, the plant was sold piecemeal for about £1500."[24]

Present-day remains

On the whole, the remains of the industrial buildings in the Angidy valley are fragmentary. Fortunately, however, most of the ponds remain in good condition and are a very attractive feature of the landscape. Although the author has spent a considerable amount of time exploring the various sites, the greatest part of the industrial archaeological work still remains to be done. The present account therefore must of necessity be a rather superficial one.

Forge Pond (P7) and Furnace Pond (P8) are in reasonably good order although rather silted. Although there are only small remnants of the forge and wireworks (M4 and M5), the long leat (L3) which took water to the latter can still be traced as it was a very substantial leat with a well-engineered formation along the hillside. It crossed the Angidy Fechan (without drawing on its water) by means of an aqueduct, the stone abutments of which can still be seen. At the point where the leat leaves the main stream there are stone erections which evidently once had gates to

apportion the flow between the leat and the river itself. So far the leats L2 and L4 have not been traced, and there are few remains of the blast furnace, M6, although part of the furnace lining remains in position.

Pond P9 is in good condition but there is no sign of the remains of the Tilting Mill (M7) or of the Wire Mills (M8 and M9). It is of course possible that the foundations of the Wire Mills have been incorporated in the houses which now occupy the sites. The course of the leat (L5) can be traced in parts.

There is no sign of the two small mills indicated by M10 but the leat L6 can be traced throughout most if its length. It is a stone lined leat about 5 ft 3 in wide and runs beside a public footpath for some of its course. The small pond P11 is derelict but the stone wall which supports it above the public road is still in good condition.

The site of the Lower Wire Works, which were the original and probably always the largest of the wire works, became a stone works for a while, but is now occupied by the Forestry Commission Depot; some of the stone buildings incorporated in this depot are probably remains of the wire works. There are few tangible remains of the railway which ran to these works except for the fine girder bridge spanning the River Wye, which is maintained in good condition as a public right of way.

The bottom pond P12 has been partly filled in to make a car park for the adjacent hotel and the main Wye Valley road runs along what must have been its dam. On the other side of this road stands a fine large mill building, still in good condition and in use as a saw-mill. On the south-eastern side of this mill may be seen the only water wheel remaining in the whole valley - an overshot wheel of 11 ft 4 in diameter and 5 ft wide. No other buildings on what was the Lower Forge site can at present be recognised as remains of the old iron works, and it is not clear whether the mill with the water wheel was the Lower Forge or the Abbey Corn-mill. Unless it has been extensively rebuilt internally it is more likely to be the corn-mill.

The Whitebrook Wireworks

The wireworks established around 1600 at Whitebrook were initially a branch of the more famous wireworks at Tintern, as stated above. They would have used the same technical processes as were used at Tintern, the most notable feature being the use of water power for the actual wire-drawing process. Water power would also have been required for blowing the forges and for other miscellaneous purposes. Thus the choice of a site or sites for the works would have been greatly influenced by the need for adequate water power.

While a branch of the Tintern works, the Whitebrook works were owned by the Company of Mineral and Battery Works, and the Company retained

their interest in Whitebrook long after they gave up their control of the Tinternworks in 1631. The land on which the works were built at Whitebrook was owned by the Earls of Pembroke, whereas that at Tintern (as also much of the other land at Whitebrook) was owned by the Earls of Worcester, later the Dukes of Beaufort. It is believed that the Whitebrook wireworks ceased operation around 1720, whereas, as we have seen, the Tintern works carried on until the beginning of the twentieth century. The Whitebrook works were smaller than those at Tintern, but nevertheless appear to have had 62 working places or "seats" in 1677[25]. The buildings must therefore have been fairly substantial.

The Whitebrook wireworks appear to be much less well documented than those at Tintern. Their location has for long been something of a mystery, and as they ceased operation around 250 years ago and the remains are fragmentary, this is not altogether surprising. The main clue is found in maps by John Aram dated 1772 — i.e. about 50 years after the wireworks ceased operation. These, like Aram's maps of 1763 already referred to, are maps of the estates of the Duke of Beaufort, drawn to a large scale and presumably fairly accurate by the standards of the time. One of them[26] shows "The Watercourse to the old wire works" and the boundaries of "lands belonging to the Old Wireworks", and this data has been shown in the author's composite map, Fig.7. The leat, shown by Aram for a length of a few hundred yards only, is at an altitude of about 460 ft, and this makes it seem unlikely that the works would be 200 ft or so below, in the bottom of the valley, which is that of Manor Brook, a tributary of the White Brook — and even more unlikely that they would be lower still in the main valley.

Field investigation led to a straightforward identification of the leat, which for about 1200 yards (i.e. for most of its length) is readily traceable, much of it having been used as a footpath in the past. It is marked as such on the large-scale O.S. maps. It was evidently a substantial leat, perhaps 6ft wide, although it is hard to be sure of the width as the walls are derelict. Where it crosses the walled footpath from Holy Trinity Church up to The Narth it turns southwards and then appears to descend the valley side, but there is little trace of this part of it now. About 70-80 ft below are some very old remnants of stone walls forming a complex of buildings, with comparatively large levelled areas on the steep hillside. There can be little doubt that this was the site of the wireworks referred to by John Aram, although this could not have been the whole of the wireworks set-up; it was too small. A residual doubt is raised by the fact that the Tithe Awards for the parish of Llandogo show this site (No.513) as "Cottage, garden, &c., 26 Poles, Void", but the subsequent use of some of the works buildings, or the site, for a cottage is not too unlikely. So probably at least a part of the wireworks were in this unlikely place, nearly 350 ft above the level of the River Wye — grid reference SO 531 066.

The author was unable to trace the leat up to its source, as there seem to be no signs of it above the grid reference SO 521 070. Confirmation that the extension of the line of the leat shown in Fig.7 to the north-west is a correct interpretation of the field evidence is obtained from a clue given in another map[27] of Aram's; in a small inset, unrelated to other maps, he shows a small field of the Duke of Beaufort's bounded by "The Watercourse to the Old Wire Works" and shows the watercourse meeting "The Road to White Brook", the field being "An Orchard opposite Pwoolth Blythan". The Tithe Map[28] shows a field called "Pull Blethin" (N.B. the word is undoubtedly the Welsh "pwll") starting about 150 yards below the mill pond of the paper mill at grid ref. SO 519 071. If then we extend the line of the leat further, corresponding with this location, we find it still lying nicely between the 400 and 500 ft contours and joining (or rather leaving) the White Brook at the mill pond, which the 6 inch O.S. map shows to be at an altitude of 461 ft — consistent with our estimate of about 460 ft at the wireworks end. (N.B. A fall of a few feet would have been adequate to cause sufficient water to flow in such a wide leat.) So we conclude that the wireworks derived their power from the White Brook itself.

Why were the works not at the bottom of the valley of the Manor Brook using the power of this brook which presumably was sufficient for the corn mill there? Why place them in such an awkward position, high up on a hillside with no easy access? Transport of material to and from the works must have been difficult and expensive. There can presumably be no other answer than that the Manor Brook was considered too small a stream and too unreliable, and that it was desired to use the water of the White Brook itself. But even so, why not site the works in the main valley, easy of access, and save the expense of a mile-long leat? The works owned most of the land in the valley. It is quite possible that other sections of the wireworks <u>were</u> sited in the main valley; another of John Aram's maps[29] shows a curious extension of the wireworks land to the north of the White Brook just where a good mill pond still exists at grid ref. SO 521071. Moreover, Heath[30] states quite definitely that three large paper mills were erected on the ruins of the wireworks.

<u>Acknowledgments</u>

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REFERENCES

1 See Badminton Papers, Group II,9040, at National Library of Wales. In this deed, dated 1878, the lessees of the works have the right to the water from "Veddw" pond and "Fair Oaks" pond,and the right to repair these ponds and the channels. The owners were not to drain the ponds so as to leave less than 5ft of water at the gates.

2 William Rees, "Industry Before the Industrial Revolution",Cardiff,1968.

3 H.R. Schubert, "History of the British Iron and Steel Industry", Routledge & Kegan Paul, London, 1957

4 M.B. Donald, "Elizabethan Monopolies", Oliver & Boyd,Edinburgh & London,

5 John Ray, "A Collection of English Words",London, 1691.

6 T.G. Grey-Davies,"A metallurgical history of the valley of the Wye", Metallurgia,72,1965,pp.153-8 - see p.155

7 S.B. Rogers, "An Elementary Treatise on Iron Metallurgy",London, 1858,pp.189-190

8 B.L.C. Johnson, "New light on the iron industry of the Forest of Dean", Trans.Bristol and Glos.Arch.Soc.,72,1953,pp.129-143,see p.131

9 Badminton Papers Group II, 10,475

10 loc.cit.,p.131

11 Rees, p.391 (ref.95)

12 Schubert, pp.175-179

13 B.L.C. Johnson, loc.cit.

14 Badminton Papers Group II, 10,475

15 ibid, 8575-8585

16 John Ogilby, Map of the Bristol-Chester road,c.1675 (copy in Chepstow Museum)

17 Badminton Papers Group II, 11,762,p.226

18 John Aram, Survey of Manor of Portcasseg, Nat.Lib.Wales,Badminton Papers.

19 Badminton Papers Group II, 9087

20 Charles Heath, "Historical and Descriptive Accounts of ..Tintern Abbey .. Monmouth,1803

21 Badminton Papers Group II, 9581

22 ibid, 9040

23 ibid, 10,512

24 T.G. Grey-Davies, loc.cit.

25 Rees, p.643

26 John Aram, Map no.7 of the Trelleg section of the Survey of the Manors of Usk and Trelleg,1772.Nat.Lib.Wales,Badminton Papers.

27 ibid, Map no.5

28 Tithe Map of parish of Penallt,1848; Nat.Lib.Wales

29 As ref.26, Map no.10

30 Charles Heath, loc.cit.

CAPTIONS

Fig.1 Map of the industrial sites on the Angidy river system at Tintern

P = pond M = mill, works, etc. L = leat

M1 Trellech Grange Mill (corn mill)
M2 Panta Mill (corn mill)
M3 Pontsaison Mill (corn mill)
M4 Pontsaison Forge (Upper Forge ?)
M5 Upper Wireworks (New Tongs Mill)
M6 Blast Furnace
M7 Tilting Mill
M8 Chapel Wire Mill
M9 Middle Wire (Tongs) Mill
M10 Hammer House ? Little Block Mill ?
M11 Lower Wireworks
M12 Abbey (Lower) Forge and Corn Mill

Fig.2 Sketch of possible design of wire-drawing machine, reconstructed from description given by John Ray

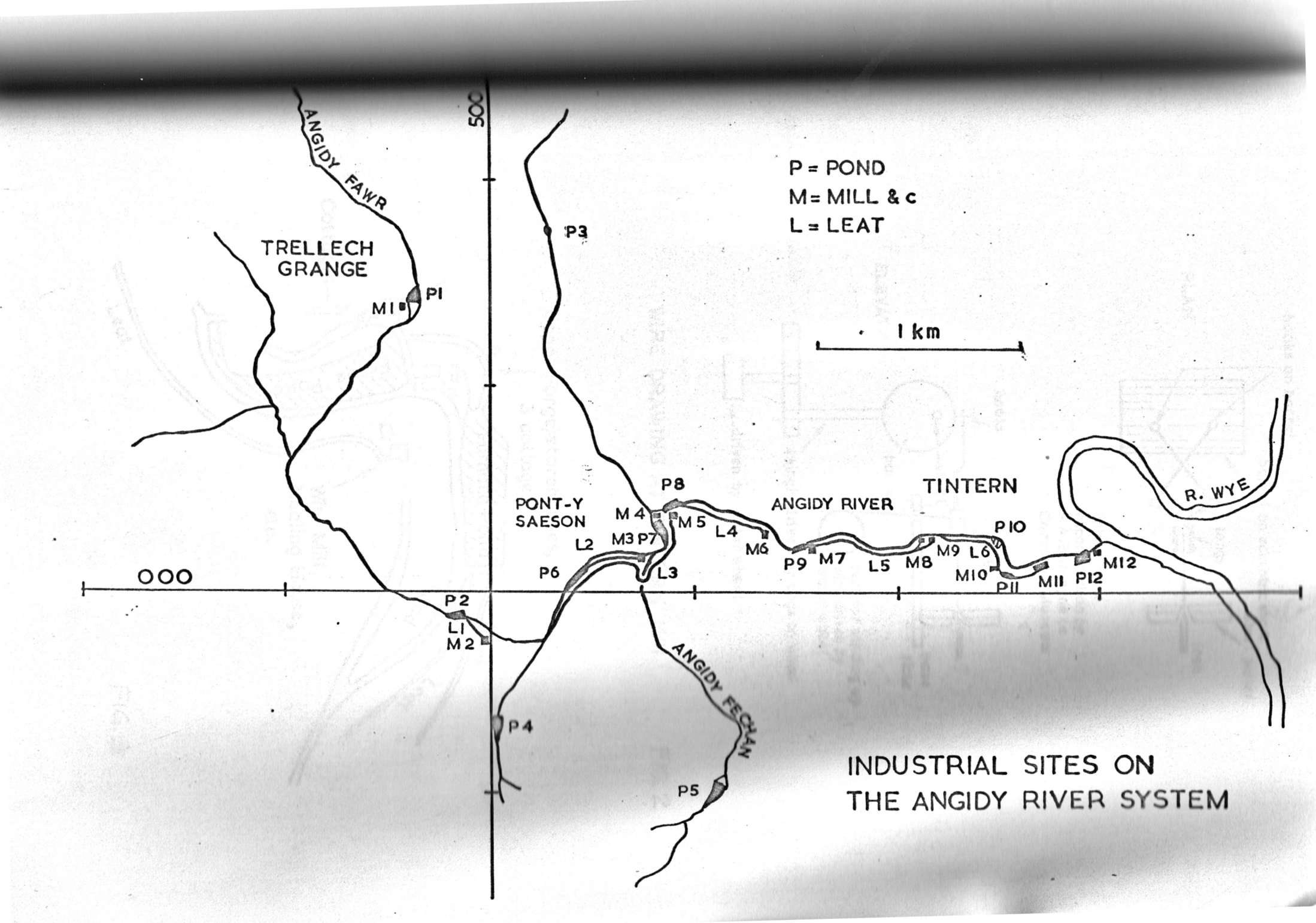
Fig.3 Map of works at Pont-y-Saeson, 1821

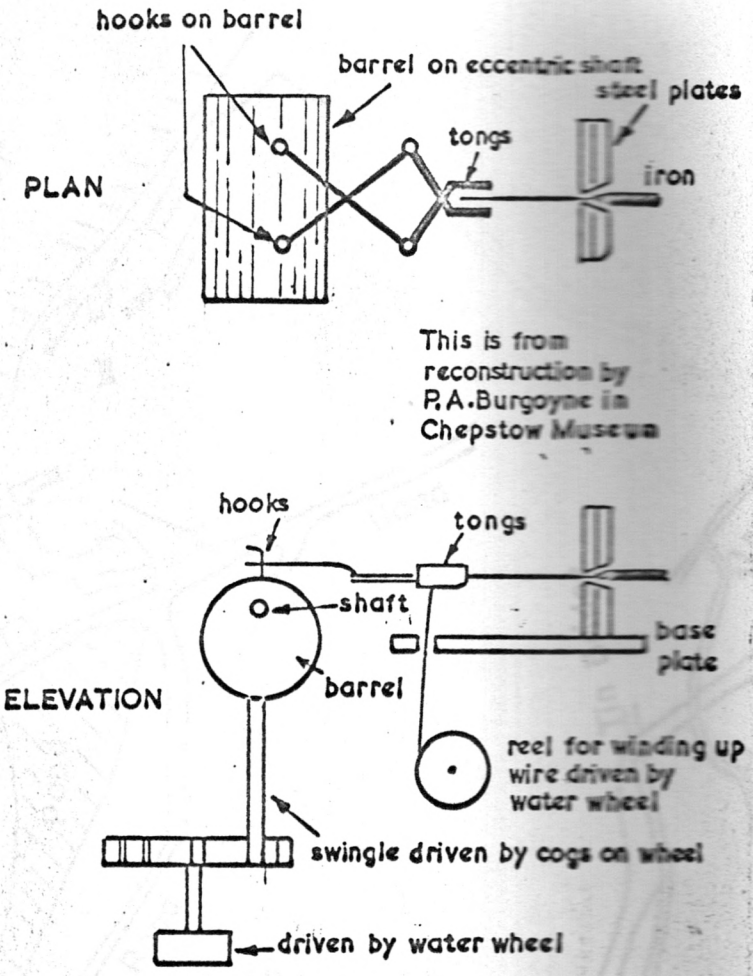
Fig.4 Map of works at Furnace and Pond P9, 1821

Fig.5 Map of works at the "middle" site (M8 and M9), 1821

Fig.6 Map of Lower Wire Works and Wye-side site, 1821

Fig.7 Map of the wireworks site and leat at Whitebrook.


P = POND
M = MILL & c
L = LEAT
1 km
ANGIDY FAWR
TRELLECH GRANGE
M1
P1
P3
500
000
PONT-Y SAESON
P8
M4
M5
L4
M6
ANGIDY RIVER
TINTERN
R. WYE
L2
M3
P7
P6
L3
P9
M7
L5
M8
M9
L6
P10
M10
P11
M11
P12
M12
P2
L1
M2
ANGIDY FECHAN
P4
P5
INDUSTRIAL SITES ON
THE ANGIDY RIVER SYSTEM



WIRE DRAWING AT TINTERN 1691 FIG. 2

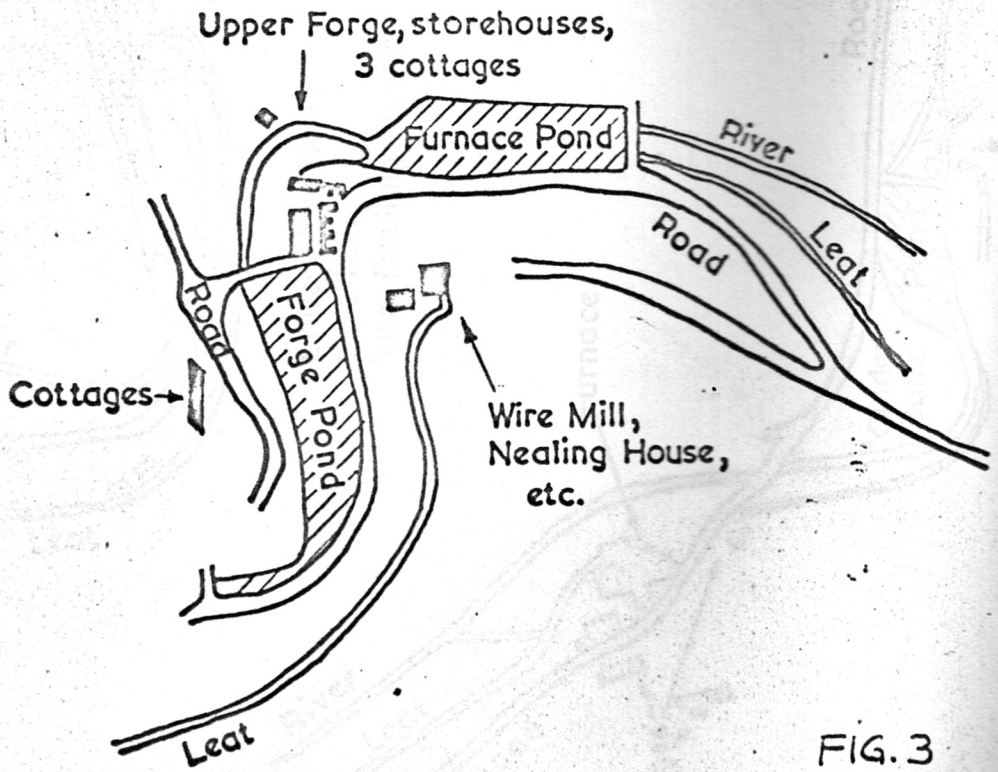


FIG. 3

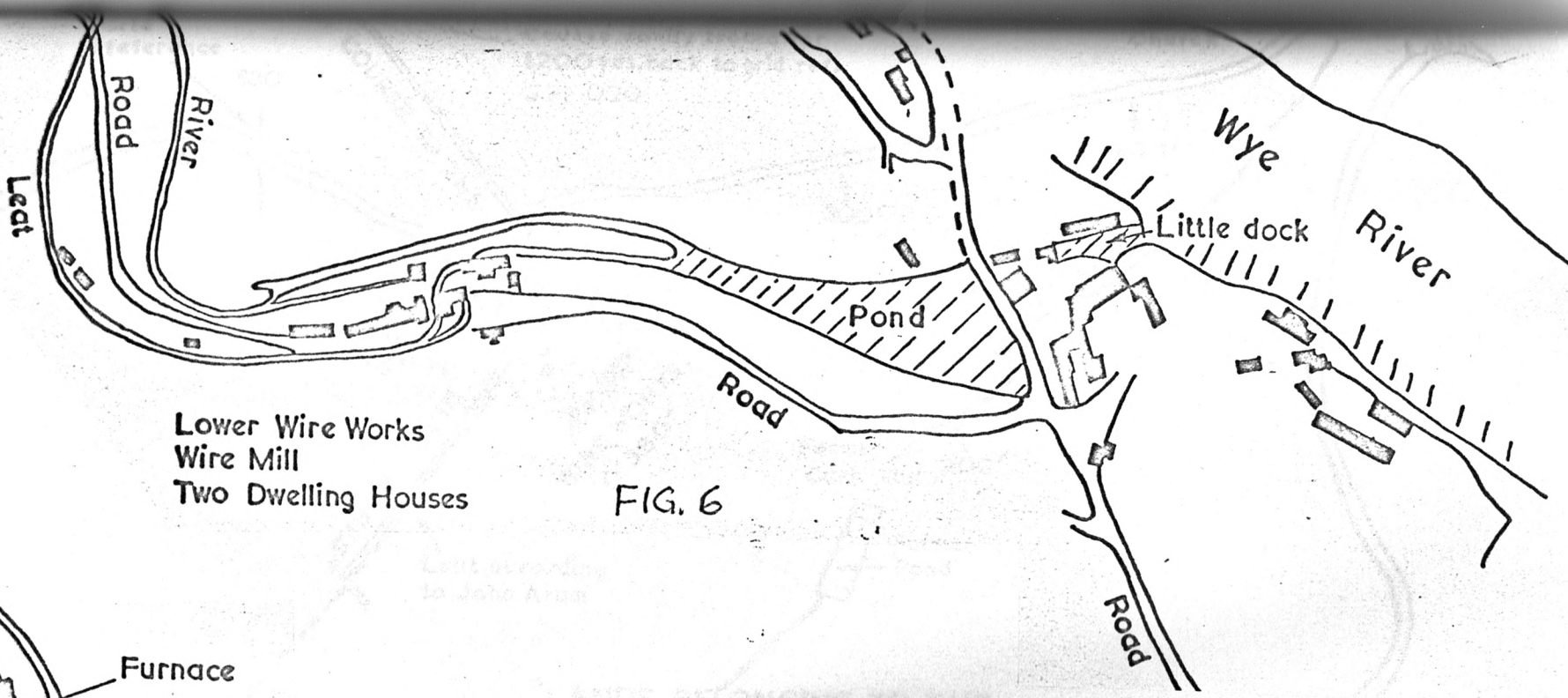


FIG. 6

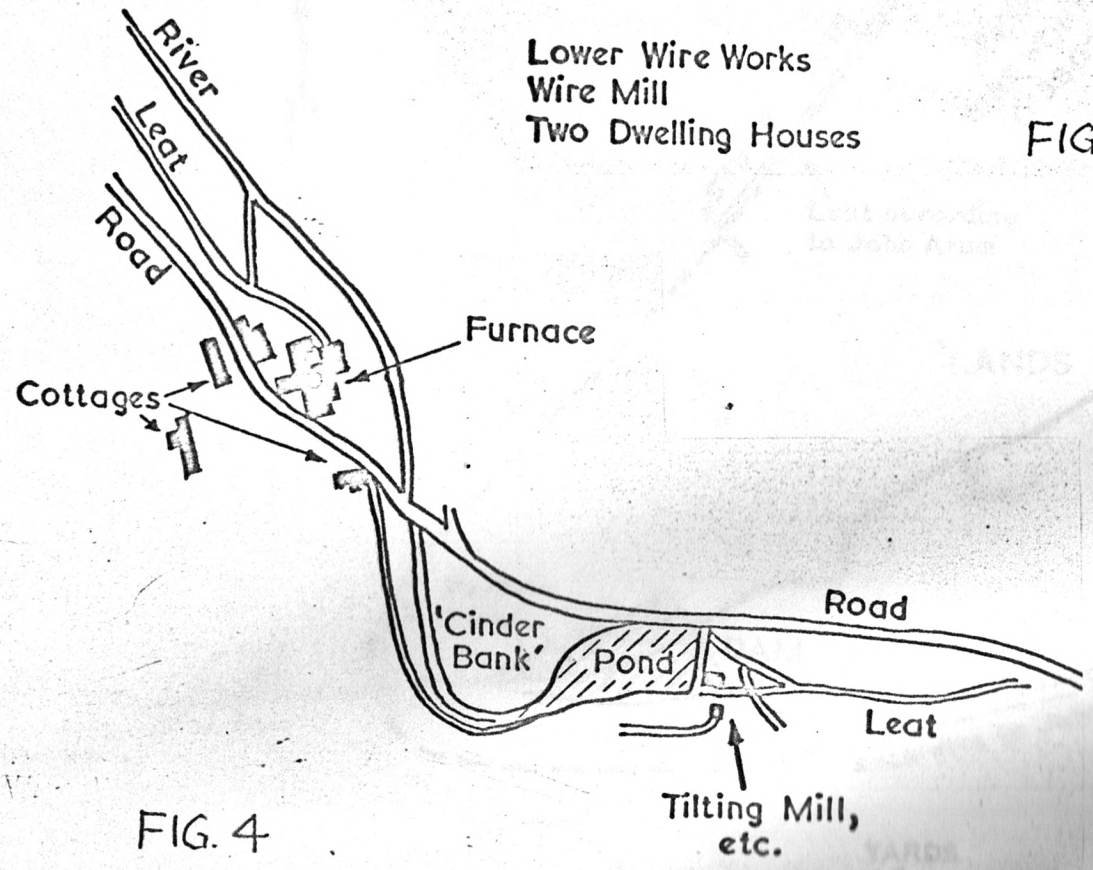


FIG. 4

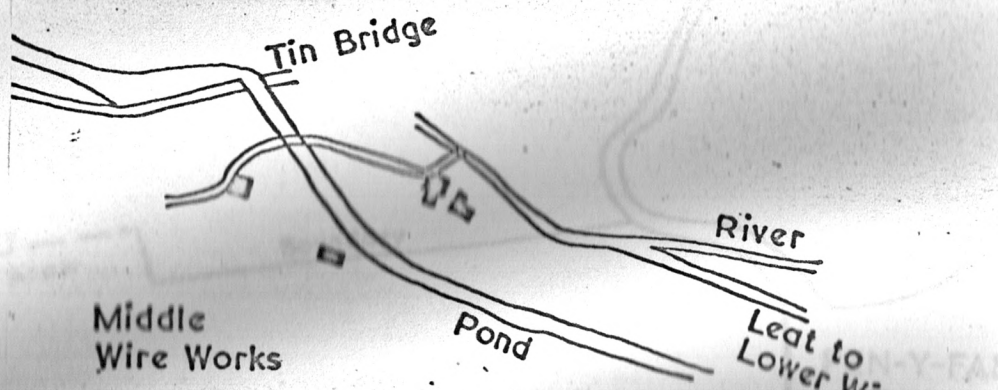


FIG. 5

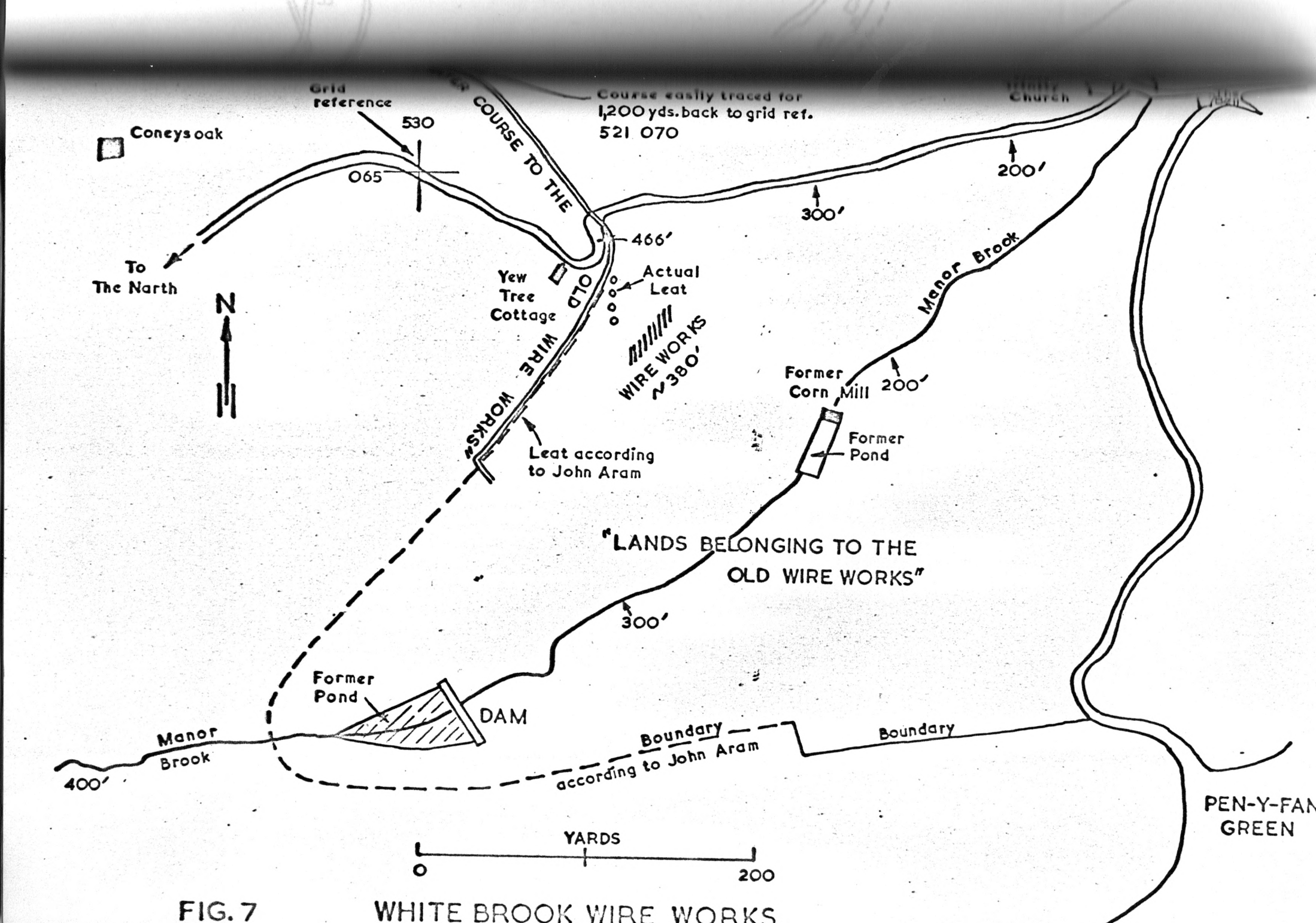


FIG. 7 WHITE BROOK WIRE WORKS