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MEMORANDA CONCERNING THE BROADMEADOW AND WHEELS RAKE MINES, ALPORT

contributed by Michael Brooke-Taylor

The following is a verbatim copy of part of an anonymous notebook dated 1836 concerning the installation of a water-pressure engine in the Broadmeadow shaft of Blythe Mines (SK 227642) and a waterwheel in the Wheels Rake shaft nearby (SK 229648). Although there is no author's name he refers to "my cousin Frank B ..." and so it is fairly certain that it was written by James Barker, one of the family of mine owners, smelters and merchants whose history has been described in an article by Lynn Willies in the Derbyshire Archaeological Journal, Vol. 93. 1976 (for 1973). The notes provide a valuable contemporary insight into how the mine owners viewed such installations. It should be noted that the engine herein described as being placed in Broadmeadow shaft was a replacement of the engine which in turn replaced that which was transferred to Wills Founder mine and which is now in the Mining Museum at Matlock.

After a brief introduction in the value of recording all one's observations at the time for posterity, as nobody can foresee what will be important, the notebook continues :

These memoranda commence January 13th 1836 on which day the base of the new engine for the Blithe was placed on its foundation, at the Broadmeadow Shaft. The engine is now in progress of completion by Mr. Fairbairn of Manchester - and the remainder of its parts are expected to be delivered at the mine, entirely, in a month: the principal parts being already received. It was promised to be delivered to us in June last - but from various causes of delay, about 7 months longer have been occupied in its construction than we expected from Mr. Fairbairn's promise. It was as well for us, that it did not arrive sooner for the excavation necessary for the engine to be placed in, was only completed on 12th inst. This delay appears to have been caused by our not having an agreement binding Mr. Fairbairn to a specific time for delivery of the engine - in the first instance - and the delay on our own part in making the excavation arose from imperfect measurement, and an inaccurate idea of the space required for the working of the engine - chiefly owing to our not having had proper plans at an earlier period. In any future work there should be a specific agreement for the delivery of the engine, & plans of all parts should be prepared immediately & the work set out accordingly.

A few days previous to this, a second lift of pumps, reaching to the top of the second Toadstone at the Wheels Rake, or rather about 2 fathoms into it, were let down and attached to the wheel. Great difficulty has been experienced in making these pumps work efficiently; owing to their having been let down too low into the shaft, the bottom of which is filled to the depth of 3 or 4 feet with the decomposed Toadstone, which is almost as bad as clay, for choking up the snore-holes of the wind-bore.

We had had nothing but a series of disappointments & mortifications at the Wheels Rake, ever since it's commencement in 1825. These have chiefly arisen from want of boldly commencing the sinking through the Toadstones at once by a powerful wheel, which might have raised the water to the surface, instead of delivering it into a level brought through Priesthill for that purpose. This will be a lesson to me not to engage in any concern of this kind unless the parties with whom I am joined are determined to enter with spirit into their operations, and to conduct their works in the best & most efficient manner, without regard to the cost, in the first instance. A man should begin mining, as though he were <u>certain</u> of ultimate success, until he has received such proof to the contrary, as to induce him to abandon his enterprize - or "adventure" as the Cornish miners term it.

This is a wet day, & as I have a cold, and have been engaged in the house, I have not been to the mines to enquire how they are getting on.

Monday Jany 18. Went to Wheels Rake, where I found Mr. Melland, who said he expected to roll the water in a few hours to the bottom of the lodge. Tuesday Jany 19. Went to Wheels Rake, where I found the water had been rolled to the bottom of the lodge, which is sunk about 2 fathoms in the 2nd Toadstone. When the lodge was sunk, the water was lifted by a small wheel borrowed from Mr. Alsop, but as we had great difficulty in keeping down the water, we were forced to erect our new Wheel, which is 18 feet diam^{r}. and 14 feet broad. We started this Wheel in Nov^{r}. last and worked the pumps which the former wheel had wrought & which were only 6 inches diam. We pumped with these 25 strokes were minute of 5ft stroke, and the water fell rapidly in the lodge - but having occasion to change one of the buckets during this operation, the water rose rapidly in the lodge, and a large quantity of air bubbles came up to the surface of the water. We concluded therefore that the Toadstone had yielded to the pressure of the water & burst somewhere - allowing a (?) free passage for it. On endeavouring to roll the water we found the spring was permanently increased, and it was readily accounted for by our discovering that the water in Mr. Winchester's level, at the forefield of Wheels Rake in Haddon fields, across the Polack Sough (or Ladies Vein) was entirely gone.

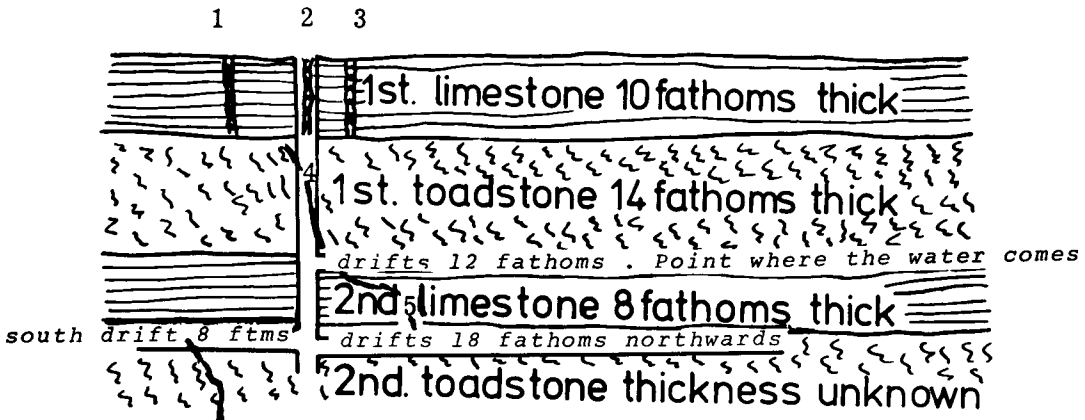
We therefore inferred that the first cross vein, being a fault, had so broken the strata, as to allow a free passage for the water through the Toadstone, under which, and along the Wheel Rake vein for the distance of 900 yards, it came to our lodge.

We therefore decided on ordering 9 in. pumps, in place of the 6 in. lift, which we determined to draw out as soon as we could. But owing to their being fast in the lodge, by chains and stays, we could not accomplish this, till the water was got sufficiently low, to enable us to set them at liberty. This, with much difficulty was accomplished; and succeeded at length in drawing out the whole pile, and at length we got out new ones to work. After many hindrances as before noticed, we at length rolled our water about midnight on Monday the 18th, and found that the new spring of water came on the sole of a gate, driven on the south side of our lodge, about 4 fathoms from the lodge. The gate was driven on the surface of the Toadstone, taking the limestone as our roof. It was driven in search of a vein or veins which were supposed to lie on that side of our shaft, from the circumstance of a large quantity of iron pyrites being observed in the top of the soft Toadstone (or Toadstone clay) immediately under the limestone. This iron pyrites was found in crystallised particles varying in size from a pea to a walnut; and being a metallic substance such as is found in veins, and not known to exist as a constituent part of the Toadstone, I have been led to infer that the substance has been deposited subsequent to the formation of the Toadstone, and in fact, that it is caused by a vein lying flat between the upper surface of the 2nd Toadstone, and the bottom of the 2nd limestone. The same appearance was observable across the entire portion of our lodge immediately under the 2nd limestone and in driving forward a gate on the north side of the lodge, we observed the under surface of that limestone lying upon the soft Toadstone, to be thickly <u>plated</u> with compact pyrites, in addition to the loose particles before described, lying in the soft Toadstone. The soft portion of the Toadstone was filled to the depth of from 1 to 2 feet with this substance, but in the deeper part of the Toadstone which becomes harder the pyrites was not observable.

In driving both these gates, there was very little water, and indeed there did not appear to be room for any to come, except a slight oozing which appeared in each of the gates, as the driving proceeded. This now evident, however that the heavy pressure of water (about 34 fathoms in height) has forced a passage through the 2nd Toadstone, as the new spring (which affords more water than all the others) boils up in the sole of our South drift, about 4 fathoms from the lodge. The drift is carried forward about 4 fathoms farther, but no water comes at that part. I consider that the vein lies flat on our drift, and that if this be continued, we shall find a vein putting up into the 2nd limestone, which forms the roof of our drift.

The remainder of our water comes as it did before we tapped the new spring - viz. a small quantity at the points where our North drift has crossed two veins which are poor and barren - but the principal part still

comes at a thin parting in the limestone in an upper drift 8 fathoms higher than the north drift, and carried in the same direction with the intention of cross-cutting the principal vein, which, I apprehend, runs still further North than our deep drift, which has been carried about 18 fathoms from our shaft. Should this prove to be the case, we have, I think, moved a manifest communication between all these veins (the Wheels Rake vein, & probably the Amos-Cross, which is a parallell (sic) vein, being divided into several joints) for the space of about 30 fathoms. This communication appears to take place in the soft part of the 2nd Toadstone, immediately under the 2nd limestone, where, I imagine, the whole of the veins lie flat, before they jut (?) up into the limestone above. Should this prove to be the case, the circumstance is strongly indicative of an expansive force acting from below, and finding a free passage on the soft surface of the Toadstone, which has enabled it to break the limestone above at different points most favourable to fracture: these various fractures forming the several joints belonging to the Wheels Rake vein, and probably the Amos Cross. The little section underneath may give some idea of my own view of the circumstances in which we are now placed.



supposed vein where the water springs into the gate at the sole, this being the new spring.

1. *Amos Cross Vein*
2. *Wheels Rake vein shaft*
3. *A joint of the Wheels Rake Vein*
4. *A vein met with in the shaft which passes through the toadstone and the limestone below*
5. *A vein running through the 2nd limestone which had carried a little ore.*

(Redrawn from indistinct original)

From these facts I infer that we shall have a much larger quantity of water than we have yet seen, or than we have hitherto calculated. I apprehend when we carry forward our drifts Northward and Southward, we shall find the principal veins putting (?) up into the 2nd limestone, which in all probability will bring an accession of water, especially from the North side, as the principal quantity of water (till the last spring broke up through the 2nd Toadstone) has always come from that side - and the spring is not altered in the upper drift, but still comes there as before, in either (?) parting in the stone.

This spring originally came at the Vein No. 4, which we found in sinking our shaft through the Toadstone. But as we drove our upper drift at the top of the limestone Northwardly, the water gradually came at the parting in the stone, before described, and ultimately left the veins we had crossed, nearly dry. From this, I infer that there is a more open fissure in a Northwardly direction, which has a communication with the parting in the stone which brings the water - and, as this water sometimes came with great violence (after a blast for instance)

it seems as if there was great pressure exercised upon it, to force the water through a space so small as the aperture caused by the parting in the stone, which is not thicker than a straw.

Before sinking our lodge any deeper, I should like to carry forward our 2 bottom drifts, to see if we cannot discover the veins which I expect lie to the North & South of our present workings. I am also very desirous of ascertaining where the source of the water is which comes Northwardly, and in so doing, to prove the quantity of water we shall have before we go any deeper, and whether we have any good vein in the 2nd limestone.

From the circumstances of the new spring having burst its way up through the 2nd Toadstone, I imagine it will prove to be a thin bed, as we had but little water in sinking through the upper part of the 1st Toadstone.

I also think the veins which we have crossed in our North drifts have not put down into the 2nd Toadstone, as there have been no traces of them seen, though the Toadstone near them was more compact than where the water comes up in the South drift, owing to our North drift being taken about a fathom deeper than the South one.

The appearance of Iron Pyrites also in the soft Toadstone & adhering closely to the bottom of the limestone, still continues Northwardly; which makes me think that those veins which we have crossed, break up through the 2nd Toadstone, farther North than we have yet seen.

The circumstances being quite new in this neighbourhood, where the Toadstone has not yet been seen through previously, we can only reason upon such facts as present themselves to our notice.

I am anxious to see how far my own inferences accord with the truth, as I differ in opinion from our agent Mr. Melland, and from all our miners, except John Twyford.

A careful observation of these facts however, and sound deductions drawn from them, are the very essence of good mining - without which all our efforts are crude and uncertain, and will, except by some lucky chance, generally end in failures.

Tuesday Jan^{y} 19

Went down the Broad Meadow shaft to the place where the new engine for the Blithe is to be fixed. My cousin Frank B. went with me, and we remained some hours to see the bed plate laid level in its place. This was accomplished while we were down, and a very good job it seems. Rich^{d} Page, our engineer, made use of <u>water</u> to level our floor & then applied the same means to the base plate of the engine, to fit it to the floor, as the under surface of the casting was not quite true.

The water level appears to be the most effectual & simple mode of obtaining perfect truth in work of this kind. The base for the engine, although upwards of 4 Tons weight, & being about 14 feet long and upwards of 6 feet wide, is now laid with such perfect accuracy, that there is scarcely a hairs breadth difference in the level of the 2 ends, or of the sides. It is however a very tedious piece of work, and it is a question with me, whether it might not be advisable to have the under surface of the base plate <u>planed</u> to perfect truth, and the floor upon which it lies, levelling with water, and then polished with long rubbing stones; so that as soon as a base for an engine arrives, it may be placed immediately on its bed & bolted down. No time would then be lost in the erection, and the perfect fitting of the parts would be extremely favorable to the good working of the engine. I have suggested this to Mr. Smith of Manchester (Mr. Fairbairn's eng^{r}).

For my own part, where perfect truth can be obtained at a moderate cost, I am fully convinced it should be obtained in all engineering work, and I think the day is not distant, when this will be the case.

Jan^{y} 25. Wm. Billinge, one of the miners employed in erecting the Blithe engine, fell from a scaffold in the engine house, and was much hurt.

Jan^{y} 26 & 27. Went down the Wheels Rake and carefully examined the whole of the present workings. I find that the new spring of water in the South level, does not appear to come from beneath the 2nd Toadstone, but breaks out on the sole of the drift, at a kind of parting in the Toadstone, which is the only part of it sufficiently open to admit of water finding its way in any quantity. There is also a slight oozing of water in the soft Toadstone

about the forefield of the drift, which shows that there is a pressure of water in that direction. I am of the opinion, that this strong spring does not come from underneath the 2nd Toadstone, but that it proceeds from a vein Southward of the forefield of our present drift, and that there is a communication with this vein from our drift by the horizontal parting in the Toadstone which brings the water. We cannot at present continue the driving of this gate, as the material would have to be drawn by hand, until the apparatus for drawing by the water-wheel can be got to work. This cannot be accomplished till our shaft is widened for the depth of 8 or 10 fathoms where the form of the shaft is different from what it is upwards. This shaft was sunk without a plan being previously made, and it has since had to be adapted to the site of the new water wheel; which has been attended with great inconvenience, expense, & loss of time.

The shaft is also too small, being only 10 feet dia^{m} by 6 feet, which does not allow sufficient room for any one of the purposes to which the shaft is applied. My wish was to have had the shaft 12 feet by 8 - but in this I was overruled by Mr. Melland and Rich^{d} Page, who set it out, in its present size. They have both discovered their error, now that it is too late to repair it. On examining the south drift, I found a very striking proof of the theory of the volcanic origin of the Toadstone, in the extremely confused & irregular form of its upper surface which presents the greatest inequality - the interstices being filled with limestone. It is quite obvious from an inspection of this surface, that the form could not have been derived from deposition or injection of the stratum of Toadstone; but that the limestone lying upon it, must have been deposited upon a very broken & uneven surface. The Toadstone is the worst substance which I have yet seen in our rocks to bear exposure to the action of water even in a stagnant state. The 2 drifts which we have carried in it, were found to be <u>run in</u> as soon as the water was drained from them. And where the sides had been supported with wood, this was broken by the lateral pressure, although the roof of the gates was perfectly sound & firm, being of limestone. There appears to be no other way of supporting the sides & bottom of these drifts, but by turning an inverted arch of stone - the key-stone of the arch being at the sole of the gate. I propose making these drifts 5 feet wide & 6 feet high (inside measure) besides a space in the bottom to lay iron pipes, or to form a flue for ventilating the mine. Rich. Page proposes a <u>flue</u> of stone or brick work made air tight, which would certainly be cheaper than iron pipes, if it could be made to answer the purpose as well. I propose these drifts being made large enough to admit a small locomotive steam engine, for drawing the materials of the mine to the shaft foot as I fancy this is the way in which ultimately our mines will be worked. The economy of human labour is the great object - and I imagine that a locomotive engine would be a less nuisance than employing horses underground. It would also be much cleaner, and less injurious to the sole of the level.

Feb^{y} 2 1836.

The large beam for the Blithe engine arrived. It required 18 horses to draw it up the hill at Priesthill. We got it unloaded without any accident. I find there is not sufficient room excavated for the balance tub to move in - so that it must be done immed^{y} & will cause a hindrance of some days. All these delays and hindrances might have been avoided, had we been furnished with drawings of the several parts of the engine and the space required for them to work in.

The fault is chiefly with R. Page, who set out the miners work without sufficient data to enable him to complete it.

16th Feb^{y}

The interval from the last date was employed in letting down & fixing the vibrating pillar, and in paring the shaft, after sufficient space had been blasted for the balance tub, and room had been cut in the roof for the wooden bearers. On going to Alport this day, I found that the beam could not be lowered for want of the central rod which rests on the vibrating pillar - and as the men were all at a stand for want of it, I went to Manchester in the evening, and returned the next day bringing the rod with me by coach.

Friday the 19th.
The beam was let down safely this morning, & without any difficulty or accident.

Saturday the 20th.
The nozzles of the old engine were drawn up the shaft, & the beam fixed on wooden bearers, to lie there till the balance tub arrives from Manchester.

Monday the 22nd Feb^{y}.
Mr. Fairbairn's man who is to assist in putting the engine together arrived. The cylinder was let into the shaft, and stuck fast in the walled part, which had not been pared off sufficiently to admit its free passage.

Monday 28 March.
The time passed from the preceding date, has been occupied in letting down & fixing the various parts of the engine which is now almost completed. The remainder of the work being the attachment of the balance tub to the beam - fixing the upright pillars of the base plate - putting in the column pipes and the air vessel - with the throttle valves, rods, and small branch pipes for the little cylinder. I hope to get the engine to work before May day. We have been fortunate in having no accident.
At the Wheels Rake we have been engaged in completing the shaft, and connecting the new apparatus for drawing, to the water wheels. This has been at work about a week, and answers very well - but at the present speed of the water wheel, the drawing chain travels too slowly. This is the first apparatus of the kind which has been erected at the mines in this neighbourhood and will prove a great saving in the expense of drawing. The men are now got to work in the South drift which I have not been able to examine on account of an accident to my arm.

Nov^{r} 22.
This accident proved a longer hindrance than I expected, & I broke into the course of examination and recording which I had commenced. I was unable to climb into the works for several weeks, and early in May I was obliged to go to London - my agency there expired at Mids^{r} -, and will now be conducted solely by T. Dunnage - so that I shall be more at liberty to attend to mining and smelting. After my return from London at the end of May, our slack (?) season commenced, and in the month of August, I made an excursion to see the Cornish mines, upon which I drew up a report for the benefit of our proprietor.
These circumstances proved a great interruption to my observation of the various events which occurred at the mines, and they have consequently not been recorded.
In putting together the Blithe engine so many unforeseen circumstances arose to hinder us in our operations, and so many parts of the engine had to be fitted together at Alport having never been put together at Manch^{r} that instead of May day, the 1st of Sept^{r} was about the day on which the engine was fairly started. The old engine had been started and rolled the water there on Mids^{r} day, after going about 3 days at 3 ¼ strokes per minute. This circumstance surprised us greatly, as we had last year attempted to work the engine, and could scarcely lower the water in the lodge a fathom. We were led to account for this great difference, by supposing that the engine had for some time not been lifting its proper quantity of water - in consequence of the bad state of the buckets, which were much corroded where the valves sit down the hardest. Previous to starting the engine this year, the valves were repaired by running some lead into them, and to this temporary repair we attributed the rolling of the water in so short a time. The old engine continued to work without interruption till the Blithe engine was started - at which time we began to fall very short of water in the Bradford. On the Blithe engine being set to work the speed of the old engine slowend (sic) to about 2¾ strokes per minute, while the Blithe engine rolled its water at about 3 strokes per minute, and after working some time, gradually fell off to about 1½ strokes per minute - at which speed the water was kept on the roll. On starting the engine, everything was very tight about it (especially the leather of the valves, it was found

necessary to keep a man to watch it day & night for about 10 days - by which time it was so much improved in its working, as only to require occasional examination & greasing. It was started without the air pump, and, as the air vessel was not tight, the column of water was cut off without any releif from the elasticity of compressed air. But such was the great size of the falling pipes, and so easy was the mode of cutting of the water from entering the cylinder, by the improved valve, that no shock was perceptible, even when the engine went at a fast speed. The men said they worked the engine so much as 9 or 10 strokes per minute; but as they had no watch with them, we considered they were mistaken.

On one or two occasions however, when the engine had been standing, and the water had risen to its usual height in the lodge, it was entirely rolled in 2 or 3 hours after the engine was started. This is a source of very great satisfaction to us, and particularly to myself, as I had been engaged for several years in endeavouring to plan an engine upon an improved construction from that of our old one, which is a very imperfect machine, though a very good piece of machinery for the time (30 years ago) when it was erected. The Blithe engine was constructed, partly on a plan adopted by Mr. Stephenson of Newcastle, which we saw in operation at a colliery of Ld. Carlisle's near Brampton in Cumberland. The valves of this engine were however bad in principle, and we adopted a valve suggested by Mr. Smith of Manch[r] which seems to answer extremely well. The apparatus for striking the valves was planned by Richard Page and is very ingenious and compact. The air pump and air vessel were suggested by myself, as also the size of the falling pipes, and the apertures to admit the water to the engine. These latter were however made rather smaller than I had intended. My object being to prevent any loss of power in having to force the water through narrow apertures to the cylinder, and also as much as possible, to prevent any shock when the water is cut off by the valve - by allowing a large diameter to the falling pipes, so that the water would descend slowly in them.

The Falling pipes are 20 inches diam[r]. R. Page wanted to have them only 15 inches but I was confirmed in my own opinion of the advantage of having them larger by Professor Airey, whom I consulted on the subject.

The very smooth working of the engine and the freedom from any shock, is mainly attributable to the large size which has been given to the pipes and the valves; and when the air vessel is in action, I think it will be difficult to assign a limit to the speed at which the engine may be worked.

It is a great source of releif to my mind to find this engine answering so well after the time which has been lost since the erection of the former engine at the Blithe which commenced in 1820, and which failed in its object about 1827, when my further attempt at working it was abandoned. Several years were lost after that period in considering what kind of engine should be substituted for the former one. Mr. Dakeyne of Toadhole [Two Dales] having taken out a patent for a new hydraulic engine, which was considered likely to be more simple and efficient than anything of the kind hitherto used. Mr. D. was however so long in getting his engine into anything like effectual working, that we were forced to abandon the idea of adopting it, and were compelled seriously to consider what kind of engine we should adopt as the best for our purpose. In this emergency I made inquiry of all persons whom I saw in London or elsewhere, respecting hydraulic engines but could not hear of anything at all likely to suit us in this country - and the plans of any German engines appeared so complicated and expensive that we did not venture to adopt them. At length Mr. George Burnett junr., whom I saw in London, mentioned an engine which Stephenson was constructing for Lord Carlisle, and I decided on taking a journey to Newcastle and to the mines and collieries in the North of England, when I was led to expect we should derive much valuable information respecting the working on mines and the dressing of ores. In this journey I was accompanied by Mr. Melland, Wm. Wyatt and Mr. Robert Howe Ashton of Castleton.

We saw the drawings of an engine erected by Messrs Stephenson for Lord Carlisle near Brampton at Midgeholme (?) Colliery - and afterwards went to see the engine, which had not been long at work. We sent for

Richard Page to meet us at the colliery as on inspecting the engine we agreed to adopt the principle, making such alterations as we thought necessary.

We agreed to order the engine from Messrs. Stephenson - but they were so full of orders that the time which they required for executing the work seemed so long, that we engaged with Mr. Fairbairn of Manchester, who promised to construct it in less than 6 months - but did not let us have any of the principal parts in so little as a year.

Michael Brooke-Taylor
"Thorncliffe"
Parsonage Croft
Bakewell DE4 1DF