

William Smith and his Venture into ‘Stone Manufacture’

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How to use this document

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Wherever you see the symbol [\[FIGxx→\]](#) you can click it and be taken to the relevant figure.

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Introduction

One of the most enigmatic aspects of the life of William Smith, the ‘Father of English Geology’, is that his attempt to quarry stone - in an area where he knew the rock strata extremely well - led to his financial ruin. The venture into ‘stone manufacture’ that he initiated in the years just before 1810 failed so disastrously that by 1819 he had not only lost his home at Tucking Mill, and all his investment in the project, but he found himself contemplating the vicissitudes of his poor lot in the confines of a debtors’ prison. As his nephew and biographer, John Phillips, describes events:

“The project, which looked well at first, failed utterly by the unexpected deficiency of the stone, on whose good quality the whole success depended. The abandonment of this cherished scheme was followed by the compulsory sale of the still more cherished property, a load of debt remained to be discharged, and the miserable effects fell heavily on others besides himself.” (Phillips, 1844; 78)

Phillips refrains from embellishment but, today, the story of Smith’s attempt to quarry, shape, and sell fine quality Combe Down Oolitic limestone, or Bath stone, is well known through Simon Winchester’s best-selling (though occasionally erroneous) account of his life (Winchester, 2001). In essence, he describes how in 1798 Smith bought a plot of land surrounding an old fulling mill, called Tucking Mill, which lay adjacent to the Somersetshire Coal Canal, and about half-way between the villages of Midford and Monkton Combe. Smith had been employed previously to survey the Canal and supervise its excavation¹ [FN01→]. The old mill became his occasional base for writing and drawing and mapping, and his home to return to as he journeyed for days, or even weeks at a time, to clients around the country who employed the surveyor and mineralogist for advice on local drainage works and other engineering projects [FIG01→]. According to Winchester he bought a quarry at Combe Down in 1807 “hoping to supplement his

income with a steady flow of funds without having to do much work” (Ibid. 245). By 1811 the quarry, a railway, a saw mill at Tucking Mill, and a wharf to load narrow-boats on the Canal with dressed stone for shipment to London were all complete, and in 1814 everything was in ‘full-swing’. The next year, however, following Wellington’s victory at Waterloo and subsequent economic recession, and because his quarry possessed “an unusual quantity of very poor stone”, Smith’s quarry “went instantly and spectacularly bust” (Ibid. 246). Despite valiant efforts to stave off bankruptcy it was ultimately Smith’s poor business acumen that led to the darkest and dankest moments of his life in June 1819, when he entered the forbidding portals of the Fleet prison for debtors,

Prior to Winchester’s populist account of Smith’s life, recent scholarly appraisals have been offered by the late Joan Eyles and, latterly, by Professor Hugh Torrens. Both have uncovered new aspects of the life and work of William Smith, and the fine detail of so many facets of Smith’s labours can be read with crystal clarity. But the episode concerning Smith’s quarry remains glossed over; and a critical question has yet to be asked. It is this: why did ‘Strata Smith’ fail so spectacularly when it came to staking out a claim to such a potentially valuable stone resource? For years he had been working on the production of a geological map that would be the culmination of his careful and insightful enquiries into the true state of the world (or, at least, England, Wales, and part of Scotland). Indeed, this “Map That Changed the World” had already been published, in 1815 [FIG02→]. In the confines of the Fleet prison, however, at the age of 50 years, he was now left to ruminate on the question of why his knowledge had apparently let him down so badly. What exactly did he have to reflect upon, and why, precisely, had things failed so utterly? Was it really the case that William Smith could not tell the difference between good rock and bad rock, or profitable stone from rubbish stone? This paper, for the first time, attempts to explore in detail the events surrounding Smith’s venture into stone ‘manufacture’ in Combe Down.

Sources

The personal writings of William Smith provide the most immediate, and intimate, key to understanding his intentions at Combe Down. Although his diary in particular has been widely cited in accounts of Smith’s life, one gets the feeling that the quarry episode is treated by many biographers as a sideshow to other aspects of his busy schedule, such as maintenance of his fossil collection and compilation of his famous map. Indeed, Phillips in his “Memoirs of

William Smith” set this precedent by barely giving Combe Down a mention, despite the fact that this was Smith’s cherished ‘home’ for more than 20 years.

The diary and extensive notes of William Smith are held as a single collection at the Hope Library at the Oxford University Museum of Natural History. The folios are somewhat small, and are comprised mostly of booklets made from folded 9½ inch (23cm) x 7½ inch (18.5cm) sheets of paper. Diary entries for each day of any given month are all squeezed onto a single half-sheet, so that the writing is cramped and the language terse, often abbreviated. Moreover Smith’s handwriting is ‘spidery’, at best, and often appears hurried. Although all sheets have now been sorted, catalogued and, in some cases stabilised, all can be described as fragile, and some are, in fact, very, or even extremely fragile. Mildew has also taken a toll, leaving many sheets with brown stains. Some of the notes are written in faint pencil, which have faded almost to the point of illegibility. Use of digital photography can now be used to enhance readability, but the point remains that all transcriptions and interpretations of the notes may be subject to a degree of ambiguity, and even a little guesswork.

The diaries are arranged by month, each one being a single folded sheet. On the ‘cover sheet’ are the name of the month and the year, and a brief list of the main events of the month. A typical entry, for May 1811 reads (in list form): “Kidwelly Harbour; Bath Turnpike Road Contract; Combe Down Railway; Batheaston; Warminster Turnpike Road, 27th & 28th; Lady Rivers” [FIG03→]. The inner, folded sheet is laid out by writing, from top to bottom, each day of the month. The page to the left of the fold is arranged as an appointments page, with his planned schedule of meetings on various committees, or with clients. To the right of the fold is a daily summary of events, usually contained within a single terse sentence. For example, his entry for Thursday May 9th, 1811 is: “wrote deal(?) on Strata”. The ‘end page’ is usually blank, but may contain a brief memo or jotting. Inserted within each ‘booklet’ is a printed summary of the relevant month, probably cut-out from an almanac, highlighting feast days.

Occasionally the diary is expanded by the insertion of separate sheets on which are penned more detailed daily summaries. This is the exception rather than the rule, however. August 1811 is one such instance, with a typical entry (August 18th) stating: “m[orning] walked to Tucking mill. Mr Wm. Hill called and talked over the proposed sawing of Stone by the power of my Watermill &c.”. Although there are many days left blank in the diaries, it does seem that Smith did attempt to keep up both the short and the more detailed summaries for most months. Unfortunately most of the detailed versions appear either to have gone missing or to have been destroyed at some point. The extent of this loss can be best appreciated by comparing both entries for a single day, where they exist side by side. The short entry for March 24th, 1812, for

example, states in typically terse style: “at Tucking mill looking over Works”. The more detailed entry (on a separate sheet) states: “m at Tuckingmill J.S. gave C.C. Compy. agent proposal to build T.mill bridge with stone for £36 and the old bridge. Viewed the Alterations and Improvements made in the Pond [...] method of getting water several feet higher on to the millwheel” [FIG04→]. Whilst hardly written in the most expansive of styles, the latter version offers considerable detail concerning the ‘works’, and one can only wonder what lies behind other entries which describe a day spent, typically, as “at Tucking mill”. A refreshing exception to this mode of diary upkeep is the year 1815. This year Smith paid for printed diary sheets with sufficient space for detailed summaries each day. The effect is rather like comparing a desk-top diary with a pocket version. However, most unfortunately, the diary for the whole of 1808 is lost.

Apart from the diaries, William Smith’s extensive notes have also been well documented. They are grouped under such headings as “Bath Stone Great Oolite”, or “Freestone and Quarries”. They are usually, but not always, dated and written on the same sized folded paper as the diaries. In a sense, many of the notes may be described as ‘diary extensions’, perhaps jotted down during some of those days spent “at Tucking mill”. In more reflective moments Smith would write verse, though many surviving examples were written some years after he had left Tucking Mill when perhaps the thoughts behind his recollections had either hardened or softened sufficiently to allow for poetic licence. In a rather similar vein, some draft copies of letters are in the archive, but it can never be said for certain that the sentiments expressed were those actually communicated rather than, on occasion, merely wishful. Other documents include the handbill Smith produced in April, 1807 when he had a mind to offer his small estate at Tucking Mill for “immediate disposal”, and a similar notice advertising his cottage for let published in the Bath Chronicle in October, 1816. These notices are of particular interest because they span the period during which the venture into stone manufacture was both conceived and made operational. Both also serve as reminders of Smith’s constant state of financial impecuniosity. In similar vein is an abstract of title for the conveyance (actually mortgage or, technically correct, an ‘assured tenancy agreement’) of property between Smith and Charles Conolly in April, 1814, when the entire Tucking Mill estate was offered as security against a loan of £1000. (It was, of course, failure to repay this loan which led ultimately to Smith being declared a bankrupt and confiscation of his property by Conolly.) This is accompanied by another abstract of title dated 1828 when the executors of Conolly’s estate resold Smith’s former lands to John Rorke. Both deeds contain useful descriptions of the property, including the saw mill and railway, and copies have recently been archived at Bath Record Office in the unofficially named ‘Broome Collection’² [FN02→].

The Venture

In 1807 William Smith needed immediate cash to fund the upkeep of his various households, the cost of hostelrys he required on his extensive travels, the luxury of time to pursue his research on strata, and, crucially, the back-log of regular small payments still owed to the agents from whom he had bought the Tucking Mill Estate³ [FN03→]. He was also to get married that year. In order to raise these funds he decided to sell Tucking Mill - unsuccessfully as things turned out.

The handbill he published first described the physical attractions, or the ‘picturesque’ qualities of the site [FIG05→]. It waxed lyrical on the “hanging woods and plantations”, “the rich meadows”, and the:

“Near two acres of ... land ... many years since improved and planted with fruit trees, now in the most thriving state, which, with the fine sheet of clear water, well stocked with trout, and beautifully environed and well sheltered, renders it admirably calculated for the site of a genteel house or ornamental cottage” (Broome Collection).

He goes on to suggest that “persons solely dependant on business which requires less capital” might consider raising “choice and early vegetables for the Bath market” utilising “manure obtainable by canal boats...”. For those with a mind to fulfil the greater business potential of the site he highlights the waterfall, “remarkably well calculated for a paper-mill”. Helpfully, he suggests “...such water might of course be well employed to work the small wheel necessary for moving the paper engine, and be re-used on the main waterwheel”. Finally he draws attention to the convenience of the location, noting:

“...these canals (i.e. The Somersetshire Coal, the Kennet and Avon, and the Wilts. and Berks.) form together a most extensive water conveyance to a large and most populous part of the counties of Somerset, Wilts, Berks, and Middlesex, and connected with the Thames and Severn navigations, it gives this site a water communication with South Wales, and all the other

numerous canals and navigable ramifications of those two rivers, and of course with Birmingham, and all the inland navigations in the north of England”.

He signed himself “Mr. WILLIAM SMITH, Engineer and Mineralogist, Norwich”.

The problem, perhaps, was that the Kennet and Avon Canal did *not* offer easy connection to London at this time, and would not do so for another two years or so. This could explain why potential buyers were somehow deterred. Whatever the reason that the property did not sell, it is clear that Smith had *not* yet conceived the idea of sawing stone extracted from a nearby quarry. He had, however, clearly paid great attention to how the waterfall on the old fulling-mill site could be developed to power a more economically viable enterprise with sales extending to the national market.

His thoughts on this matter were undoubtedly influenced by the new De Montalt Paper Mill (built in 1805) which was situated directly above Tucking Mill higher up the slopes of Horsecombe Vale [FIG06→]. In fact this mill boasted one of, if not *the* largest waterwheel in England at this time (56-foot diameter), and was so spectacular that it had become something of a tourist attraction (Addison, 1998; 86). As events turned out Tucking Mill was eventually leased at the end of 1807 to a man named James Sutton. One of the conditions of the lease was that Sutton should rebuild a mill on the site of the original fulling stamps, and this construction took place during 1808 and 1809 [FIG07→]. Whether or not Smith had any say in the purpose of the new mill is not known, but he seems to have offered no objection when it became a simple corn mill (Broome Collection). In any case this was a time when his thoughts were engaged on various drainage and related projects as he travelled to all parts of the Kingdom, his “practice extending from Norfolk to Kent, and from Wales to Yorkshire ... his time ... fully occupied in journeys (amounting to 10,000 miles in a year)” (Phillips, 1844; 50). Yet, despite his frequent absence, he kept abreast of events around Bath, and a key moment in the evolution of his own venture into manufacture is suggested in a diary entry made in December, 1807:

“Sunday Dec 20. m(orning) John Allen & had conversation with him respecting the proposed purchase of Prior Park Estate & the advantages of reviving the old Railway for stone etc.”

Notwithstanding Smith's clear admiration for Ralph Allen⁴ [FN04→], tinged perhaps with a sense of nostalgia, it seems he was also aware of subtle changes which had taken place in the local stone industry, centred on Combe Down, at this time. Whenever he got the chance to walk the two mile route between Tucking Mill and the centre of Bath, he would have passed the now revitalised and rapidly expanding quarries of Combe Down which overlooked his estate. The quarries were becoming especially busy after 1806, with orders just coming in to supply top quality Bath stone for the west-wing extension to Longleat, the home of the Marquis of Bath (Irving, 2005). Smith would have noticed that the owner-occupier quarrymasters of the early 1800s were, unlike Ralph Allen, also the builders, or master-masons of the various local, mostly small-scale construction projects being carried on at that time. They would quarry sufficient stone for each project, and transport it by horse-drawn cart to the building site. Since blocks as often as not had to be taken uphill as well as downhill, this seemed the only practicable way. Moreover, as individuals they probably lacked the organisation and wherewithal to construct a railway from their quarries to the river/canal-side in Bath. Smith realised that with completion of the Kennet and Avon Canal, and also the Wilts. and Berks. Canal near at hand (the final link to connect Bath with London was opened in the early summer of 1809 according to the Bath Chronicle of April that year) the cheap transport of stone to London and other expanding urban markets could soon be achieved. He envisaged that the Bath stone quarries would now move away from their emphasis on local markets to the emerging national one - a dream which Ralph Allen had shared but never really attained.

Ralph Allen's innovative railway had been dismantled over four decades earlier, following his death in 1764, but William Smith would still have had plenty of opportunity to witness at first hand the transport of stone by railway. In fact one important task for the canal surveyor of the day was to identify the location of suitable quarries where stone was required for construction of canal features such as locks, wharves and bridges. By 1800 it was common practice to construct short stretches of railway to facilitate transport of the stone to the canal-side, since invariably the stone took a downhill route from rock outcrop to valley floor. In other words, the transport of heavy blocks of stone was achieved most efficiently, and smoothly, if they were placed on four-wheeled carriages whose course was guided by a set of parallel rails. The motive force could be gravity, or horses, or, commonly, a combination of both. The railway itself comprised two lines of rough-hewn stone sleeper blocks, each stone up to about one-foot square (30cm²), placed so that three-foot (91cm) lengths of rail could be laid between the sleepers, and fastened with nails hammered at each end of the rail into wooden plugs inserted into holes drilled into the stones. One nail was sufficient to secure two adjoining rails, or 'plates'. The plate-rails themselves were cast-iron and had an L-shaped cross-section

[FIG08→]. The railways could be constructed and dismantled with relative ease, and so could be re-used if it became desirable to move the stone source from one quarry to the next as the canal moved onwards towards completion. This would not have to be the case in Smith's mind, however, since in his vision the railway would serve for as long as building stone was being produced by the quarry, or quarries which it served. If he was able to conceive of revitalising Allen's old railway at the end of 1807, it must surely have been only a short while later that he first mulled over the possibility of using his own wharf at Tucking Mill as a transshipment point between railway and canal. After all, it was rather nearer to London than Dolemeads - the site of Ralph Allen's old yard and wharf at Widcombe.

During the course of his travels Smith no doubt came across many types of mill, both wind and water powered. Windmills in the Norfolk area would have been of direct concern to him for his drainage projects in lands 'breached by the sea' (Phillips, 1844; 50), but elsewhere he would have been aware of the particular workings of not just corn mills and fulling mills and paper mills, but also mills for grinding and sharpening and, indeed, sawing, as well as a host of other applications. Whether related to his work or not, Smith held a particular fascination for things mechanical, and he would not have missed any opportunity to explore ways in which the rotary motion provided by the wheel or vane could be applied to almost any industrial process. At Dolemeads Ralph Allen had employed sawyers for the specialist art of cutting quarried blocks of stone into squared 'plates' (for ashlar facing), or smaller blocks for general building or for further shaping by masons. It would not have required any great leap of Smith's imagination to recognise that this relatively straight-forward, albeit skilled, mechanical process could indeed be 'mechanised' by the use of water power. The great advantage would be that by placing a number of saw blades in a 'frame', multiple 'plates' of stone could be cut simultaneously [FIG09→]. It is unlikely that Smith was the first to consider this particular application, and there is a possibility that he may have seen mechanised stone saw frames during his travels in Wales and the Lake District where, for example, marble was sawn into plates, or 'slabs'⁵ [FN05→]. There is the chance, however, that he conceived this potential use for Tucking Mill entirely by himself and under his own initiative.

In 1810 Smith was employed by Bath Corporation to solve a problem with water-flow at the old Roman Baths, and so was able to spend substantial time again at Tucking Mill⁶ [FN06→]. Once more his journeys into Bath would take him past the Combe Down stone quarries and a friendship seems to have been formed with Henry Street, one of the more successful local quarrymasters. Clearly Smith was given access to Street's various quarries, including that behind his own home at Crossway Place (Irving, 2005, 50-51). Superficially, William Smith was using this opportunity to describe the nature of the strata exposed and exploited by the quarry

workings, but he must also have been mulling over the possibility of - like Ralph Allen himself - opening up his own quarry. Perhaps it was not too late yet to seize the opportunity to purchase a quarry and so begin his venture into 'stone manufacture'⁷ [FN07→]. Indeed, this very phrase held the key to unlocking his dreams for he now saw that he could supply the emerging national market for Bath Stone by integrating the quarry, a railway, a mill, and a canal wharf into a single enterprise.

'Co-partnership'

In 1808 Charles Conolly purchased Midford Castle, and so became William Smith's immediate neighbour [FIG10→]. He naturally requested the advice of such an eminent surveyor on various aspects relating to his newly acquired estate, and in particular seems to have sought Smith's help in the design and construction of a series of fishponds that he wished to build along the stream just above the pond at Tucking Mill⁸ [FN08→] (Parfitt, 2001; 109). It soon after became apparent to Smith that his grand, 'Allenesque' project for stone manufacture would depend on the inclusion of Conolly into the scheme, partly because the scheme involved use of Conolly's land, but also the fact that Conolly was the most likely man to underwrite it - and substantial financial investment was crucial. Smith records in his diary that, towards the close of day on October 15th, 1810 he made the journey from Bath to see "C. Connolly (sic) Esq.". The next day has no entry, but for the 17th it is recorded that breakfast was taken at Midford Castle, then - in very faint pencil, as if whispered - "and explained him" (Diary: Oct 15-17, 1810).

From this point onwards, it is generally assumed that Smith entered into a two-way partnership with Conolly, with the latter offering land for quarrying (at the edge of Kingham Field), a major share of railway investment (where it crossed Conolly's land), and cash loans *in extremis*. In return, presumably, Conolly would share profits generated by sales of cut, or sawn, stone. In Smith's diary entries, however, it is clear that a third partner was involved in the scheme - a man named John Neal, or John O'Neal. It is possible that this man was merely the agent of Conolly, or his factor, and that the investment risk was limited to just Smith and Conolly (Pollard, 1982; 17). However, Smith's description of the project as a "co-partnership" really does suggest that more than just two men were involved. The alternative explanation is that O'Neal was an equal third partner, in the sense that he built a section of the railway himself which was for the benefit of all three involved in the enterprise. Furthermore, he operated a quarry (almost certainly Vineyard Down) near to Smith's, also on land owned by Conolly, and so contributed a supply of stone to the saw-mill operated by William Smith. Significantly, in his

diary, Smith's monthly summary for July, 1811 states "Tucking Mill Railway to the Freestone Quarries"⁹ [FN09→].

John O'Neal appears in three diary entries, in January and April, 1811 when Smith was busiest in setting up the venture:

"Jan 20. Advising with Mr Hill on report to Corpn with o'neal about proposed Railway etc."

January, 1811 happens to be a month for which detailed notes survive on a separate diary sheet, and the appropriate entry for the 20th reads, somewhat ambiguously:

"Saw John Neal and wrote to Mr Conolly respecting rails for proposed Railway from his freestone to the Canal at Tucking Mill."

The third entry is for April 9th and, without any detailed notes, is also highly ambiguous:

"pm in Crescent Fields - agreed with Mr Conolly for O'Neal to begin his part of Railway."

Two observations arising from these entries seem pertinent. First, it would hardly be incumbent on William Smith to write to Mr Conolly if O'Neal was indeed Conolly's agent. Second, it seems appropriate that O'Neal should begin construction of his part of the railway (as opposed to Conolly's) when it is clear that, according to later diary entries, neither Smith nor Conolly were yet ready to lay their own sections. Indeed, a letter from Conolly to Smith dated 9th May, 1811 specifically reminds him that iron rails still had to be ordered. The implication is that O'Neal was ready to go, for he was already in possession of the required material for his own section of the railway.

Beyond Smith's diary entries little is known about John O'Neal. It is tempting to speculate that he was an Irish itinerant who, along with a number of other fellow countrymen, came to work on canal construction schemes in the early 1800s. He would certainly have known Patrick

Byrne, a quarrymaster with interests in Combe Down who additionally owned a canal wharf to serve his various construction projects in the local area (Irving, 2005). Byrne had exactly the type of entrepreneurial spirit that Smith hoped to emulate and, like John O'Neal and Smith himself, was an 'outsider' who had gained success in the local stone business through his initial connection with canal construction. (Smith would eventually follow Patrick Byrne to the Fleet Prison for debtors!). John O'Neal made his home in Southstoke where, according to the parish registers, he was present at the baptism of his illegitimate child in June, 1801. He appears to have regained respectability, or at least a degree of trust, when he was elected to lead the local militia in 1803 (Parfitt, 2001; 31). William Smith should perhaps have taken this into account, for it seems clear from later developments that O'Neal was not a man to tolerate fools.

In the meanwhile, having gained Conolly's support, the deal was effectively sealed when Smith sold part of his estate, Tucking Meadow, to Conolly for £1330 (Diary: Jan 26, 1811). This gave Smith the financial leeway for equal participation in the "co-partnership" for "stone manufacture". Essentially, William Smith and John O'Neal would quarry stone separately from an area high up, on the south-facing outcrop of the Great Oolite at Combe Down, on land owned by Conolly. O'Neal, who may already have been quarrying for some while before this time, and Smith, who would open a new quarry, about 350 metres to the east of O'Neal's, would share the costs of construction of a railway with Conolly. O'Neal would supervise the laying of his section of track (including the 'inclined plane' - a shared facility navigating the steepest section of the slope down to the canal), while Conolly and Smith would co-operate on the laying of their respective sections. When eventually these sections were joined up, the railway would facilitate the removal of stone to Smith's new saw mill at Tucking Mill. Then, by transhipment to narrow boat, they could all anticipate the dispatch of lucrative loads of sawn stone 'plates' to the rich markets of London and beyond.

The Railway

According to Smith's diary the greater part of 1811 was taken up with the planning and installation of the railway. Shortly after Smith had come to an understanding with Conolly that O'Neal should "begin his part of the railway" (Diary: Apr 9, 1811) he was in Bath "calculating on Railway" (Apr 12), and a little later "calculating what a Horse can draw on Combe Down stones" (Apr 21). By early June Smith had seen "Mr Thomas" (John Thomas: Bristol merchant; owner of Prior Park; and trustee of the Kennet and Avon Canal Company) at Bath "& agreed

with him for 32 Ton Rails for Mr C. & 13 for myself at [£]8/7/0" (Diary: Jun 9, 1811). By 18th June Smith was able to record in a (draft) letter that "... Mr Conolly has succeeded in getting the second hand Plates for the Tram Road ...". Given John Thomas' association with the K&A it seems certain that these were straight lengths of plate rails which had previously been used for the construction of the Kennet and Avon canal, possibly for the building of the Caen Hill flight of locks. The letter, written to Mr Raby, an iron-founder, continues with a request for more rails which presumably had to be custom made (Broome Collection). Later, on August 23rd, Smith was able to record the arrival of these rails, noting that a "Second Boat Load of Iron Rails came to Tuckingmill" (Diary). Canal records indicate that this delivery totalled a little over 16 tons plus nails for a cost of £137/0/9 (Pollard, 1982; 17).

In the meanwhile Smith had been very proactive in overseeing construction of his section of the railroad, noting:

"Aug 13 ...Examined railroad &c..."

Aug 15 Went to Tucking mill Railroad & ordered better Spikes to be used in laying the Rails.

Aug 17 after breakfast in Bath went to Railway and advised about the laying &c. ...Pd some of the workmen now about my Railroad."

(Diary: August, 1811)

No maps or plans survive to indicate the precise line of the railroad, and the issue of where exactly it was located has generated a certain degree of controversy. Much of the problem stems from the fact that the Somerset and Dorset Joint Railway was cut through this landscape late in the 19th century, apparently obliterating all trace of many previous structures. Emerging from a tunnel into a small stream-cut valley, the change of gradient of the valley side associated with the railway cutting appears to have accelerated the process of soil slip or soil creep, further obscuring evidence of the older railroad. However, sufficient evidence does remain to suggest, with near certainty, that the route sketched by Pollard (ibid.) following the footpath from Summer Lane to Tucking Mill via Bluebell Steps is the route actually constructed by the co-partnership. Figure 11 shows this route superimposed on Cotterell's map of Combe Down, published in 1852 [FIG11→].

At some point, after the venture into stone manufacture failed, the rails were taken up and recycled. In all probability some of the stone sleepers that the rails were affixed to, and a scattering of the ‘nails’ or ‘spikes’ used to affix the rails to the plates, would have been discarded. So far there has been no formal attempt to conduct a metal-detector survey of the possible lines of the railroad, but field walking has revealed a number of possible sleepers, particularly within the confines of Tucking Mill Wood [FIG12→]. There is also strong evidence that a railway siding was located here, and possibly stables for the horses which hauled the trolleys. Elsewhere, a stone ‘platform’ near the foot of Bluebell Steps, and a cast-iron ‘roller’ placed upright where the steps meet Summer Lane may also serve as contemporary reminders of the railroad. Certainly, a case for further archaeological investigation can be fully justified. In the meantime, plenty of supporting evidence is available in documentary sources.

To begin with, Smith’s ‘mortgage agreement’ with Conolly, dated 29th and 30th April, 1814, refers to “*Tucking Mill Wood*”, within which

“... was made a railroad communicating with the Railroad of said Charles Conolly and extending from thence to near the Coal Canal ...”.

Another indenture dated 7th October, 1828 refers to an agreement reached on the occasion of Conolly’s second marriage, to Jane Lawless on 11th September, 1817¹⁰ [FN10→]. This mentions that the railroad, emerging from the wood, crossed over three fields belonging to Conolly, called “Great Rodneys, Little Rodney, and Ashmead” (Broome Collection). The 1851 Tithe Map for Monkton Combe shows all these fields and pastures (although by this time each field had been divided in two). Significantly, a faint hachured line is shown running through them, or along their shared boundaries, leading to, and through, Tucking Mill Wood [FIG13→]. This line is consistent with the course of the present footpath, and would seem an obvious course along which, in 1851, there may still have been the scars or remnants of Smith, Conolly and O’Neal’s rail road. A lithograph of De Montalt Mill, also dating from the mid-19th century, actually shows people walking along this track, and shows clearly its relation to field boundaries shown on the Tithe Map and later OS Maps [FIG14→]. The question is whether this was an ancient right of way, perhaps the same as that used by Leland on his journey between Midford village and Bath town some centuries previously, and even by Smith himself on his frequent perambulations between Tucking Mill and Bath, or was it a track actually created by Smith and his colleagues?

It is not clear whether Smith was ever aware that the place he called his home, Tucking Mill, was once the property of the man he so admired, Ralph Allen. Whatever, a map of the estate belonging to Ralph Allen was begun in 1741, and amended shortly after Allen's death (Chapman, 1996). This "Survey of the Manours" is the best indication of the lay of the land surrounding Tucking Mill as it existed at the time shortly before William Smith acquired his estate [FIG15→]. It describes "Tuckin Mill wood & meadow call'd new Lease" (plot 159) as well as "Chambery's Meadow or Alder bed meadow, a Spring running down the same from Spring bottom" (plot 150), from which the former plot had apparently been sectioned. Despite the excavation of Conolly's fish-ponds in the meadow around 1809, the essential shape of Alder bed meadow is recognisable in the 1851 Tithe Map where it is named "Aldermead or Ashmead". It has a hammerhead appearance on the original Survey, reflecting the pattern of a short gully spreading out into a small alluvial fan. (It was through this gully that the S&D Railway was laid in later years.) The eastern lip of the gully, where there was a natural break of slope, is marked by a hedgerow where it adjoined Rodney's Field (as stated in the Conolly deeds and 1851 Tithe Map), or Radneys (as stated in the Survey of Allen's Estate; plots 138, 151 and 156; and 152 - Lower Radneys). The trackway suggested on the 1851 Tithe Map exited Tucking Mill Wood to enter Great Rodney's, then followed or formed the boundary with Ashmeads to the point where the ascent of Bluebell Steps begins today. The earlier map, however, gives no indication whatsoever of a trackway in this area and, in any case, the 18th century field boundaries of this oft enclosed piece of arable land are such that they would block rather than conform to the route of a path. The conclusion has to be that this was no ancient right of way.

One further observation helps to confirm this reckoning. William Smith himself recounts (in poetic mood) the first time he journeyed from Bath, passing Combe Down village, to come across Tucking Mill:

*"...Just o'er the hill was Tucking Mill
In scrambling through that thorny ground
Amidst the waste
The site I found
The old foundations traced"*

(Vales of Bath - Tucking Mill, Doncaster, 1825)

Smith clearly did not consider that he had retraced the steps of Leland along a well trodden pathway. He, along with Conolly and O'Neal, created a trackway which in their own minds was merely practical, but which to later generations has been purely delightful [FIG16→].

In order to transport rough-hewn blocks of stone from the quarries to Tucking Mill a descent of more than 350 feet had to be negotiated. By laying the line along the edge of the gully, along the boundary between Ashmead and Rodneys, the steepness of slope was minimised and would have allowed for descent by laden horse-drawn carriage under braking; and normal ascent of the returning empty carriage by horse power. The great advantage of this system was that only a single track of railway was required, supplemented by sidings or, perhaps, the occasional 'passing loop'. In the area just below Summer Lane, however, in the vicinity of Bluebell Steps, the gradient is clearly too steep for a horse-drawn system [FIG17→]. The solution, well-known to Smith by this time, was to construct a special section of railroad where gravity provided the motive force. A funicular system allowed for carriages to be lowered down the slope by gravity, counter-balanced by an ascending empty carriage, both trolleys being connected by a rope or chain wound around a revolving drum located at the top of the slope. The system required two sets of rails for the carriages to run along (or a 'passing-loop' half way along the incline); guide-wheels called 'sheaves' to separate the chains; and 'rollers' to ensure smooth passage of the chain during ascent and descent. In the railway terminology of the time such a system was known as a "self-acting or balanced inclined plane", and this device would necessarily have formed an integral part of the co-partnership railroad scheme (Pollard, 1982).

Smith's diaries and the Kennet and Avon Canal Journal note the times and quantities of rails delivered for both Smith's and Conolly's sections of the railroad. Cast iron 'rails', 'short rails', and 'turnouts' (switches or 'points') are mentioned in these accounts, as well as 'nails' (or 'spikes' for affixing the rails to the small, flat-topped stone blocks which acted as 'sleepers'), but there is no reference whatsoever to the specialist items such as 'sheaves', 'rollers', long ropes and chains, and a 'drum and brake' required for the operation of an inclined plane. This uncharacteristic absence of detail in Smith's accounts suggests that this particular stretch of the railroad was one that John O'Neal had sole responsibility for, and was the one for which he began construction ("proceeded with") from April 1811. (Smith's diary entry for May 16th, 1811 does note, rather vaguely: "Bath writing on wheels - rollers etc.", but this is likely to have been a reference to carriage design). Details of the order and delivery of materials for the inclined plane, and of its construction, simply did not warrant mention in Smith's diary since they would have been O'Neal's responsibility entirely. Almost certainly this section of the railway followed the line of Bluebell Steps. The remnants of a stone platform at the bottom of the steps most likely marks the point where horses were re-hitched to the stone laden carriages, after they had been lowered down the inclined plane, and where empty carriages were unhitched to be hauled back up the incline [FIG18→].

At the top of the inclined plane the rail lines diverged; west to Vineyards Down Quarry (O’Neal) and east to Kingham Field Quarry (Smith). These sections had a gentle enough incline for horse-drawn loads. While O’Neal worked independently on the acquisition and construction of his section of railroad, Smith and Conolly appear to have worked together on their respective sections, each contributing his own portion of the capital expense, but sharing shipment and possibly labour costs. A letter from Conolly to William Smith dated 9th May, 1811, berates Smith for being “in Town so long” that it is “a hindrance to the affairs we have in hand” since Conolly himself had plans to “shortly go from here, for some time” (Broome Collection). Conolly had clearly been busy trying to fulfil his own commitments to the railway; Smith recording in a draft letter dated 18th June that “Mr Conolly has succeeded in getting the second hand Plates (ie. Rails) for the Tram Road” (Broome Collection). It was only a few days previous to this letter, of course, that Smith had recorded in his diary the first delivery of iron rails for the project. Despite Smith’s earlier absence, and the clear frustration felt by Conolly since he himself had to go away for a while, construction was now able to commence on their ‘shared’ sections of railway.

The kind of railway devised by Ralph Allen some seventy or eighty years previously was by no means a one-off occurrence. Similar rail tracks had been laid down subsequently across a number of stone producing regions in order to ‘lower’ stone from quarries located at outcrops on the high ground to canal and other construction projects on the valley floors below. Smith’s railway was different, however, in the sense that it was intended to be, like Allen’s, a more permanent structure supplying stone for as long as the quarry was viable rather than only for as long as canal or other construction projects required. The advantage to Smith’s scheme was that essential supplies for the co-partnership’s railway might be provided cheaply if other ‘temporary’ building projects were coming to an end. John O’Neal would have shared this advantage and was probably able to obtain at least some of the special materials for the ‘inclined plane’ second-hand. As for William Smith, his letter of 18th June, 1811 offers further light on the supply issue. It was addressed to Mr Raby, an iron-founder from Wells with a foundry in South Wales, and mentions that:

... a few tons, only of curved Rails for the turns will now be wanting...

Carriages are also featured in the letter, for Smith had “been further informed of the great Expense of greasing Railway Carriage wheels” and that he would be “very eager to see [Raby’s] improvements on them” (Broome Collection). The clear implication from this is that Smith was resorting to a specialist supplier, who would have to fabricate the items desired by Smith. ‘Curved’ rails seem to have presented a particular problem, especially where very tight turns

were required, such as at the canal-side where the railway had to follow the canal bank, and then enter the saw-mill. Second hand supplies for these 'special' items were simply not to be had. Although Smith refers to the rails as 'curved' it seems most likely that the turns were achieved by using a combination of specially modified standard straight rails and 'short rails'¹¹ [FN11→]. The major modification would be to the shape of the lobes and cut-outs at the ends of each rail, allowing them to be slotted together in a tighter curve. Short rails would also be required on the inside track at each bend - because of the shorter distance to be negotiated. Of course, the sequence of straight rails arranged in a curve could only be effective if the carriages upon it had a short wheel-base. This issue would account for Smith's concern with the amount of grease required to ensure smooth running around tight turns.

Smith and Conolly ordered, between them, 61 tons of plate rail. Conolly's section(s) totalled 32 tons of plate-rails, all of which were second-hand and supplied by Mr Thomas via his Kennet and Avon Canal connections. Smith acquired 13 tons of rails from the same source, and a further 16 tons of new rails from Mr Raby, giving a total of 29 tons. Standard plate rails were one yard (3 feet) in length, and were in common use throughout the industrialising parts of Britain. The weight of each length varied considerably, however, from a light-weight 23lbs (10.4kg) to a heavy-weight 60lbs (27kg) or more, depending on the loads they were designed to support (Hughes, 1990; 172-3). A section of rail discovered near Wellow in 1960, which almost certainly was used in conjunction with the building of the Somerset Coal Canal, survives today in an extremely well-preserved, though somewhat worn state [FIG19→]. It is currently in the private possession of David Pollard. This one-yard length weighs exactly 50 lbs, which seems appropriate given the weight of the stone blocks being carried from the local quarries.

Assuming this plate is also representative of the type used for construction of the Kennet and Avon Canal, then it is reasonable to suggest that if a total of 61 tons of rails were delivered to Smith and Conolly, equivalent to 136,640 lbs of rail, this equates to 2,732.8 yard lengths. The railway of course required two lengths of rail in parallel, so that the maximum possible total length of railway built by Smith and Conolly was 1,366.4 yards (about 1250 metres). In reality, however, this distance would not have been attempted, since a considerable number of yard-lengths would have to be kept in storage as 'spares'. As can be imagined, a fully laden carriage trundling downhill at a speed slightly greater than the load capacity of each rail could bear would frequently result in the sudden, and presumably spectacular, fracture of one or more cast-iron rails. Spare rails would have to be kept at hand in order to ensure continuous, if not necessarily smooth, running of the railway.

Using OS sheet 'Somerset XIV, 14' (surveyed 1883/4, and published 1888 at 1:2500 scale) the actual distances between Kingham Field Quarry and Tucking Mill can be calculated. Measured

in metres (a necessary modern convention using present-day electronic map-measurers) the presumed route of the railway is 40m from quarry face to arched entrance (Smith's responsibility); 207.5m from the 'arch' to the top of the inclined plane (Conolly's responsibility), 160m from top to bottom of the incline (O'Neal, requiring up to 320m of railway, in addition to the 140m or so he would require to connect to his own quarry); 310m across 'Rodneys' and 'Ashmead' (Conolly); 335m through Tucking Mill Wood (Smith); approximately 65m for the siding in the wood (Smith); and 67.5m from the edge of the wood to, and into, Tucking Mill (Smith). The total length, including the inclined plane but excluding the link to O'Neal's quarry, is 1279.5m, or 1,400 yards. In other words, the equivalent of 2,800 standard plate rails would be required to build the railway. This is more than the 2,733 yards actually delivered to Smith and Conolly and, especially if the need for spare track is considered, is by itself clear indication that they could not have been responsible for the incline. The total length of Smith and Conolly's sections was 959.5m, or 1,050 yards; equivalent to 2,100 plates. This suggests they ordered the equivalent of 633 plate rails more than required for immediate construction, representing 23% of total stocks. Given that many of the rails were purchased second-hand, and were presumably slightly worn, this seems a reasonable contingency.

Of course these measurements can at best be considered only a rough guide. It is simply not known how much rail was used in the siding, or at Smith's quarry face, or at O'Neal's quarry face, or at any other potential 'turnout'. The real answer may vary from this solution by ten, or even tens of metres (yards). Nevertheless, considering that the ratio of Smith's rail to Conolly's rail is 1:1.10 on the original delivered orders (ie. 29 tons : 32 tons), the measurement of length of Smith's part of the railroad compared to Conolly's (484 yards : 566 yards¹²) [FN12→] produces the remarkably similar ratio of 1 : 1.17. This is too close to allow for significant deviation from the routing of the railway outlined here.

Kingham Field Quarry

The full extent of Smith's quarry, which lies hidden in private woodland a little to the north of Summer Lane, is difficult to determine precisely because the site has been used at various times in the past as a tip for building waste and unwanted metal furniture. Nevertheless, salient features such as "the Great Fault" can be identified from Smith's sketch of the quarry (drawn in 1812), and the "quarry arch" which he "saw opened" on November 6th, 1812 (Diary) is clearly visible, though presently blocked up.

Smith's acquisition of the quarry did not happen until May 26th, 1811 when, according to his diary, he was "at Bath" and signed a "Conveyance and Agreement for A Lease of the Land & Stone & Railway". Following the conventions of the day the extent of the quarry leased to Smith was determined by boundaries delineated on the surface. The lease entitled Smith to quarry all the stone underneath that surface area, whether by open-cast methods, or by tunnelling. Reference to the railway anticipated the works Smith and Conolly would complete later on this piece of land.

It seems likely that from this date Smith employed quarrymen to 'clean up' the rock outcrop, and expose the valuable freestone beds to be excavated later. He would have observed this procedure elsewhere in Combe Down, the village which lies atop the 'cap' of freestone which Ralph Allen had first exploited on an industrial scale, and whose south facing outcrop provided the location for Smith's quarry. In early June, 1811, a few days after signing the lease for Kingham Field Quarry, Smith made some notes on the state of stone in some of the neighbouring Combe Down quarries. In general terms he compared the qualities of stone beds on the 'north' (i.e. Entry Hill) side and 'south' (or 'other') side of the Down, where Kingham Field was located. He suggested the depth of overlying rag stone was thicker on the south side than the north, and that stone from the quarries on the north side cut good ashlar, but could not be processed in large blocks - whereas "blocks of large dimensions could be got on the other side". Probably the largest quarry at this time was operated by Henry Street, and Smith notes the "enormous expense" incurred when opening the quarry because of the thickness and hardness of the rag and cockly beds overlying the freestone. Rather closer to Kingham Field Smith described Vineyard (Vinegar) Down Quarry as having "nothing but stone that could withstand the weather", and noted that one bed was "remarkable for its firmness and fineness". On the other hand, late Godwin's Quarry, "also in this Down", had some "bad stone" where proximity to gullies associated with the "Great Fault" caused a degree of staining of the rock. This was the same 'fault' that ran through Smith's quarry, and though the exact location of Godwin's quarry is not known for certain, it must have been located very close by (Notes on Bath Stone - Great Oolite, Apr - Jun, 1811).

Viewed today, Kingham Field Quarry presents something of an enigma. Approaching from the road (Summer Lane) the first and most obvious feature is the "quarry arch" which clearly provides access to underground workings [FIG20➔]. Above this entrance is a steep bank which, when surmounted, offers a view across a small amphitheatre, the back wall of which seems to have been a surface quarry, or perhaps the face 'cleaned' and exposed by Smith in the summer of 1811. The underground entrance, however, appears to lead to the base of the surface quarry face - a view supported by the fact that Smith's sketch of the quarry indicates a total

height of around fifty or sixty feet [FIG21→]. This is approximately the same difference in height between the top of the quarry and the arch. This situation actually highlights the quandary which would have confronted Smith as he contemplated the means to begin quarry operations. In order to surface quarry the expensive process of removing the overlying rubbish rock, or ‘ridding’, had to be accounted for. Then, a place had to be found to store all this waste, preferably avoiding the need to transport it any distance. The usual method was to build a dry-stone wall behind those working the quarry face and then tip all the waste behind it. The waste would be carried in wheel-barrow along a raised plank walkway level with the top of the quarry - a somewhat hazardous procedure! As the quarry face gradually receded, so the waste tip would creep along behind, partially filling the void. This sequence would explain the amphitheatre-like appearance of the quarry today, but does not account for the arched entrance which would, in effect, have been excavated through the spoil-heap at needless effort and expense.

The more likely explanation of what happened is offered in Smith’s sketch of Kingham Field Quarry. Despite his reservations of opening a quarry in near proximity to the ‘great fault’ this is, in fact, precisely what he did. However, the ‘Great Fault’, along with two other faults he has marked in the sketch, are not actually faults at all. The correct terminology is ‘gulls’, which are fissures created in a process known as ‘cambering’. This is where a cap of hard rock (in this case Great Oolite) overlies a softer rock (Fullers Earth) adjacent to a well-formed valley (Horsecombe Vale). An escarpment is formed (allowing quarrying at the scarp face), but the edge may be broken into large blocks if further erosion of the softer underlying material occurs [FIG22→]. These blocks will slide downslope under gravity, tilting away from the face as they do so (rotational slumping). Smith’s sketch suggests at least three of these blocks lay to one side of the quarry face, but a better understanding of his problem is achieved if one imagines the drawing to be a cross-section of the quarry rather than a plan of the face. In other words the blocks formed a barrier to Smith, throwing up a wall of hard ragstone and preventing easy access to the main quarry face where the valuable and hopefully undisturbed freestone lay. Having excavated the ‘Great Fault’ to expose the quarry face (and so create an amphitheatre effect), his solution to the problem was to tunnel through the slipped blocks of rock to provide direct access to the face for his railroad. Indeed, a second, rather simpler sketch of the “great Fault in the Stone Quarry” drawn January 4th, 1813 suggests not only that rotational slumping had occurred, but that the top of the freestone beds on one side of the rubble-filled ‘fault’ were on the same level as hard ragstone on the other side [FIG23→].

These events are alluded to in Smith’s diary, though not until as late as November, 1812. It was in that month that the issue of access seems finally to have been discussed at the quarry; a

situation that demanded Smith's personal attention. He determined that the solution was to drive in an adit, stone-lined and with an arched entrance tall enough for an upright man to walk through and wide enough to haul wagons loaded with stone. Two days later, on November 6th, he "saw the quarry arch opened", and then made another visit the following day to inspect progress (Diary: Nov 4-7, 1812) [FIG24→]. By the end of the year Smith was ready to embark on full production. The adit enabled an underground quarry to be opened for extraction of the "Prime Freestone" and "Bottom Beds" which could all "stand weather" according to his quarry sketch. The question remains, however, why was there such a long delay between the original lease of the quarry and this final resolution to make it operational?

The answer seems to lie partly in the fact that Smith was often away on his travels, and was engaged on issues related to the conception, production and funding of his "Map of the Strata of England and Wales". Having spent much of August, 1811 sorting affairs relating to the railway there is curiously no mention of any kind of event to indicate that the venture had become operational, presumably sometime near the end of that year. There can be little doubt that he had been under pressure from his co-partner, John O'Neal, to complete the railroad to the mill in order for O'Neal to transport his own stone there, utilizing the inclined section that he had already constructed himself. Conolly would also be looking for a return on his own investment. For the moment, perhaps, Smith simply ignored the development of Kingham Field quarry so long as O'Neal could provide stone and get the venture underway. Thus it was that in March, 1812, Smith recorded that stone could be supplied to the Coal Canal Company for rebuilding the bridge at Tucking Mill (Diary: Mar 24, 1812).

There were, however, two other major problems. The first was one which seemed to plague Smith at this time - he had run out of cash! The high cost of completing the railroad (including the order for custom-built rails, and payments for workmen to lay them) meant that he was now broke. In a draft letter to William Hill, Engineer at Batheaston, dated 26th October, 1811 Smith pleaded that "...the delay this arrangement (ie. lack of finances) may occasion & has already occasioned is very inconvenient to me on account of the heavy Expenses continually going on" (Broome Collection). In fact the letter reveals that, not only was he desperately seeking funds from other sources to "...carry on the Works which are still required...", but that he had also offered a fourth share in the venture to Mr Lowder, a Bath architect. The same letter states:

"Although Mr Lowder seems anxious to have a considerable share in my proposed manufacture of Freestone there are difficulties in arranging the

seperate [sic] interests in the concern according to his wishes, which seem for the present insurmountable..."

There can be no doubt that Conolly and O'Neal were beginning to run out of patience with Smith, and that they would object vehemently to the suggestion that another party should become a 'co-partner' at this late stage - purely for the sake of baling Smith out of self-incurred financial difficulty. This particular problem leads on to the next. The saw-mill was not yet operational, and it was not until March, the next year, that Smith finally got round to noting that the drop of the waterfall had to be made greater in order to accommodate a larger and more powerful wheel (Diary: Mar 24, 1812). The mill was clearly not yet up to the task of 'manufacturing', or sawing stone at an appropriate industrial scale.

The Saw-mill

Tucking Mill was so named because it had been the site of a mill for fulling (or tucking) newly woven cloth. When William Smith bought the site in 1798 only the ruined outline of the original mill remained, and the pond which fed the waterfall had all but disappeared. One of Smith's first goals, accomplished in 1802, was to restore and even enlarge the pond and to stock it with fish. The potential of full restoration to industrial use had of course been recognised by Smith and in fact the waterfall was listed as the most prominent feature in his notice of sale of the estate in 1807. As he commented in verse many years later:

*"Great plans were laid a fish pond made
Combining taste with trade"*
(Biographical verse: "Tucking Mill", 1825)

Later in 1807 Smith leased Tucking Mill to a man named James Sutton and one of the stipulations seems to have been that Sutton should rebuild the mill. Work commenced in 1808 and early in 1809 the site once more resounded to the noise of water driving a wheel in order to mill - flour! (Broome Collection). Sutton, who was irregular in his rental payments, ceased to be a tenant probably in 1810, and it was in October that year that Smith first approached Charles Conolly with his scheme. Then, in January, 1811, in the company of Mr Hill from Bath,

he “Walked to Tuckingmill to show him waterfall etc. etc. and the Freestone proposed to be sawed by machinery” (Diary: Jan 13, 1811).

The conversion from a flour mill to a saw mill should not have presented too many problems. The gearing producing the horizontal rotary motion of a grindstone would have to be rebuilt to enable the horizontal reciprocating motion of a double-handled mason’s saw, or ideally, an array of such saws. Such an array would require a frame in which the saw(s) could be mounted, positioned over the rough hewn block, or blocks of stone to be cut (and still, presumably, mounted on the same carriage they had been placed on at the quarry). Guide rails either side of the frame would ensure straight cutting, and the whole frame would move back and forth from the power transmitted via a crank, or possibly two in parallel, connected to a geared wheel turned by the main drive shaft. The ‘frame’ would, of course, have been designed to fit the dimensions of the existing mill, but special modifications would have had to be made to accommodate the movement and correct positioning of large blocks of stone. Given the lack of evidence in Smith’s diaries to indicate any kind of reconfiguration of Tucking Mill during the first half of 1811 - a time when he was mostly concerned with construction of the railroad - one of only two possible conclusions must be drawn. The first is that he delayed conversion of the mill until after the rail tracks had been laid in order that he could focus full attention on each of the elements of the scheme in turn. If this is the case his quarry, the very source of his stone, was ranked last on his list of priorities. His co-partners meanwhile would have been frustrated at the prospect of completing, at considerable expense, their own sections of railroad, enabling transport of stone from O’Neal’s quarry to a canal-side where the only industrial facility could grind corn to flour or, perhaps, stone (and dreams) to dust.

The alternative explanation is that Smith ordered a reconfiguration of the mill to be rigged-up in the hope it could fulfil the desired tasks, even if only on an experimental basis to test the workability of his scheme. Whatever, having spent much of August finishing his own section of railroad he was able finally to copy a map of his estate and “marked the Railway thereon...” (Diary: Aug 29, 1811). The preceding days, however, marked a time of serious discussion regarding the project. In fact it was only now, after the railway was complete, and after a “long conference ... on the subject”, that the terms of the “proposed partnership in Stone Trade” were either finalised or, more likely, amended (Diary: Aug 26 and 27, 1811). Just one week earlier he had recorded at Tucking Mill that, once again, “Mr Wm Hill called and talked over the proposed sawing of Stone by the power of my Watermill &c.” (Diary: Aug 18, 1811). O’Neal in particular must have been frustrated not to have the saw mill in operation, but at least he would have been able to employ sawyers at the wharf and to load his own stone to a narrow canal boat for shipment to market. John O’Neal is never mentioned again in Smith’s

diaries, and it is possible that he threatened to leave the scheme about this time. Smith's letter to Hill in October, when he mentioned the possibility of recruiting a fourth partner, suggests that O'Neal remained a partner at least until then, however.

It took more than a year for the next sequence of events to unfold. Smith had determined that the waterwheel was under-powered and that a larger wheel, requiring a longer waterfall was required. This may well have been a 'pet-scheme' of Smith's (perhaps influenced by the size of the waterwheel at nearby De Montalt Mill, which was said to have been the largest in England at this time), already described in his notice of sale of the estate in 1807:

“The fall on the trout stream, which, in a very imperfect state, was many years since employed as a fulling-mill, has been much improved, and the reservoir or mill-pond ... is well calculated for an overshot wheel. The fall between head and tail-water being more than 16 feet, but might at a trifling expence be increased to five or six and twenty feet without risking any material injury from floods or tail-water.”

(Broome Collection)

In March, 1812 he viewed alterations and improvements to the pond and considered the options for getting water higher on to the millwheel (Diary: Mar 24, 1812), perhaps implying that all operations had ceased over winter while essential repairs and modifications were carried out. Then, on August 11th, while in London, he visited “Moorman's Old Street [and] ordered 9 x 9ft saws & two Circular for Stone Manufactory at Tucking Mill” (Diary). His next diary entry on the subject is dated November 3rd when he “Came to T.mill”, presumably after they had been delivered, “Contriving about new Frame of Saws”. Then his attention turned to problems at the quarry, and the opening up of the arch. This whole sequence of events seems to beggar belief, and Conolly must surely have said something on these lines to Smith. A full two years after the scheme proposal, and one year after his partners had completed their part of the deal, only now was Smith on the verge of being ready to ‘manufacture stone’.

Whether or not Smith did ever get round to increasing the diameter of the waterwheel is hard to say. The earliest surviving sketch of the mill is a watercolour in the collection of the Victoria Art Gallery in Bath, attributed to Rev'd. John Skinner of Camerton and drawn in the early 1820s (This painting is reproduced in Addison, 1998; 83) [FIG07→]. The earliest

photograph dates to the mid 1890s and shows a very similar scene (Broome Collection) [FIG25→]. Most striking is the lack of depiction of any waterwheel at all, suggesting it must have been at the back of the building with its axis perpendicular to the dam wall. Scales are difficult to judge, but it does seem that a 25 feet diameter waterwheel would be wider than the main part of the mill building itself (according to the painting), and would therefore be oversized. There is also no evidence of a raised mill-race or iron pipe to feed the wheel (such as was employed at De Montalt Mill), or that the dam behind the mill was extended or made taller at this time as such structures are absent from both pictures. The only other way to extend the drop of the waterfall would have been to excavate a deeper gutter, or tail-race, underneath the wheel, all the way to the culvert which followed the line of the original Horsecombe Stream where it flowed underneath the canal and eventually into the Midford Stream in the valley floor below.

The saw frame on the other hand was definitely built, and must have been an imposing sight. Indeed, it was probably one of the very first of its type to be used in the stone industry, and use of circular saws (mounted separately to the 9ft saws) for cutting stone was possibly unique at this time. The nine-foot saws were mounted side-by-side within the horizontal frame, cutting the stone into a number of straight-sided slabs of stone simultaneously. The width between the saws in this array was adjustable to produce either ashlar blocks or thinner stone 'plates'. Saws mounted in this kind of arrangement were later known as 'gang-saws', but would be unsuitable for cutting very thin plates, of - say - less than one inch thickness, and certainly not the $\frac{5}{8}$ th inch plates which Smith is known to have produced in quantity¹³ [FN13→]. Circular saws would have been used for this task, although no details are available concerning the way they were mounted. Probably they were affixed to a purpose-built table, on a pivoted arm which could be lowered by hand onto the stone, which would be held in a small jig-frame. The stone had to be portable by hand, and so would have been slabs already cut on the horizontal frame, and further cut to the required finished dimensions. One circular saw could then cut a one and a half inch thick slab into two $\frac{5}{8}$ th inch plates. Power would have been transmitted via a belt, pulley and spindle system, either from the main drive shaft, or possibly from a second smaller waterwheel of the type Smith described in his 1807 "Notice for Sale".

In fact, the saw frame was so successful that it must be counted as one of the singular achievements of the whole venture, for Smith was able to sell the basic design to other manufacturers. In the spring of 1815, just a few weeks before the Waterloo campaign, Smith was in London and recorded in his diary:

Apr 11. m early with Mr Wills to Crayford Saw mill met Mr Barne there ex'd the Works of the Vertical Saws - the rail surrounding machine &c. &c. Advised with Godwin about the creation of the 3 saw spindle and with the above gents on the new proposed arrangements &c. - the Cargo of Timber now coming up the beck &c. &c. - and back with Mr W to Town.

The Crayford Saw Mill was indeed a timber mill, producing floorboards amongst other products. Since early machines tended to replicate the manual actions they replaced, the saw frame in this case was arranged vertically as if in a saw pit. Only three gang-saws were mounted in the frame, and the length of each of the saws would have been much shorter than those used for stone blocks. Smith would have had to devise a means to propel, or drag the timber through the frame. Power would still have been via a crank for the saw frame, and possibly a pulley and chain to haul the timber across the saw table. Smith revisited the mill in September that year, as his diary records:

*Sep 18. m went to Crayford Saw Mill
Set the vertical saws to work to show Mr Barne their work*

Sep 19. Br(other) J(ohn) S(mith) came to meet me at Crayford SawMill

*Sep 23. m B. Barne at the Mill Br. and myself explained to him how the improved application and the division of water on the wheel might be affected
[in very faint pencil] Rec'd of BB 1 - -
Evening came with Br to Town*

Although the stone sawed at Tucking Mill was never used in any major project it would surely have brought a wry smile to Smith's face when he learned later that floorboards sawn at Crayford Saw Mill had been used in the construction of the New Buckingham Palace in the late 1820s (Crayford Directory, 1852). It is also recorded that the mechanized saw frame at the mill was "ingenious", and thus a credit to Smith's engineering skills.

Stone Manufacture

Not a great deal is known about the level of trade in sawn stone that Smith achieved, although it does seem that manufacturing continued until at least 1816 when the property was once again advertised for let. In November, 1812, just at the time the whole venture was beginning to get under way, he scribbled a rather curious, but potentially revealing calculation of the actual costs involved in the manufacture of one ton of sawn stone [FIG26→]. He begins by noting that 360 perches or tons (of quarried stone, delivered to the mill - presumably) at 6/10d would cost a total outlay of £122 (Diary: November, 1812). Here, Smith uses 'perch' in the sense of a solid measure or volume of stone. Although in other regions this measure was said to equate to just under 25 cubic feet (OED), Pollard suggests that at most local quarries at this time 20 ft³ was reckoned to weigh one ton (Pollard, 1994; 37). In a separate note, however, Smith refers to one ton of 'hard' Bath Stone being equivalent to just 16 cubic feet (Papers: "Bath Stone", undated). This is equivalent to a block of stone with edges just over 2 feet 6 inches each. In other quarries on Combe Down a perch was used in the sense of an area of quarried land, the imperial unit representing 16 feet 6 inches squared. Thus an average quarrymaster in the late 18th century could hope for an average annual output of between two and seven perches (Pollard, 1994; 11). Although not easy to equate precisely, it seems the 360 tons Smith refers to would be equivalent to the annual output of a very modest sized quarry, perhaps based on a very rough calculation of one ton of stone per calendar day, excluding Christmas and other major feast-days! Bearing in mind the fact the quarry arch had not been opened until the same month he made this calculation, it seems he was estimating future costs of production, perhaps to present a case to the co-partnership.

The same note goes on to calculate that sawing would cost 1/6d per ton, and final dressing with a mallet and tool an extra 8d, making a grand total of nine shillings per ton at the point of loading on to the narrow boat. He appears to estimate wastage at 74 tons of the 360 tons quarried (approximately 20 percent), leaving 286 tons to be loaded on to 13 boats at 22 tons per boat [FIG27→]. This is exactly one shipment every four weeks, and appears to represent gross under-utilization of mill capacity, especially if Kingham Field Quarry was working full-time to produce 360 tons annually. Smith must have realised from very early on, therefore, that partnership with another quarrymaster was essential if the enterprise was to prove profitable, and so he joined with O'Neal. Nothing is known about the output from O'Neal's quarry at Vineyard Down, though given the longevity of the quarry it was almost certainly greater than that from Kingham Field. The thought must have occurred to both of them, however, that they should offer the use of the railway and saw-mill, for an appropriate fee, to

other quarrymasters on Combe Down. Indeed, transport of stone to the incline on Summer Lane would not have been a problem for the local quarrymasters of the time, being only a few hundred yards distant from the Byfield and Davidge's Bottom mine entrances (Irving, 2005).

In October, 1816 Smith realised that he did not have sufficient time to devote to the 'venture', and that he was unable to draw sufficient income from it to support all his other activities. Once again, therefore, he advertised the property and land at Tucking Mill for let, describing first and foremost:

"... the MILL for sawing Free-Stone to any thickness or shape required, and particularly for facing inferior or decayed fronts of Houses, great quantities of which are sent to and used in London and also a capital RAIL ROAD, from Kingham Stone Quarry, including the same, to the Coal Canal, with proper convenience for loading stone into the boats."

(Bath Chronicle, 24th Oct. 1816; 3).

The wording implies that the quality of ashlar stone produced at the quarry was not so good, being suitable only for facing existing "inferior" structures or those where the facing had already decayed once. Nevertheless, "great quantities" had been shipped and the expectation was that this market could be sustained. Of course, as everyone knew at this time, England had entered economic recession in the post-Napoleonic era and the building trade was in a slump. No-one wished to lease a quarry and saw-mill in this climate, particularly if the quality of stone was poor, and so Smith failed to find a tenant.

Smith probably realised the poor quality of his "prime freestone" bed early in 1813, soon after the opening of the quarry. It was likely to have been stained because of its 'proximity to the Great Fault' as well as fractured with 'bad joints' because of the pressures associated with cambering and gulling at his quarry site. Nevertheless, he could rely on a greater depth of "Bottom Beds" which provided a harder Bath Stone and which could all "stand weather" (Sketch of Kingham Field Quarry). This was a quality Smith rated highly in terms of value of the stone, because of the wide range of uses to which it could be applied (Papers: "On the Impropriety of using bad stone, ...", Nov, 1812). Not least of these was its potential use for 'paving slabs', a quality the Combe Down quarrymaster Henry Street had exploited years earlier on the north side of the Down. On September 6th, 1813, in the only diary entry in which he mentions the venture into stone manufacture that year, he states, tersely, "Calculation on

sawing thin stuff. Stone Merchant called” (Diary). Various other notes have survived which give a hint of the way his trade was changing. Most intriguing is one on “Bath Stone”, although unfortunately it is undated. It states:

“...
 ...

256 sq ft ⁵/₈ Inch plates per Ton

at 2¹/₂ per foot on Board = 53^s/3 per Ton

[illegible] stone 10/7

sawing 42/8

...
 ...

Reckon carriage 32^d per ton makes at 42^s/₀

in London --- 3-18-6 per ton of plates or 3^d/_{1/4} per foot superficial” (Papers).

‘Plates’ obviously refer to thinly sawn stone, although a thickness of just ⁵/₈ inch would seem too thin for use as paving and would more likely be used for roofing. The figures are difficult to interpret, however, particularly the exceptionally high cost of ‘sawing’ compared to Smith’s original estimate in 1812 of just 1/6d. What does seem clear is that the cost of thinly sawn stone f.o.b. in London was 53 shillings and 3 pennies per ton, or 2¹/₂ pennies per foot. The sale price appears to have been 78 shillings and 6 pennies per ton, or 3¹/₄ pennies per foot. This would represent a mark-up in price of exactly 33% - a reasonable entrepreneurial trade given the risks involved.

In 1839, when a commission of four people, led by the architect Charles Barry and including William Smith, toured the country in search of a suitable stone to build the new Houses of Parliament, they visited Combe Down and made notes on the suitability of the local stone for use in the project¹⁴ [FN14→]. At that time the cost per cubic foot of stone at the quarry (Lodge Hill) was 6d, approximating to just under 10s per ton (The Commission calculated that there were 19.3 cu. ft. to the ton at this particular quarry). Transport from the quarry to a canal boat loading point cost between 2d (Combe Down to Dundas) and 4d (Box to Laycock) per cu. ft., or approximately 40d to 80d per ton. Canal charges from Laycock to Pimlico (London) were 16s per ton, and the total cost at London per cu. ft. of Bath stone was therefore 1^s/₁₀^d - 1^s/₁₁^d, or about 37s per ton (Report of the Commissioners for ... the Building of the New House of Commons, 1839). It is of interest to note that canal charges were roughly 45% of total cost, but it must also be borne in mind that the Commission was only considering the cost of “plain-rubbed” stone rather than sawn and dressed stone. Although ‘sawing’ and ‘dressing’ together

accounted for one-quarter of the total cost of stone loaded on to boats at Tucking Mill (according to the 1812 estimate), Smith's final calculation of 53s per ton of stone plates f.o.b. in London does seem a little high. This leads inevitably to the question of whether or not his price was right for the market and, perhaps more importantly, just how many customers was he attracting in this time of looming economic recession? Smith's diary offers only the smallest, but most tantalizing of clues. On September 25th, 1815 (in London, and only two days after he had concluded business at Crayford Saw Mill) he visited:

"... Carters Yard, Dean St. & looked over the new applications of sawed stone to casing [?] Inlaid Pavements

Sep 26 with Br J.S. to Sowerbys & Carters & Wyatts Inlaid stone pavement concern & ex'd the stone used &c.

Afternoon with Br. Dined with Mssrs Wyatts and had conversation about continuing to cut their stone plates for them"

Was Smith negotiating price, or possibly arguing over the quality of his sawn stone? Was the conversation about the current poor state of the market? Was this, perhaps, just a quiet way of recording that he had lost an important, possibly crucial contract? Whatever, this is the last reference to the stone business in Smith's diary.

The End of 'The Venture'

In June, 1819 Smith's failure to repay the 'mortgage' agreement he had undertaken with Conolly in 1814 led swiftly and directly to the loss of his Tucking Mill estate, including the mill and his share of the railway, and to his imprisonment in the Fleet (presumably repayment had been set over five years). He was now left to ruminate on the reasons for his predicament, and why his venture had failed so badly. Doubtless influenced by countless tales of misfortune suffered by his fellow inmates, Smith put the cause of all his woes to simple bad luck. It was the quarry that had let him down. After all, despite his skills and experience as a surveyor, how was he to know what actually lay behind that blank quarry face he had sketched in 1812? How was he to know that the stone would prove so utterly deficient in quality? Filled with a

sense of self-pity he perhaps composed even then in his mind the couplet that he would later write down in his 'ode' to Kingham Field quarry:

"...

*There it was I sought a prize
But there interred my money lies."*

(Biographical Verse, "Vicinity of Bath - Tucking Mill and Combe Down")

He seems to have made up his mind never to return to Bath, as suggested in a rambling verse he wrote on an early day in February, 1826 called "*1819 - Defeated*":

"...

*Though still I have one good friend there
And ere I quit o' Bath thy Vales
My mind relieve by its own tales."*

(Biographical Verse, Box 50, Folder 3)

Twenty years later Smith did in fact return to Bath, as a member of the Commission seeking a source of stone for the new Houses of Parliament. He stayed just one night, however, and though the group must have passed close to Tucking Mill on their way to Wells, he never set eyes on the place again (in fact Lodge Hill Quarry, which the Commissioners visited, was just the other side of Kingham Field from Smith's former quarry).

John Phillips, his biographer, was certainly persuaded that it was the poor quality of stone that let Smith down - but is this really the case? In November, 1812, shortly after his quarry was opened, Smith wrote a short pamphlet on the "impropriety of using bad stone" in which he noted that even though the quarries of Combe Down all worked the beds of Great Oolite, and despite the fact they were all located in quite a small area, differences in various characteristics of the stone were often apparent. He seems to have recognised that the stone in his own quarry did not have a consistent colour and that the jointing was not always good, but he seemed happy that he did have access to beds of harder freestone which "could withstand weather". He was admitting, in effect, that although his quarry did not possess the best stone on the Down it was still worthwhile to excavate it, shape it, and transport it to London where the returns, even for thin cut plates, could be high.

Probably Smith hoped that as he quarried deeper, and further from the “great fault” the quality of stone would improve. The face he worked is unfortunately no longer accessible, but some years ago, in the early 1980s, David Pollard and a colleague claim to have gained entry (oral communication with David Pollard). David suggests that Smith did indeed quarry underground, along a line that is a continuation of the passage marked by the ‘arched entrance’, but veering slightly to the left. After some metres, however, it appears that Smith encountered another in-filled ‘gull’ (or ‘fault’, as he would have described it), then another, and then yet another. Although the stone beds remained level, progress became increasingly difficult because when each ‘fault’ was encountered the stone ‘ceiling’ shifted accordingly [FIG28→]. There can be no doubt, therefore, that the quality of stone did not improve as the mine progressed, and that the effect of cambering and rock fracture extended over a wider area than Smith had originally anticipated. Over a longer and more sustained period of extraction it is likely that issues of stone quality and accessibility would have improved, but sufficient time was a luxury that Smith never really enjoyed.

It has already been argued that for Tucking Saw Mill to operate at full capacity Smith and his venture would have probably required custom from other quarrymasters on Combe Down. Despite the apparent excellence of the facilities offered, however, there are important reasons why Smith could not attract their stone to be processed at his mill. First and foremost, the quarrymasters at this time were stone-masons - master-builders who extracted the stone they needed for projects in hand. Almost without exception their work was in the local Bath area, and they would generally have little use yet for quay facilities located on the Coal Canal. There may have been one or two exceptions, of course, such as Patrick Byrne who in 1811 provided stone and built the New Bridewell at Devizes. He, however, would not have been able to enjoy Smith’s transport and milling facilities since they were still under construction at that time. Presumably this is the kind of work that Smith would have been encouraged to see, and would wish one day to be sent his way. He would have been alarmed when he learned that Bryne actually preceded Smith to the Fleet debtors prison, but may later have been encouraged by the fact that Byrne was released by Royal pardon just a few weeks later, in June, 1818 (Irving, 2005; 55-57). A few years later, when Philip Nowell became master builder of such major projects as the rebuilding of the palace compound at Windsor Castle, in 1824, Smith’s venture could have integrated well with the new found surge in demand (and supply) of Combe Down stone in the fashionable London market. He was, however, just a few too many years ‘ahead of his time’.

Another possible reason why the local quarrymasters were wary of utilizing Smith’s water-powered saw-frame is that the year 1812 is forever associated with Luddism - the sometimes

violent reaction of skilled workers in various trades and in various parts of the country to the threat of job losses resulting from technological innovation. Although most commonly connected with the textile industry, in Nottinghamshire and Yorkshire in particular, local woollen workers in Somerset and West Wiltshire were also vociferous, and successfully delayed introduction of the flying shuttle, gig mill, and (most feared) the cropping frame in this region until 1816 (Berg, 1994; 254). Workers in similar, tightly knit community based industries “entrenched in [their] own traditions”, would also defend “vigorously” their “customs and community from any change” (Ibid., 181). Combe Down quarrymasters would have been well aware of these disturbances, and of the implications of mechanisation to the community of specialist workers also found in the stone trade. As stone masons and builders they would have recognised the value of skilled sawyers on their teams, and would have been reluctant to risk any upset by supporting Smith - an outsider. Although never threatened, as such, it is indeed possible that Smith’s venture was deemed ‘best left alone’. Once again it was an issue of ‘wrong time - wrong place’.

The social unrest epitomised by Luddism was exacerbated when the Napoleonic Wars finally ended in 1815 and a tired, near crippled army returned seeking new employment. The soldiers were welcomed back as heroes, then left to fend for themselves. Economic recession followed and new building projects were among the first in line to be cut-back. Ironically, the cries of the Luddites became subsumed by the general din created by a growing mass of unemployed labour in all sectors, and machines were now freely introduced into industry by mill-owners in a desperate attempt to reduce production costs to improve competitiveness. For many of the Combe Down quarrymasters the question of mechanised saw-frames now became a redundant issue, since no sawing would be done at all if there were no buildings to be built. In some ways Smith now possessed a slight advantage over his rivals because he had access to a larger market via his quay and the canal network. His saw mill operated cost-effectively, and sawn stone could also be transported more cheaply than ‘plain-rubbed’ un-cut stone because waste was removed at source. But the writing was already on the wall, and was no doubt spelled out very clearly to him during Smith’s “conversation about continuing to cut [the Wyatts] stone plates for them” (Diary: Sep 26, 1815). One by one a number of local quarrymasters ceased operation, including near-neighbours William Hulonce (in 1816), Sophia Rudman (1820), and John Scrace (1821). All appear to have been on the edge of bankruptcy when they stopped quarrying, and one or more may even have joined Patrick Byrne (1817-18) in debtors prison (Irving, 2005; 55). In fact, had Smith not become so well-known for his map and geological survey work, his debt, his quarry, and his venture into stone manufacture would have been lost to obscurity for the simple fact that his failure was so typical of the time. That being said, one difference between the situations of Smith and his neighbours is that they all returned to quarrying when conditions

improved in the mid 1820s. Smith, stewing over his poor lot in the Fleet, resolved never to go back.

Poor stone, bad timing, and a vicious spiral of events beyond his control all contributed to the failure of Smith's venture. Finally, there is one other factor just as important as these - Smith himself. Of course, Smith was engaged in the completion of his major project - his map of the "Delineation of Strata of England and Wales ...", completed in August, 1815. This was to be his enduring and deserved legacy to the nation but, one suspects, he had also aspired to retire at Tucking Mill as a comfortably well-off small-scale industrialist, advisor to the wealthy, and noted mineralogist. He failed in his entrepreneurial ambition simply because he had too many other interests and could not devote sufficient attention to the project at times when it was most needed. In particular, he failed to ensure the simultaneous development of the various integrated aspects of the venture - the quarry, railway, and saw-mill - to the considerable detriment of his co-partners. One of them, Charles Conolly, eventually became so exasperated with Smith that he called in the money Smith owed him, and so changed the course of Smith's later years forever.

FN01

Smith did not lose his post with the Somerset Coal Canal Company until 1799. The reasons why he was sacked are not clear, but it is presumed that the Company were annoyed because, by using 'insider' knowledge to find and acquire Tucking Mill, Smith now faced a possible conflict of interests as a landowner with property fronting the canal.

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FN02

Dr John Broome lived at Tucking Mill Cottage, the house with the plaque commemorating William Smith, in the late 1990s. During that time he tried to discover the full story of his home and he perused and transcribed much of the William Smith archive. He also collected a vast amount of related material including deeds, maps, articles, and photographs. All these notes, transcriptions and photocopies were carefully filed and then painstakingly indexed. When he left Tucking Mill he kindly handed this invaluable archive to the Southstoke Local History Group and it became known as the John Broome Collection. In December, 2003, it was transferred, along with other Southstoke history material, to the custody of the Bath and North East Somerset Record Office. The collection has been kept intact, and is found in the "Southstoke Local History Archive, Box E (Acc. 586)" at Bath Record Office.

Embodied within these files is a hand-written (in pencil) 13 page manuscript by John Broome which summarizes, in very clear and lucid detail, the story of Tucking Mill from the time of Smith's purchase in 1798 to a point in time near the beginning of Smith's venture into stone manufacture, in 1811. The manuscript ends abruptly, and does not cover the story of Smith's quarry venture. Although untitled, it is an invaluable resource.

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FN03

According to Broome, Smith's mortgage debts had been sold from one agent to another during the first few years of the nineteenth century. Each, in turn, pursued Smith with relentless vigour as they tried to recover the debt they had purchased, even threatening him with arrest. Eventually, in January 1809, Smith persuaded a friend, Mr Bough, to buy the debt and the pressure on him was relieved somewhat. He was also harassed throughout most of 1806 as a shareholder of the Somerset Coal Canal Company to invest additional capital to support the enterprise. He was eventually forced to sell his shares in order to relieve this burden too.

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FN04

His desire was to emulate Ralph Allen, who in the 1740-60s had famously quarried stone, then transported it (by an innovative railway) to a site near the River Avon (Dolemeads, at Widcombe), shaped it, then sold the finished blocks to local architects and builders for the construction of some of the finest buildings in Bath. Smith even wrote down his thoughts in verse (many years later, in 1825, as he reminisced on Tucking Mill):

*“...
All worthy Allens lands are now in other hands
As well as mine
Few know his great design
Of Allens road so often trod
By those who seek the shade
Or that the stone for Bath's parade
On rails ran down that line
Its carriage was the sign ... ”*

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FN05

Francis Webster, of Kendal, built a mill at Helsington Laithes, on the River Kent, for the sawing and polishing of fine quality marble : “...About the year 1800, till which time every branch of the art was executed by manual labour.” (Nicholson, 1861; 246)

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FN06

Broome suggests, on the basis of letter correspondence between Smith and his tenant, James Sutton, that Sutton remained a tenant until sometime between late 1810 and early 1811. He often appears to have been tardy in his rental payments and apparently absconded from time to time, but was responsible, as part of the terms of his tenancy, for building the mill. He would have occupied Tucking Mill House during his tenancy (when he was not moonlighting); and it is clear also that some of the meadows and pasture land on the estate were let to other various smallholders during this period. Although William Smith was concerned entirely with his stone venture from the end of 1810, and was in and around Bath throughout, it is not until June, 1811 that his diary states "...at Tucking Mill". Prior to then he would often stay with his brother, John Smith, at neighbouring Broadfield Farm.

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FN07

The phrase “stone manufacture” was first used by Smith in his diary entry for August 26th, 1811 when he “Sent Terms of proposed Co-partnership in Stone Manufacture to J. Lowder Esq. Architect”.

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FN08

When Smith bought Tucking Mill in 1798 he actually made two purchases of land. The largest portion included Tucking Mill Wood and Tucking Mill Meadow and was located entirely in Monkton Combe parish. It was on this side of the parish boundary that Smith built Tucking Mill House (later extending it to become a larger structure). The second purchase was of a smaller piece of adjoining land on the other side of Horsecombe stream, which also formed the boundary line with Southstoke parish. The pasture, called 'Niplands', contained the ruined foundations of the original fulling mill, on which Smith later caused his own mill to be built (Deed of sale, 1828). In 1802 Smith rebuilt the dam to cause the stream to flood and so recreate the original millpond. His original intent was merely to stock it with trout, but he later extended the pond in order to increase the height of the waterfall when he began to realise the industrial potential of the site (Broome).

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FN09

There were at least three quarries in the area near Summer Lane on the south side of Combe Down. Aside from Smith's quarry at Kingham Field, he also described "Late Godwin's" and "Vineyard Down" quarries in notes he made in June, 1811. Late Godwin's appears to have been abandoned by the time he wrote these notes, but the fact it was characterised by a "gully which was probably the great Fault" suggests it was near Kingham Field. Probably it is the quarry still visible today in the same woodland that surrounds Smith's quarry, which is about 200 metres away to the south-east. Vineyard (or Vinegar) Down quarry - "remarkable for its fineness and freeness from veins" did not cease operations until the 1920s. Though no trace remains today, it is almost certainly the quarry operated by John O'Neal. The point where the railway meets Summer Lane, at the top of Bluebell steps is more or less equidistant from Kingham Field and Vineyard Down quarries, and so offered the best line for partners Smith and O'Neal to transport their stone. Oral traditions received by the Revds Pitcairn and Richardson in the early 1920s are somewhat confused regarding the role of these quarries in the construction of both the 'Midford' (S.C.C.) Canal and the later 'Midland' (Somerset and Dorset Joint) rail line. Nevertheless, the following can be extracted from their account of the history of Monkton Combe:

"When Midford Canal ... [was] being made, the owner of this quarry (ie. Kingham Field Quarry a.k.a. Jackday Quarry) and the owner of the Vinegar Down quarry near De Montalt House ... joined hands, and truck lines were laid between them and carried down into the Midford valley, by which the stone was provided for the work."

(Pitcairn and Richardson, 1924; 63)

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FN10

The 'mortgage agreement' of April 1814 between Smith and Conolly appears to have been arranged in the form of a sale of all Smith's land and buildings at Tucking Mill to Conolly, albeit for the paltry sum of £1000. In the 'marriage settlement' of 1817 the land, mentioned separately to Conolly's neighbouring properties, is described as being "let" to William and John Smith. The 1814 contract was actually a legal device (known as an assured tenancy agreement) to provide the strictest possible terms on the surety (i.e. Tucking Mill) for Conolly's loan to Smith. It was failure to repay the loan, rather than rent, to Conolly which led to Smith's internment at the Fleet Prison in 1819 - and the loss of his estate.

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FN11

The casting of specially designed curved cast iron rails at this time would have been: experimental; complex; and extremely expensive. There is no evidence that any similar tram or railroad at this time actually used curved plate-rails (Hughes, 1990; 104-105).

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FN12

From the top of the incline to Vinegar Down quarry is about 170 yards. If O'Neal was also responsible for the incline he would have required a total of 520 yards of track, broadly comparable to both Smith and Conolly's individual shares.

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FN13

Smith does not mention the purpose of these thin plates, but almost certainly they would have been used as, and cut to the dimensions of roofing tiles.

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FN14

The “Report of the Commissioners appointed to visit the quarries and to enquire into the qualities of the stone to be used in the building of the New Houses of Parliament” was co-authored by Smith and submitted to Parliament in 1839. Three ‘local’ quarries were visited: Lodge Hill at Combe Down; Drewes at Monkton Farleigh; and Bayntons at Box.

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FIG01 : Tucking Mill House, the home of William Smith



Despite the fact that a plaque commemorating William Smith is affixed to nearby Tucking Mill Cottage, careful research by Joan Eyles (1974), and Hugh Torrens (2003) has demonstrated that, without a shadow of doubt, the right-hand 'original' part of the building in this photograph was the home that Smith built for himself in the early 1800s. The house is situated on a country lane about mid-way between the villages of Midford and Monkton Combe. A footpath directly behind the house (following the line of Smith's railway) leads towards Bath, two and a half miles (3.8 km) away. This route passes through the village of Combe Down, which was the centre of quarrying activity for Bath Stone during Smith's day.

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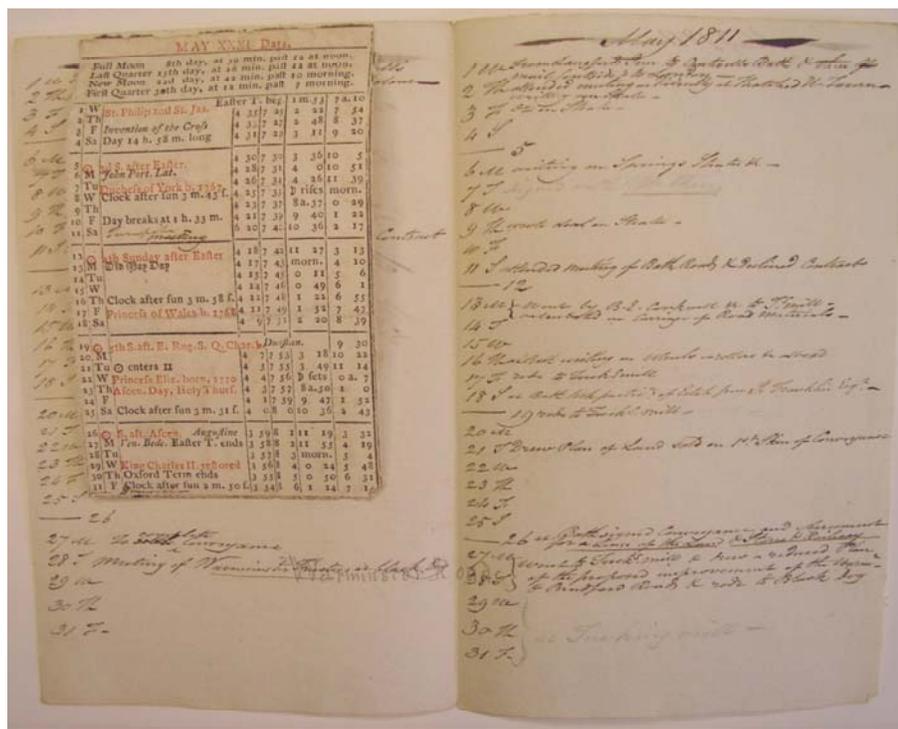
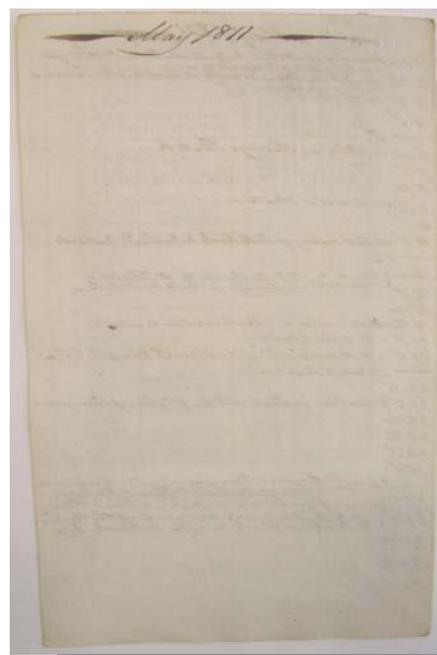
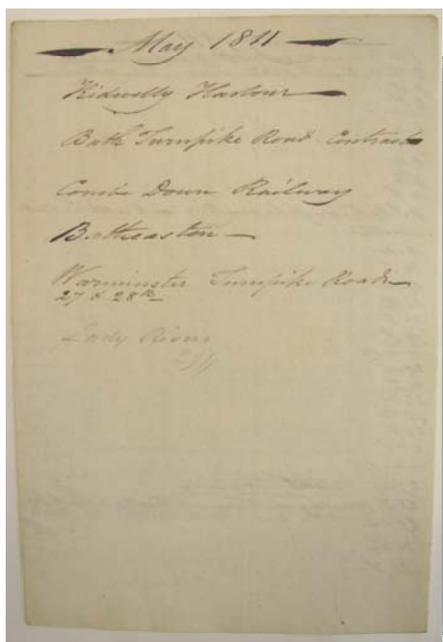
FIG02 : Smith's Map of Strata, 1815.



The full title of Smith's famous map is "A Delineation of the Strata of England and Wales, with part of Scotland; Exhibiting the Collieries and Mines, the Marshes and Fens Formerly Overflowed by the Sea and the Varieties of Soil According to the Variations in the Substrata, Illustrated by the Most Descriptive Names, By W. Smith". This small section, reproduced from an original copy held at the National Museum of Wales, highlights the area around Bath, and "Combe".

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FIG03 : An example of Smith's diary - May, 1811.



Top: End-pieces of the folded diary page. Bottom: Diary entries with almanac insert (left).

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FIG04 : Comparison between Smith's 'short' and 'extended' diary entries

14th S
 — 15
 16th M
 17th I returned to Town about 10 — called at Mr. Mallet's
 18th W. In London
 19th Th Calculating on Repairs of Rye Don Quay &
 20th F. wrote Egan — Mr. B. Borne called to see —
 21st I about to sundry places in London & —
 — 22nd In London — I went out of Bath —
 23rd M. arrived at Bath — attended Lady Rivers,
 Mr. Lowders Mr. Townsends & Tuckering Mills —
 24th I at Tuckering mill looking over works —
 25th W
 26th Th

Hatfield Colliery gave him price at 42,000 £
 which he said he should believe — Saw Workmen
 — and walked to Tuckering mill —
 — T. 24th —
 m. at Tuckering mill — I. I. gave C. C. Compt's
 agent proposal to build T. Mill Bridge with
 36 £ and the old Bridge — Viewed the
 alterations & Improvements made in the Pond
 method of getting water being several feet higher
 in to the Mill wheel —

Top: The short entry for 24th March, 1812 occupies a single line in Smith's cramped diary.

Bottom: Considerably more detail is offered in this extended description of Smith's busy Tuesday, 24th March. As the short version reveals, he had only just returned from London.

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FIG05 : Notice of Sale for Tucking Mill, April 1807

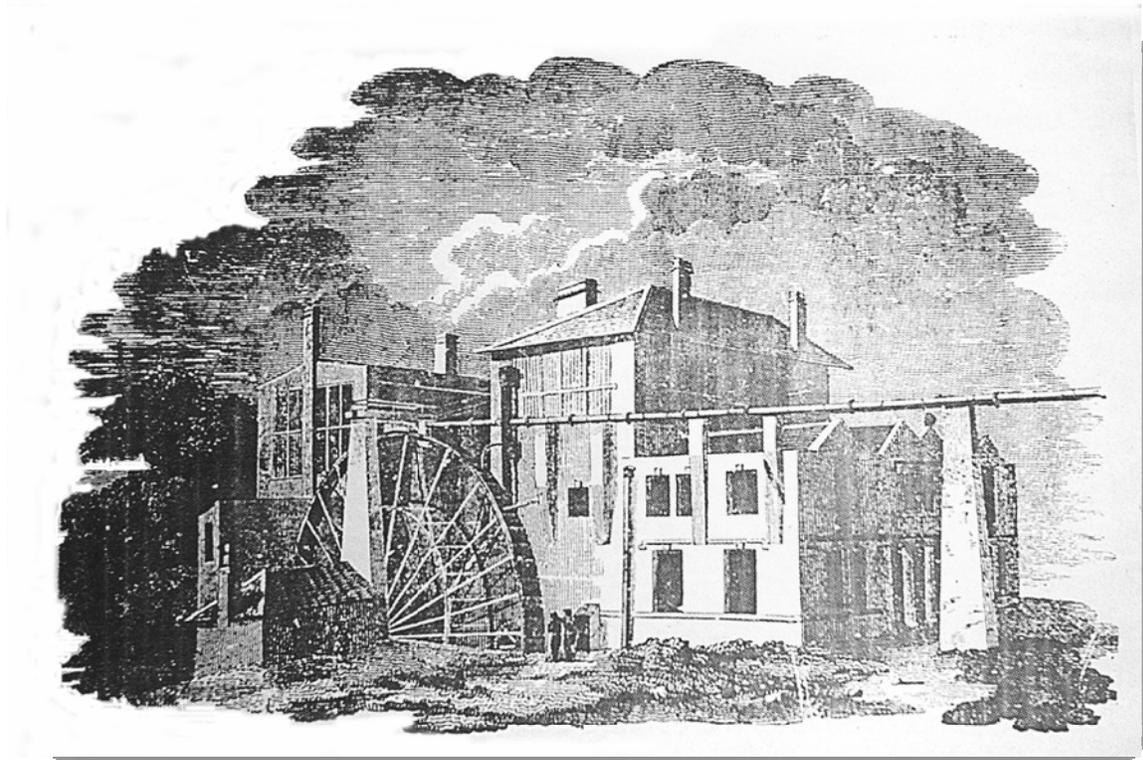
APRILth 16th 1807

TO BE DISPOSED OF IMMEDIATELY,
EXCELLENT WATERFALL,
AND
SMALL FREEHOLD ESTATE,
IN ONE OF THE
FINEST VALES IN THE VICINITY OF BATH,
SURROUNDED BY
Hanging Woods and Plantations,
THAT RENDER IT TRULY
Picturesque and desirable to Persons of Fortune or Business.

Smith attempted to sell Tucking Mill on a number of occasions, always extolling what he perceived to be the primary virtues of the site. On this first occasion he noted the opportunities created by the 'excellent waterfall' for industrial purposes, but made no reference whatsoever to the possibility of a waterwheel being applied to the enterprise of 'stone manufacture'.

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FIG06 : Engraving of De Montalt Mill, 1820s



Built for the manufacture of high quality paper in 1805, De Montalt Mill was powered by a 56 foot (17.07 metre) diameter overshot waterwheel fed by water channelled through an iron pipe mounted on pillars. The mill was situated just a few hundred feet from Tucking Mill, higher up on the slopes of Horsecombe Vale.

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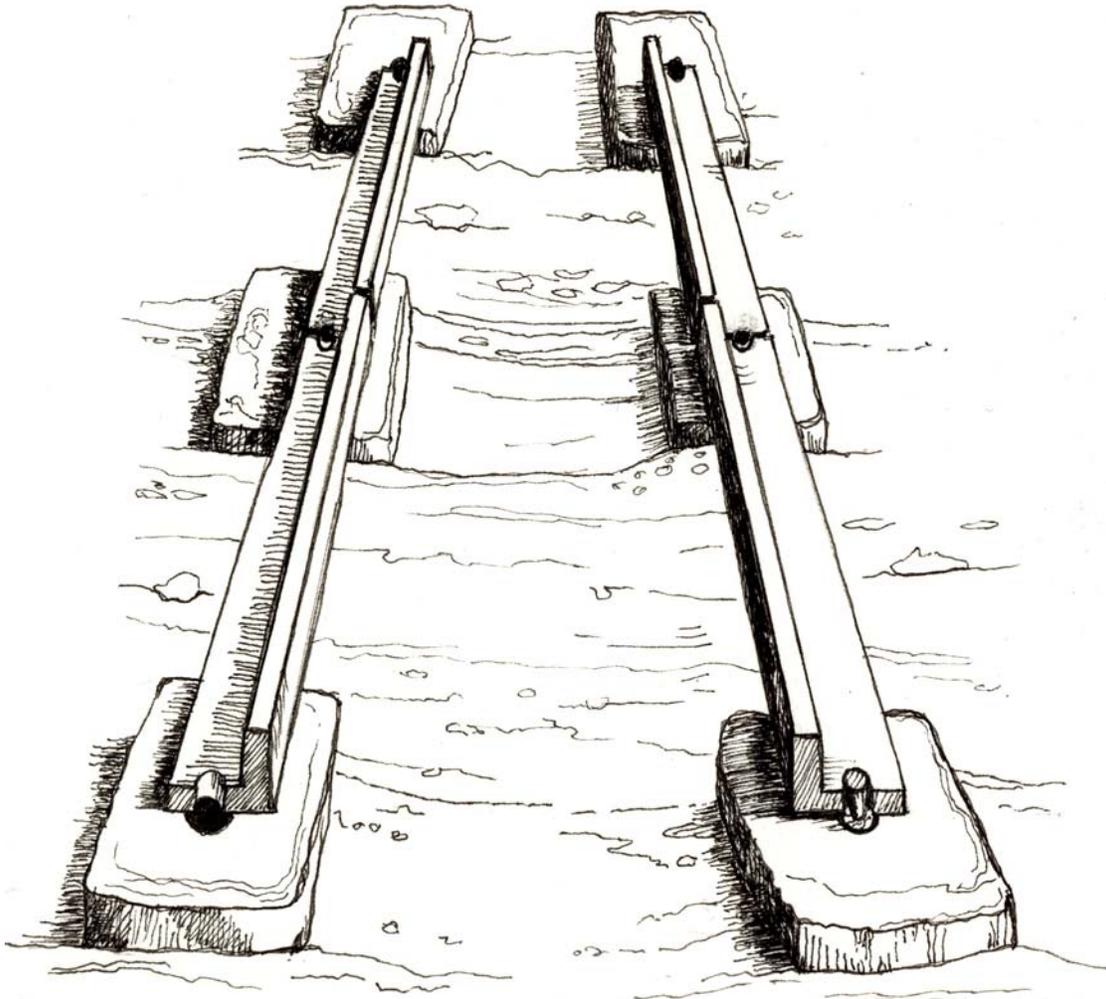
FIG07 : Water-colour of the mill at Tucking Mill, c.1820



This is the earliest known depiction of Tucking Mill and the adjoining house, painted just over ten years after James Sutton had rebuilt the original mill structure. The mill was powered by a relatively small waterwheel, situated at the back. Water was channelled along a ‘gutter’ running parallel to the canal, so the wheel was probably undershot. The house is the building known today as Tucking Mill Cottage, and has a plaque which suggests, erroneously, that William Smith ‘lived here’. It was probably constructed just a few years after the mill, at about the time Smith’s venture got fully underway. Almost certainly it housed the mill manager: Smith’s brother John.

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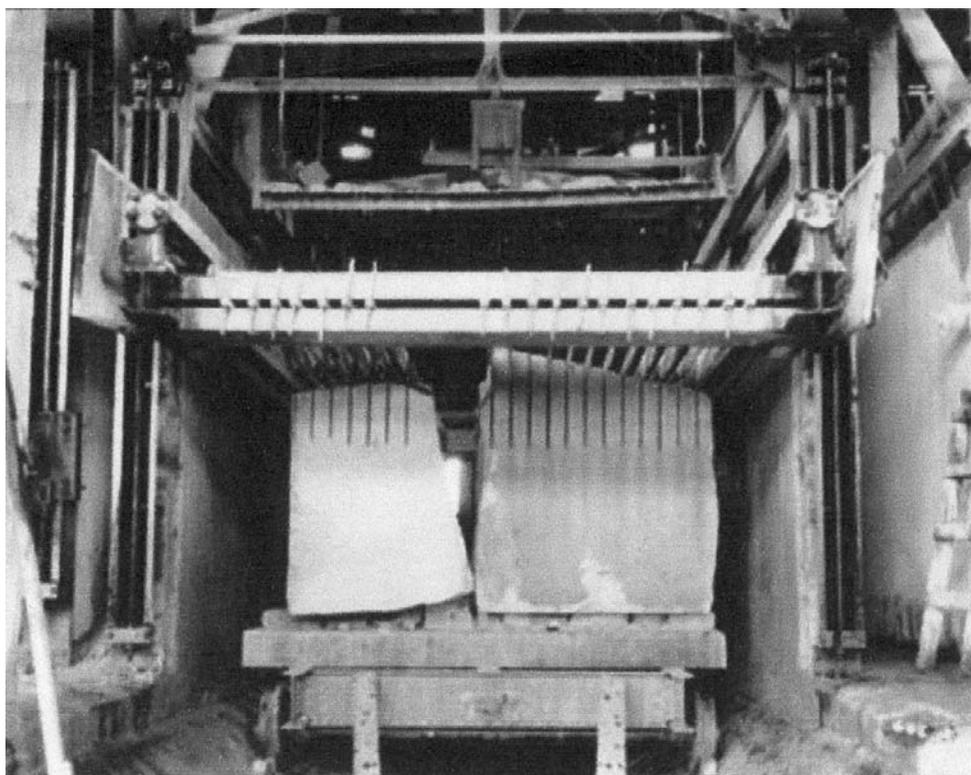
FIG08 : Representation of Plate Railway.



Even in the years preceding 'Industrial Revolution' the horse-drawn and/or gravity powered plate railway had become an important landscape feature. The simple arrangement of cast-iron rails laid on, and fixed to stone sleepers enabled heavy loads to be transported over ground which might otherwise become mired when wooden wheels formed deep ruts in waterlogged clay.

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FIG09 : Mechanized saw-frame c. 1920; Indiana, USA



No drawings survive to indicate the precise arrangement of Smith's saw-frame. As far as possible the mechanical frame would have replicated the motions of a single saw, held by two skilled sawyers. The difference was that multiple cuts could be made with a single 'stroke' of the frame whereas only one cut could be made by hand. Smith's frame seems to have been designed to hold nine 'gang-saws', each nine feet in length. His mill facility was probably on a smaller scale than this early 20th century example, therefore, but it is probable that his railway terminated directly underneath the frame, as in this picture.

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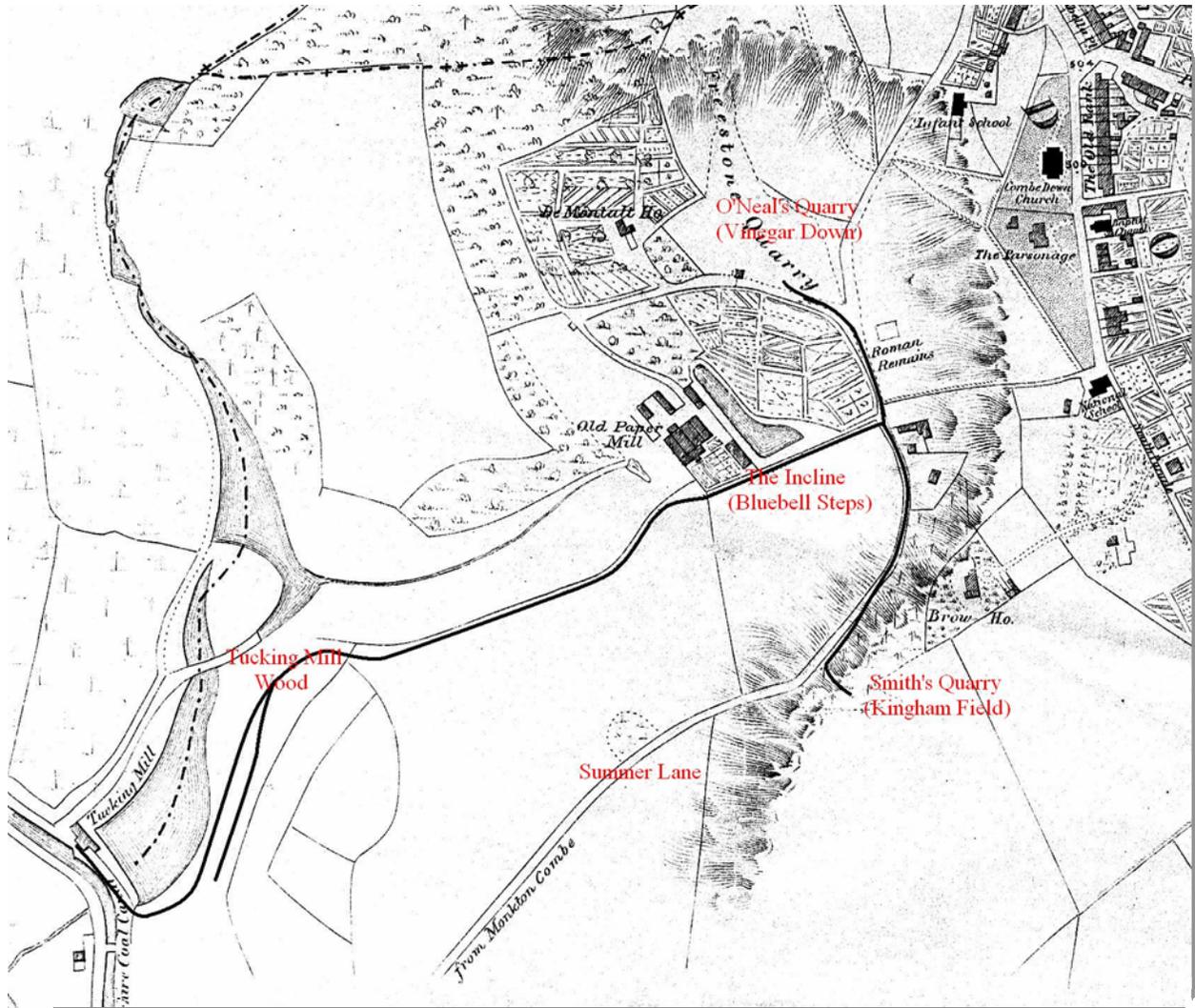
FIG10 : Midford Castle today



Charles Conolly acquired Midford Castle in 1808, some thirty years or so after it had been built by Henry Woolhouse Disney Roebuck. It is said that Roebuck chose the 'ace of clubs' design for the ground plan because this was the card that provided the win at gambling which enabled him to fund the property. The photograph is taken from the lane between Tucking Mill and Monkton Combe.

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FIG11 : The Line of Smith, O'Neal, and Conolly's joint railway



The line of the railway has been superimposed on Cotterell's map of Combe Down, published in 1852. Although the shape of some field boundaries are probably different to those familiar to Smith, this map does give a good impression of the lay of the land along and below the steep Greater Oolite escarpment where the quarries were located.

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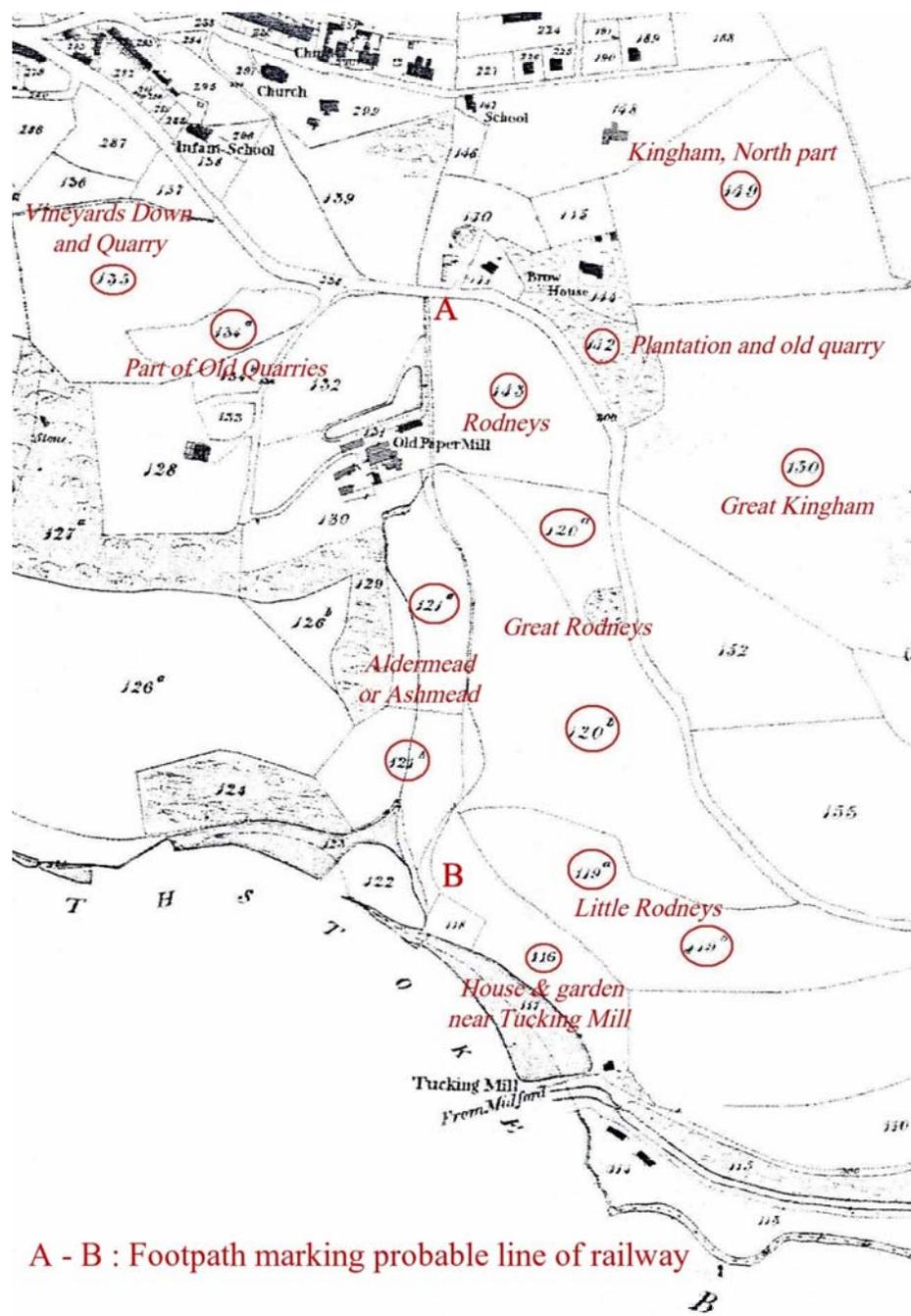
FIG12 : The footpath and old railway track today (I)



This place marks the transition from Conolly's section of railway to Smith's, where it left Rodney's field and entered Tucking Mill Wood. The large stones in the foreground appear to be original railway sleepers.

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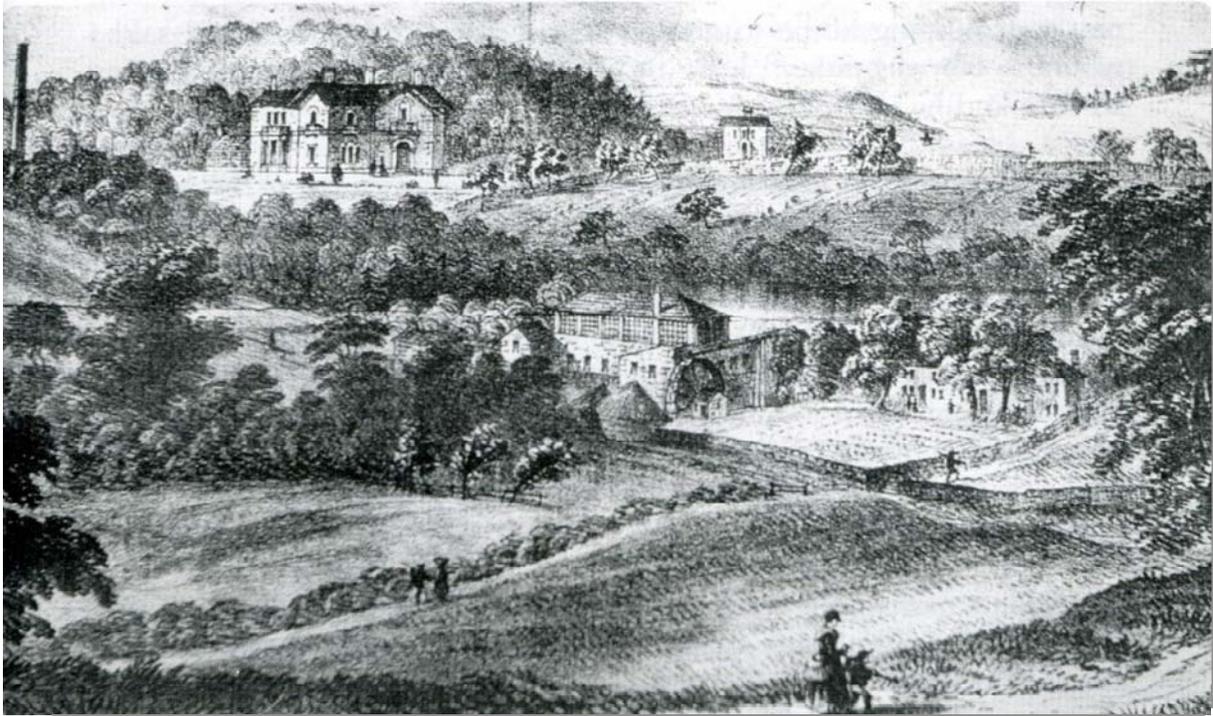
Figure 13 : Monkton Combe Tithe Map (Annotated), 1851.



Field or plot names are as recorded in the Schedule of Tithe Apportionments except, for example, 120^a and 120^b which are both described as 'Part of Great Rodneys'.

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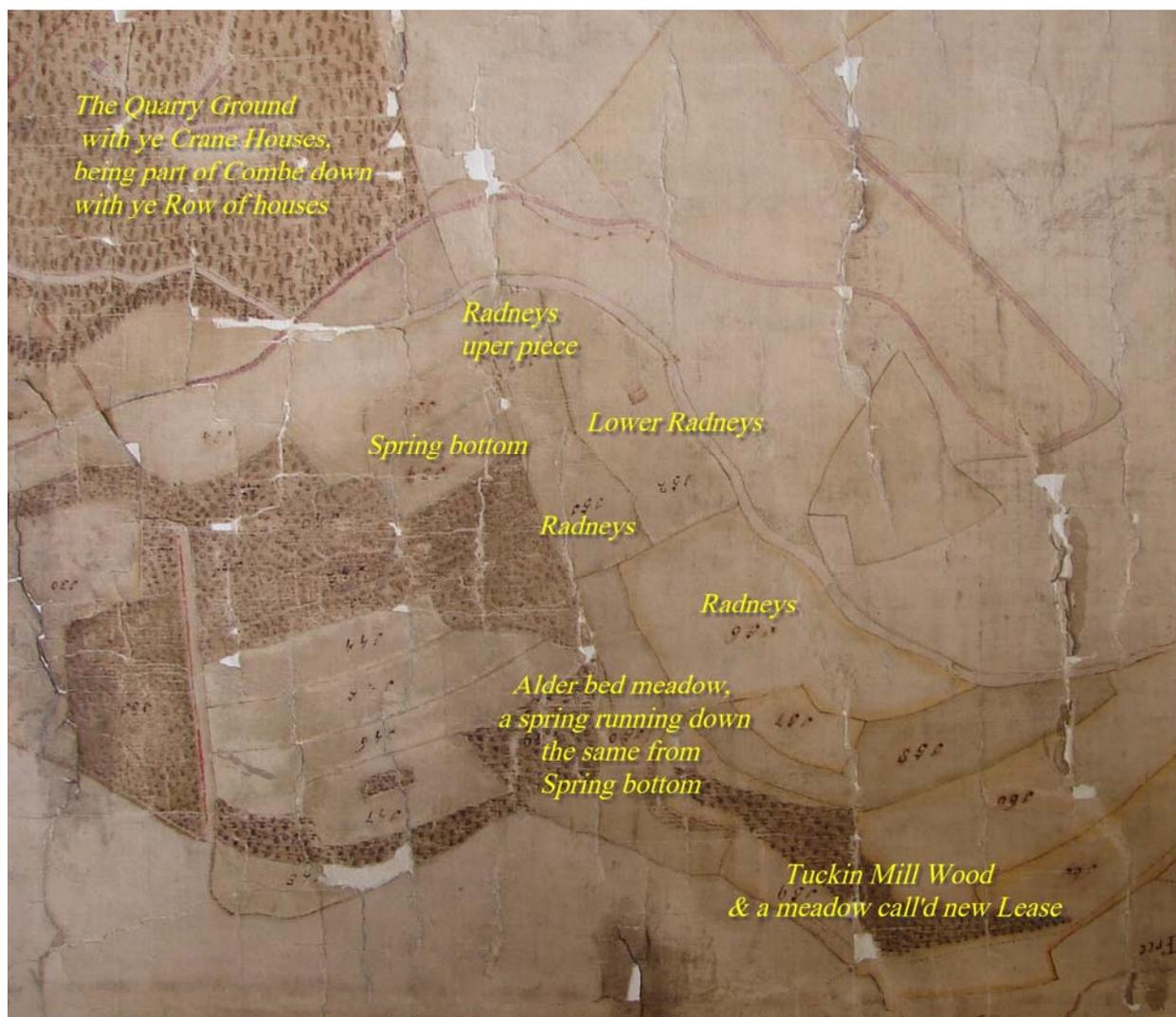
FIG14 : Mid 19th century lithograph of De Montalt Mill, showing the line of the railway



This drawing was made from Summer Lane (near foreground), a hundred metres or so south from Smith's quarry. The footpath in the middle-foreground, with three individuals walking along it, follows the line of the railway built by Smith, O'Neal, and Conolly. No such path is shown on maps drawn prior to construction of the railway. The 'inclined plane' ascended from the point an individual traveller is seen striding forth on this uphill section - away to the right where the path is partially obscured by the tree. Tucking Mill Wood was away to the left. Vinegar Down Quarry was tucked away in the woodland between and behind the two houses shown in the middle distance.

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FIG15 : Part of Ralph Allen's Estate Map



The full title of this map is “A Survey of the Manours of Hampton, Claverton’ with Widecombe Belonging to Ralph Allen Esq^r”. Originally surveyed by Thomas Thorpe in 1741, there is plenty of evidence to suggest that parts of the map were modified after Allen’s death in 1764. The original map is orientated so that south is at the top, hence, for the sake of consistency, it is shown here ‘upside-down’. Field names and descriptions are listed according to the tenants who leased them and the large field originally called ‘Radneys’ had been by this time sub-divided into Richd. Rickett’s Radneys (uper piece and Lower); Mr. Thos. Shute’s Radneys (plot 151); and Mr Bush’s Radneys (plot 156).

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FIG16 : The footpath and the old railway track today (II)



The top illustration replicates the view in the lithograph (Figure 14) of the footpath passing in front of De Montalt Mill [\[FIG14→\]](#). The lower illustration shows the view in a more southerly direction, looking towards the Midford Valley, where the footpath progresses towards Tucking Mill Wood. Midford Castle can be seen in the upper right-hand section of the photograph. The field in the centre foreground was formerly “Great Rodney’s”, and the wooded vale in the right-hand mid-foreground was the small stream course known as “Ashmead”.

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FIG17 : The footpath and old railway track today (III)



This long, straight section of footpath follows the line of the 'inclined plane' built by O'Neal as part of his section of the railway. The slope is too steep to allow transport of stone blocks by horse drawn carriage. Instead, carriages were lowered down the rail tracks by rope or chain from a drum and brake mechanism at the top of the slope. The force of gravity would haul up an empty carriage attached to the other end of the rope/chain. The steps at the top of the slope are known locally as Bluebell Steps.

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FIG18 : The footpath and the old railway track today (IV)



At the foot of the steep incline is a broad 'stone platform' where the gravity powered railway carriages were uncoupled from the rope or chain connection to the drum-brake at the top of the slope, just above Bluebell Steps. Here the carriage carrying a large block or blocks of stone was re-coupled to a horse-drawn rig to cross Conolly and Smith's sections on its way to Tucking Mill. In its place an empty carriage was linked to the rope/chain to be hauled back up to the quarries the next time a full load was ready to descend. Today, much of the platform is hidden under vegetation either side of the footpath.

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FIG19 : Plate Rail



This 1 yard length of plate rail was discovered by David Pollard near Wellow, and was almost certainly used for the construction of the Somersetshire Coal Canal. Each end of the rail has a notch for the nail which attaches adjoining rails to the stone sleeper, and is curved to allow the railway to follow gentle bends. Sharper bends would require shorter plates on the inside track of the curve - a problem faced by Smith on his sections of the railway. Despite the amount of wear suggested by the groove and hole, the weight of this plate (50 lbs, or 23kg) offers a good indication of the total yardage acquired by Smith and Conolly, which was purchased mostly second-hand from the Kennet and Avon Canal Company.

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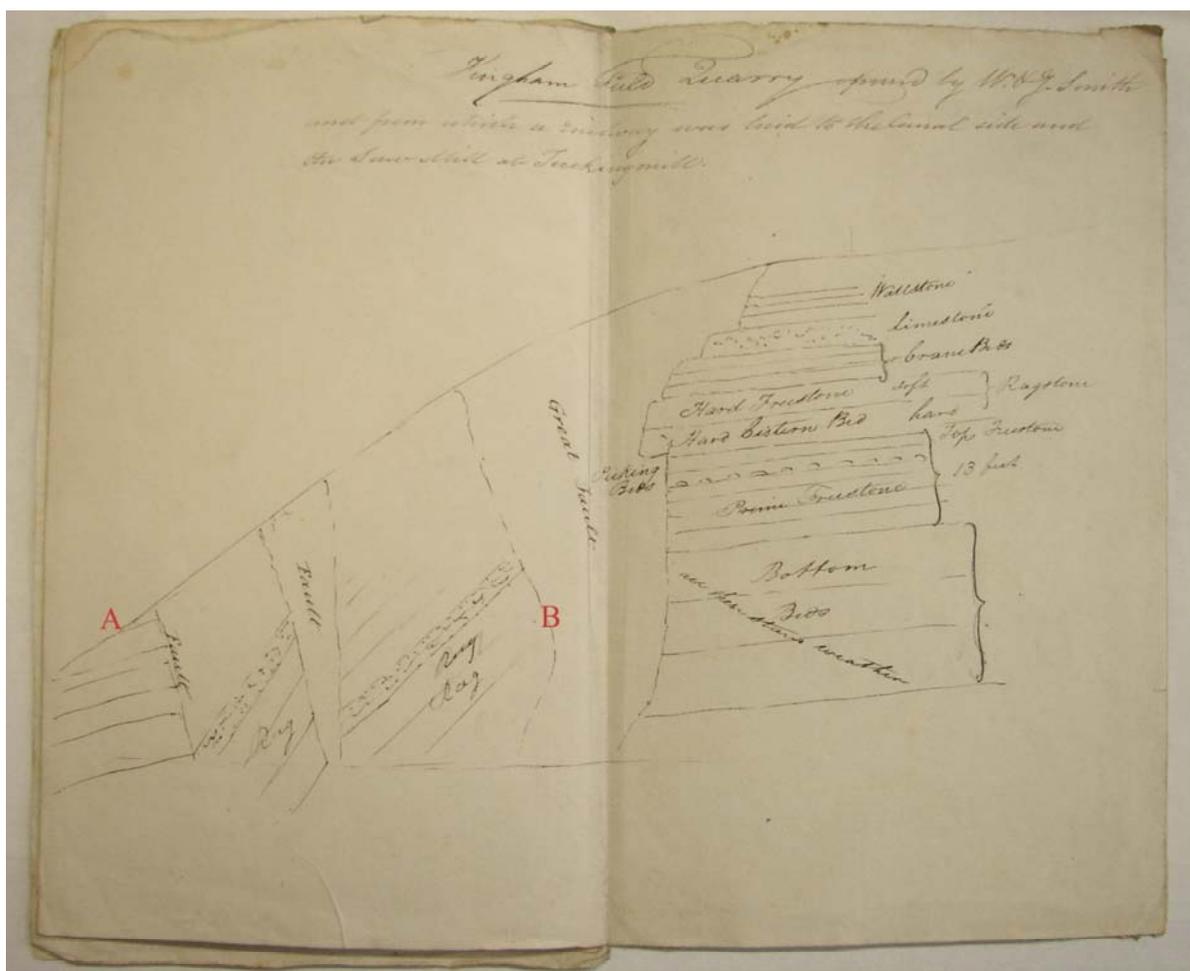
FIG20 : Kingham Field Quarry and the 'quarry arch'



The outcrop of Bath freestone that Smith intended to quarry lies on the far side of this low-lying, but steep ridge, about 40-50 metres away from this spot. Separating this ridge from the outcrop is the feature Smith described as the 'Great Fault'. It is actually a 'gull', formed when this ridge, which was the former edge of the outcrop, fell away, rotated and settled. Rather than attempt to quarry this poor quality, somewhat decayed stone, Smith's plan was to tunnel through the fallen block(s) to the intact freestone beds beyond. This was the only way he could access the good stone, and then transport it away, by railway, to his stone mill for sawing. It was not until November 1812, however, that Smith 'saw the quarry arch opened'.

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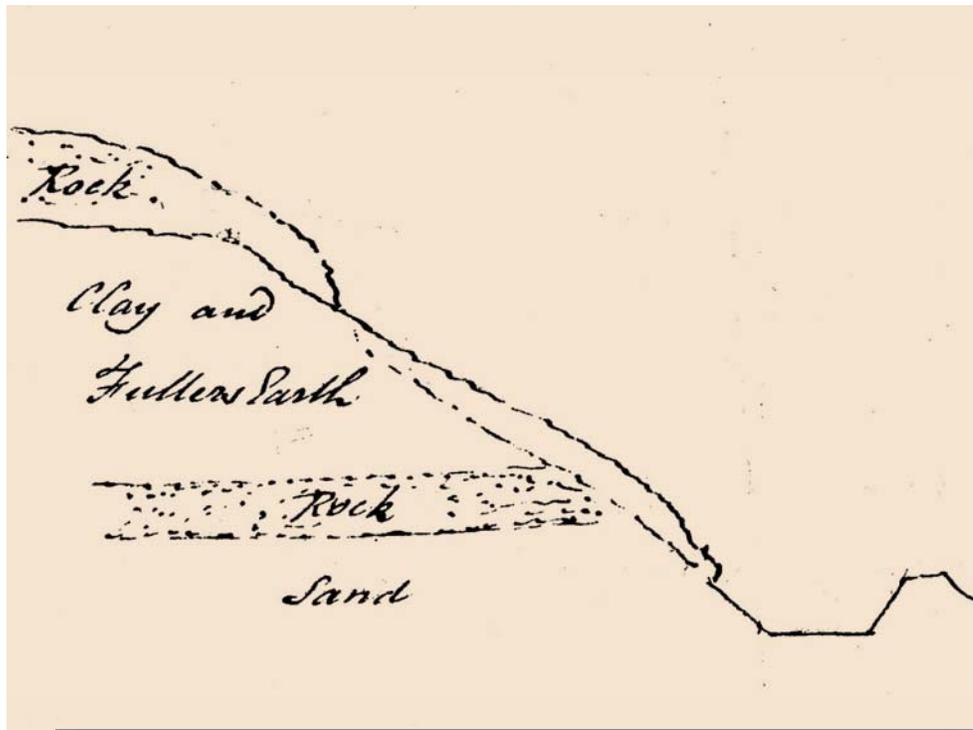
FIG21 : Smith's sketch of Kingham Field Quarry, 1812



Smith's intention was to quarry the 'Prime Freestone' and 'Bottom Beds' shown in the lower right-hand segment of this sketch, but in November, 1812, he realised that he would only get access to and egress from these beds if he removed, or cut a short tunnel through the fallen blocks on the left-hand (southern) side of the sketch. This was the only way he could transport the quarried stone via the railway to his mill. He opted to tunnel and on November 6th he "saw [the] quarry arch opened". His tunnel ran from, approximately, point A to point B. The depiction of flat and evenly bedded prime freestone suggests that he anticipated no more 'faulting', or 'gulling', as he followed and extracted the stone underground. This turned out to be an unfortunate error of judgement.

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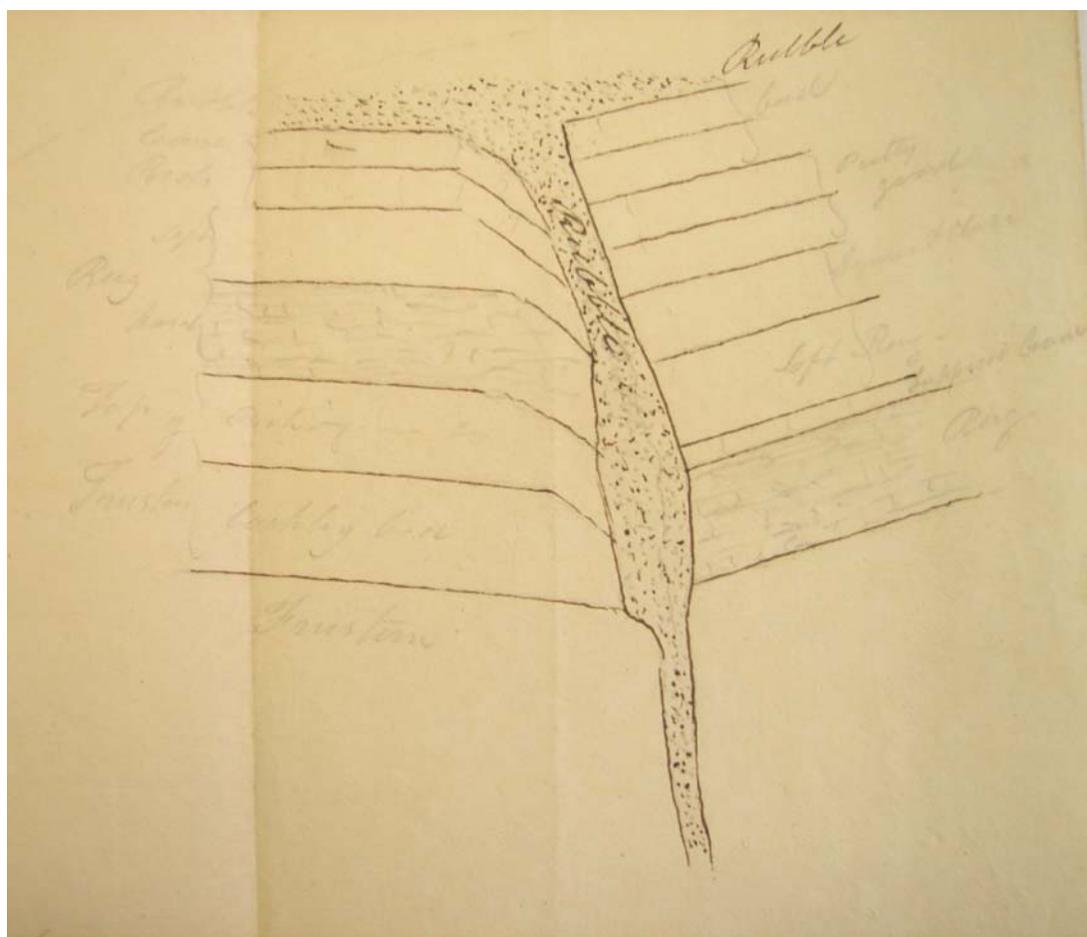
FIG22 : Smith's sketch of the escarpment below Midford Castle



This thumb-nail sketch by Smith is entitled: “Slips - Sliding of Earth into the Canal below Midford Castle, Jan^y 1800”. In essence, it shows the profile of land between Smith’s quarry at Kingham Field and Tucking Mill, following the line of the railway. Of, course, Smith had no idea of this significance at the time of drawing. Instead he portrays how the process of cambering and gulling at the top of the slope, at the edge of the escarpment, leads to the formation of a debris field and subsequent soil creep. This would have a long term detrimental impact on the structural integrity of the canal banks near Tucking Mill. Most importantly it demonstrates that he had a full and working knowledge of the actions associated with cambering at the Great Oolite outcrop (the upper layer of “Rock”), and that his later use of the terms “Fault”, or “Great Fault” does not imply tectonic action. (John Broome Collection).

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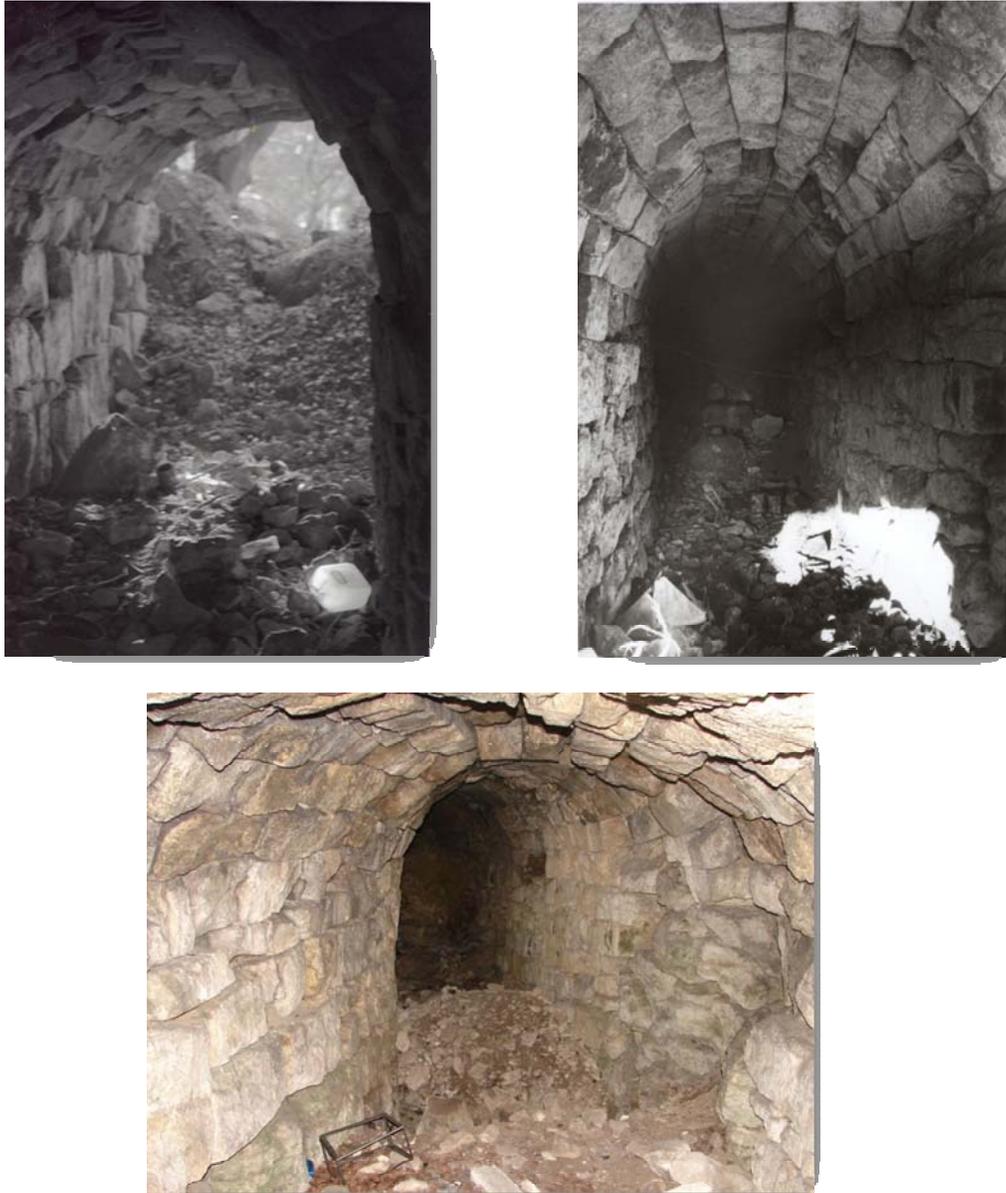
FIG23 : Smith's sketch of the "Great Fault in the Stone Quarry"



This sketch, oriented "In a North or NE direction" and dated January 4th, 1813, does not correspond readily to features, including the 'great fault', shown in his other sketch of Kingham Field Quarry. The faded pencil annotations suggest freestone formed the lower beds to the 'left' of the fault, and that beds to the 'right' were various grades of ragstone. The features are, once again, consistent with the process of cambering at the edge of the escarpment. The date of the sketch suggests the adit might just have been completed by now, and that Smith was deliberating the best direction to continue quarrying. Since Smith had driven his 'arch' in a northerly direction it seems he would have been persuaded by the nature of the rock before him to veer left. This would be consistent with David Pollard's findings at the site, when access was still possible.

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Figure 24 : Inside the quarry arch.



The 'arch' extends 30 - 40 metres, and is lined throughout with rough-cut blocks of stone. The tunnel entrance was sealed in recent years, but the two b/w photographs were taken before this time by David Pollard. They show that the tunnel was wide and tall enough to allow egress of a horse-drawn carriage. The lower photograph shows a 'gull', or 'fault' on the right hand side. The apparent instability of the rock, and the tilting strata, justified the need to stone-line the tunnel. The end of the tunnel, where it meets the 'Great Fault', is blocked by modern debris.

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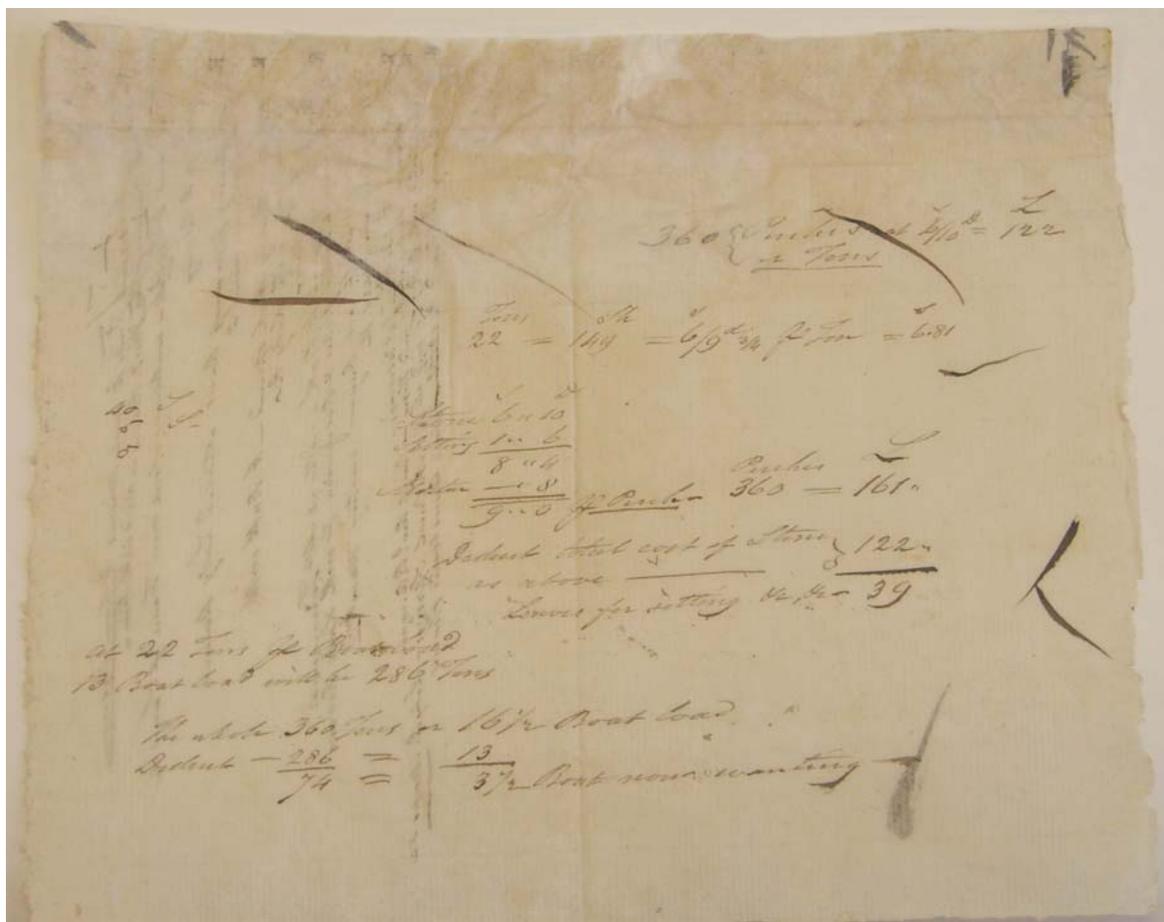
FIG25 : Smith's saw mill (Tucking Mill), photographed in the mid 1890s



Although this photograph was taken almost 80 years after Smith vacated the mill, he would certainly have recognised the basic structure. Of interest are the two stacks of stone 'plates' laid against the front wall. They appear to be just the type of product which would have been taken from his water-powered saw frame.

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FIG26: Smith's calculation on the cost of 'manufacturing' sawn stone



This jotting was made on the end-page of Smith's November, 1812 diary. The impression made by ink on the previous page shows through on the left-hand side. He also appears to have used the page to test his quill pen point, perhaps at the time he drew up his December diary. His calculation suggests that for every 360 tons of stone quarried, 286 tons of sawn plates could be manufactured, requiring shipment in 13 boat loads.

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FIG27 : The Somersetshire Coal Canal at Dundas Aqueduct.



The Somersetshire Coal Canal meets the Kennet and Avon Canal at this point, at Dundas Aqueduct - about 3 km from Smith's wharf at Tucking Mill. The narrowness of this channel gives a good indication of the dimensions of the boats that carried Smith's stone plates.

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FIG28 : Inside William Smith's Kingham Field Quarry



These photographs, taken by David Pollard in the 1980s, are the only ones to show conditions within the quarry after excavation on the other side of the Great Fault had begun. They demonstrate how he continued to encounter a series of 'faults', caused by cambering, making extraction of freestone extremely difficult as the mine progressed.

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The extensive collection of Smith's original papers, including his diary, is held at the Arkell Library in the Oxford University Museum. The papers are sorted into boxes, labelled, for example, 'Diary', 'Biographical Verse', and so on.

The 'Broome Collection' is part of the Southstoke Local History Archive held at Bath Record Office.