Mine Drainage

General (Mining Remains in South West Shropshire”, T Davies et al, SCMC Account No.18)

The removal of unwanted water from deep underground workings has always been a problem and it represents one of the biggest expenses of a mine. The earliest method was to drive a long adit from the bottom of a valley to intersect the mine workings, thus allowing water to flow freely out. To be worthwhile, the adit had to intersect the mine at a reasonable depth and, in many cases, this would have meant driving it for a great distance. The costs associated with this meant that this method was not often used. It is likely that shallow Roman workings used drainage adits and, since Roman Gravels is situated on a hillside, early drainage here was almost certainly by this method. In more recent times, the upper workings of such mines as Rorrington and Snailbeach were unwatered by long drainage adits. Some drainage adits were driven to drain more than one mine and these were costly ventures.

Where adits could not drain the mines to a sufficient depth, one answer was to draw water out of the shaft in kibbles, using hand windlasses or horse gins. Some mines used waterwheels to operate pumps and these were used extensively at Roman Gravels Mine. The major problem with waterwheels was that the water supply tended to dry up in summer and freeze in winter, thus causing the lower workings to flood. Previous to 1858, a waterwheel was used at the entrance to the Snailbeach drainage adit to drain the workings at the mine. The motion was converted into a horizontal direction by using rocker beams, with flat rods running all the way up the level to the main shaft. Here, a further rocker beam converted the motion to a vertical direction and this operated pumps which raised water to the drainage level.

Since the above methods could not cope with draining the deeper mines, these were in financial trouble towards the end of the 18th century as all the shallow ore deposits became exhausted. Luckily for them, it was at this time that the Boulton & Watt steam engine became available, offering a practical and economic method of tackling large volumes of water.

The first steam engine had been invented in 1698 by Thomas Savery but it had many disadvantages and was not practical for mine drainage. In 1712, however, Thomas Newcomen introduced the forerunner of the Cornish pumping engine. In his engine, steam was introduced into a vertical cylinder fitted with a moving piston. On spraying water into the cylinder, the steam condensed and atmospheric pressure forced the piston down the cylinder. This piston was connected to the end of a beam which was pivoted on the wall of the engine house, with the other end projecting over the shaft. As the piston was pushed down the cylinder, it pulled down the "indoor" end of the beam and thus raised the "outdoor" end. Attached to the latter was a series of connected pump rods.
which were in turn connected to pumps at the shaft bottom. As the piston came to the end of its stroke, the weight of the pump rods in the shaft pulled the outdoor end of the beam back down and thus raised the piston back to the top of the cylinder. The pumps were of the plunger type and the massive rods were often 2ft square in section, tapering with depth. After the engine had lifted the rods, they fell back under their own weight and forced water up the pump barrels to surface. This engine, although inefficient and only able to pump through limited vertical distances, was used all over the country in the 18th century. Newcomen engines were probably available in South Shropshire as there is mention of a 'fire engine' near Pontesbury about 1775. This was unlikely to have been a Boulton & Watt engine as the firm had only commenced building engines in that year.

After 1775, the mine adventurers of the district began using the Boulton & Watt engine for pumping. In the period 1775-1800, 9 engines were used in the district, after which the firm's patent expired and engines from other firms became available. The partnership was based at the Soho Works in Birmingham, Watt being the inventive member whilst Boulton handled the actual business transactions. Watt first improved on the Newcomen engine by condensing the steam outside the cylinder in a separate condenser. This meant that the cylinder itself was not cooled and, by lagging it with an insulating material or steam jacket, the heat loss was kept to a minimum. Watt's earlier engines were single acting, in that steam was condensed in the bottom of the cylinder only so that the piston pulled on the beam. In 1782, he patented his double acting engine in which steam acted alternately on the top and bottom of the piston, the condenser being in communication with the side opposite to that on which the steam was acting. This enabled the piston to also push on the beam, removing the necessity for a counter weight and increasing the power output considerably. The downward vertical movement of the beam at the shaft end was known as the stroke and the effectiveness of the engine could be measured by:

a) Length of stroke - a longer vertical distance meant that more water would pass through the pump each time

b) Strokes per minute - the faster the engine worked, the more water could be pumped.

The Boulton & Watt engines erected in South Shropshire were all single acting and had a chain which connected the piston to the beam. This only allowed a pulling action by the piston, which returned to its top position by means of the weight of the pump rods. The engines built for pumping were of a common design, the 30" engine installed at Grit Mine being a typical example. The engine house was of massive construction with a thick lever wall upon which the beam pivoted. The latter was of oak, 2ft square in cross section, and balanced at the centre. The cylinder, which was not fitted with a steam jacket, was mounted on heavy stone blocks and held in position by bolts which reached right through the foundations. As the engine was only single acting, the piston and pump rods
were suspended from the beam by chains. The condenser box was mounted outside the engine house and the air pump was operated by the main beam. With some engines, this condenser box was mounted in a pit inside the engine house. The warm condensate from the cylinder was fed back to the boiler by a pump that was also operated by the main beam.

Boulton & Watt did not manufacture everything on their engines, only the more specialised parts. John Wilkinson made the cylinders and the rest was made by local blacksmiths and mechanics on site, using plans and drawings supplied by the partners. Payment for the engine was also unusual in that it was not an outright sale. An annual payment was negotiated, based on fuel costs shown by the engine as compared with a Newcomen engine of the same power. These payments were to last until the partners' patent expired in 1800. In South Shropshire, where some of the mines found it hard just to keep in business, the partners must have found it difficult to collect their dues.

The engines installed in the district after 1800 were improvements on Boulton & Watt's design, using the expansive power of steam and some being double acting. They were also larger, eg a 60" engine was installed at Snailbeach around 1860 and a 70" engine at the Bog Mine in 1871. The famous engine builders from Cornwall installed some of these engines, which travelled up from the Harveys Foundry at Hayle, Bedford Foundry at Tavistock and the Perrans Foundry at Falmouth. The ironworks of North Wales also contributed, with the Ladywell Mine engine coming from the Sandycroft Foundry at Chester. The period up to 1850 was the time when the beam engine had its heyday, with engines as big as 100" being built in Cornwall. The drive for maximum efficiency and low fuel costs, expressed in terms of 'duty', was at its peak and mines all over the country competed to get the best results. In South Shropshire, however, the ready supply of coal made the problem less pressing and fuel economy was not a particularly major concern.

With such powerful engines, it was natural for the mine engineers to consider using them for purposes other than pumping. Thus, at Ladywell and East Grit Mines, engine houses can be seen with large slots in the lever wall for flywheels and adjacent pits for winding drums. Power was also taken from the engine to work crushing machinery, as was done at Ladywell, Pennerley and Ritton Castle Mines. Winding engines were sophisticated machines and, in later years, horizontal steam engines with more than one cylinder were used at Snailbeach and Roman Gravels Mines, amongst others. Gas engines and electric pumps and winders have been used in the 20th century but these came too late for most of the mines of the district.

There were four major drainage levels for metalliferous mines in Shropshire and these are described below.

**BOAT LEVEL**
Location : SJ358001

Driven : 1790s

Mines drained : Burgam, Tankerville, Potters Pit, Pennerley, Bog, Nipstone

The level is at the end of a small cutting and the entrance has been dug out and supported with angle iron struts. There has been silting up at this point and this causes the water to back up for the first part of the level. Just inside the entrance, the roof has been supported at some time by two short sections of brick arching. The low roof and high water at these points means that there is only 6 inches of air space. Beyond these sections, the water becomes shallower and a number of infilled shafts are passed on the right hand side, these were for access/ventilation while the level was being driven. One of these has a large tip at surface. There is an arched passage junction but the left hand side goes nowhere and the purpose of this is unknown. Burgam Mine is marked by a small cross-cut to the left which end in stopes. On the opposite side of the level is a shaft going up for about 60ft to what appears to be a wooden staging.

Near Tankerville there is a crossroads and the right hand passage originally headed for Ovenpipe Shaft. It now ends at a roof fall but, just before this, there is a short passage to the left and a narrow shaft on the right heading upwards for about 70ft before it becomes to tight. The left hand passage at the crossroads originally led to Lewis’s Shaft but now ends in a roof fall. The main passage continues for a further 100 yards to where it is completely blocked by an infill of small diameter broken rock, tip material which has been pushed down a ventilation shaft. The water flows through the blockage but it is not known if the level is completely flooded beyond. A stope leads down to the level from Potters but the level is completely flooded. The top of Hoskins Shaft cannot be identified amongst scrub and it is not known if it is merely covered or filled. Ramsdens Shaft is open underneath a cap down to the level 420ft below but has not been fully explored yet.

LEIGH LEVEL

Location : SJ331035

Driven : 1825-1923

Mines Drained : Batholes

This was originally meant to drain East Roman Gravels, Roman Gravels, Ladywell and Grit Mines but it only reached to just beyond Batholes. The level entrance is open in a wood and a small flow of water issues. Tree roots are pushing out the arching at the entrance and this may cause collapse in the near future. There are small shafts offset from the level at 350 yards and 750 yards
from the portal but both are filled to surface. There is believed to be another air
shaft south of these but it has not yet been located at surface.

The level is completely blocked at 1,100 yards by the infilled Blue Barn Shaft.
Milne Shaft near Batholes was capped with concrete in 1967 but there are local
rumours that there is a stable block at the bottom of it. There is bad air in this
level and recent exploration has only been possible with breathing apparatus.

**WAGBEACH LEVEL**

Location : SJ364025

Driven : 18th Century

Mines drained : Snailbeach

The portal is in Hope Valley and here also are the remains of a waterwheel used
to drive a dressing mill for barytes from Clifffdale Mine. Contrary to popular
opinion, the water was not driven by water from the level. At an early stage of the
working of Snailbeach, this wheel drove the pumps to drain the mine. Wagbeach
Level has been explored some distance in waist deep water to a blockage. This
has been dug through to reveal a second blockage and a third, although water
still flows freely through. These have been caused by infilling of the air shafts.

**WOOD LEVEL**

Location : SJ336004

Driven : 1790s

Mines drained : East Roman Gravels, Roman Gravels, Ladywell, Grit

The entrance has a concrete dam with a 9 inch slot from which the water issues.
Nearby is the original portal which collapsed many years ago and a collapsed air
shaft right next to the road. South-east of the road is a line of four air shafts either
filled or blocked part way down.