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GREENSWARD MINE AND ITS PUMPS, MONYASH, DERBYSHIRE

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Abstract: Lead mining on the Greensward Rake or Vein has taken place throughout the centuries, although few surface remains are now left to indicate this. Many records of the mine exist, its history as chequered as the Magpie Mine which lies nearby. Apart from being mentioned in articles relating to other mines in the area (i.e. Hubberdale and Lathkill Dale), nothing has been written about Greensward. This is the story of a set of Cornish-type pumps installed in the mine towards the end of the nineteenth century, forgotten about and discovered below ground in 1976; a partial history of the mine; historical exploration; present exploration and a description of the pumps.

INTRODUCTION

"GREENSA. All grass grown mounds, nothing to indicate gin. No stone remains of buildings. Just about the least impressive old mine I've ever walked. No hillock stuff exposed at all. No sign of rake any direction W. or N. or E. of Greensa. Examined all the mounds in main field, only one odd mound, a few acres away in another field could not examine, as crops." so wrote Nellie Kirkham in her field notes, after her preliminary exploratory visit to the area when she started to gather material for her articles on the boundaries of Sheldon (Kirkham 1963) and Hubberdale Pipe (Kirkham 1964).

Greensward Mine is described in records both as a rake and a vein. It extends in an easterly direction (122°) towards the Bakewell - Monyash road, and in an westerly direction (302°) until the vein meets a corner of the Monyash - Taddington road, adjacent to Dyke Head Farm. The fracture is very straight and well defined for its length of some one and a half miles. The mine lies within the private customary liberty of Ashford South Side, and the workings run parallel with and adjacent to, the dry limestone boundary wall that separates the Ashford and Monyash Mining Liberties, clearly associated with past disputes (Kirkham 1963). One of the major differences between the two is when measuring out the founder and taker meers to claim the title to a mine. A meer in Ashford Liberty is twenty nine yards (26.5 m), and a meer in Monyash Liberty, which lies within the Queen's Field of the High Peak is thirty two yards (29.24 m) (Stokes 1973).

Sheldon village and Magpie Mine lie to the north east, with Monyash just south of west and the old packhorse route, later the turnpiked Horse Lane, crossing over the vein, virtually dividing it in half. It lies within a sparsely populated area and is in typical upland limestone scenery, undulating and intersected by small drystone dales sometimes known as "slacks" (Kirkham 1963) and drystone walls, dividing fields, some of which act as parish boundary and mining liberty divisions. There are fine views from the mine in good weather, but it is very exposed (as is Magpie Mine) in bad weather. There is a surface-water shortage (as in all limestone districts) and water pumped out of Greensward New Engine shaft from the late ninetheenth century onwards would have been utilised for the washing floor (a buddle and tiered lagoons) that we discovered lying north of the Monyash/Bakewell road. This washing floor would have been used for lead, the ochre being separated by a different process.

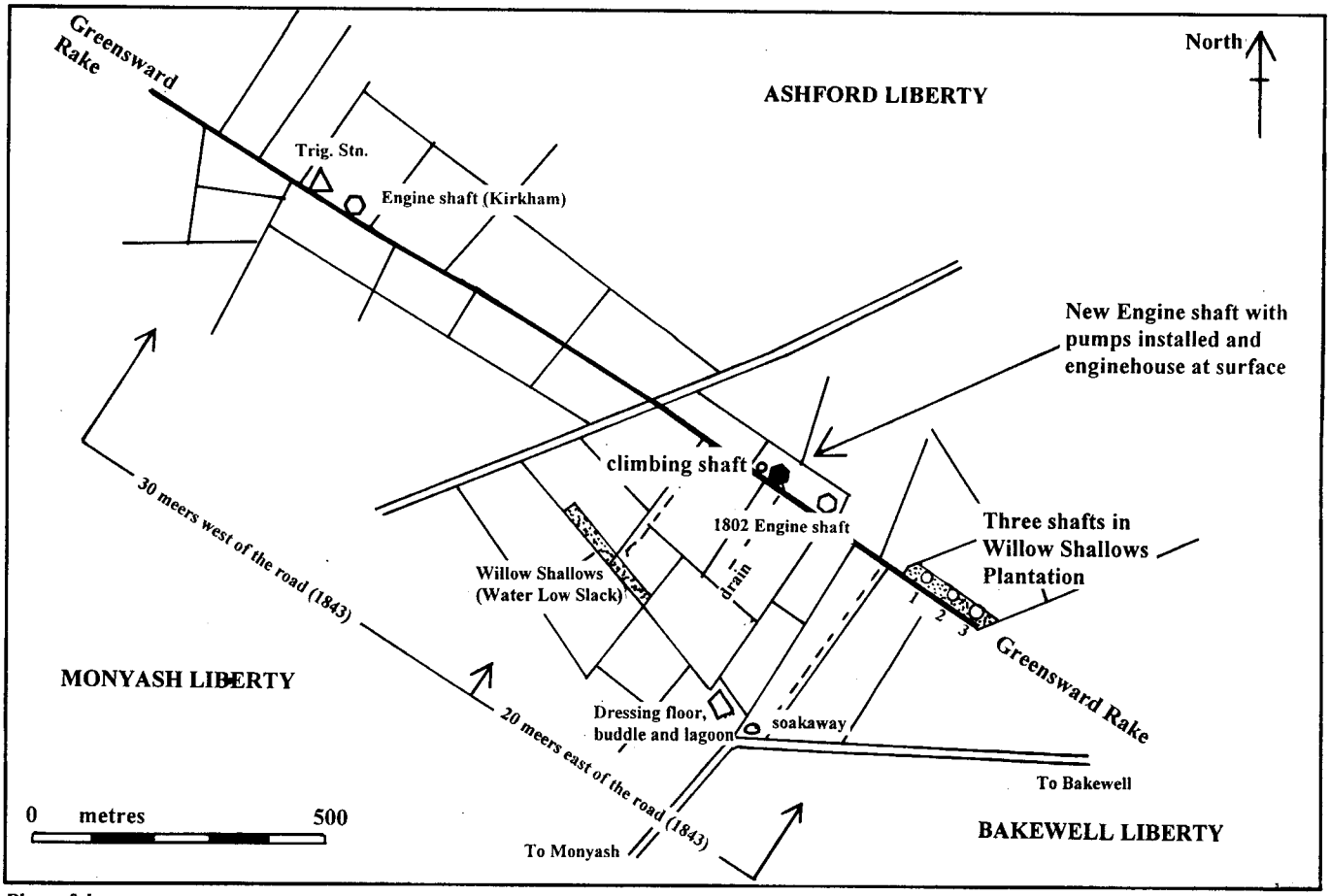
Over the centuries there have been variations of the name and spelling of Greensward, namely Greensa Rake, Greensaw Rake, Greensor, Greenswarth, Greensorake, Greensal, Greenshawe, Grensaw, Grenshaw and Greensort Rake. The dictionary defination of SWARD is "the grassy surface of land; turf". GREENSWARD is "turf green with grass". (Annandale 1956). This is very interesting because in the thirteenth century, according to custom, villagers had the right to dig turf and get "heath" in the "marsh" of Monyash (Kirkham 1963). As Greensward lies on this ground is this how it gained its name?

HISTORICAL BACKGROUND

It would appear that lead mining has taken place in the Manor of Ashford from at least 1066 when it was part of the King's demesne, changing hands several times until reverting to the Crown again, when Henry III bestowed it on Eleanor of Provence who became his Queen. In 1549 or 1550 it was sold to William Cavendish (Bess of Hardwick's second husband), she later married in 1568 her fourth husband, George Talbot, Earl of Shrewsbury, thus becoming the Countess of Shrewsbury. He died in 1590. (It was after his death that she started building Hardwick Hall). She apparently held the Manor of Ashford for life, with the right to the lead mining duties of lot and cope and all other benefits (Kirkham 1963). The Manor now belongs to the Duke of Devonshire who leases the mineral rights.

Greensward itself has a very ancient history. At the end of the sixteenth century there were disputes over the boundaries of Monyash and Ashford concerning lead mines and the payment of lot and cope, Greensa is mentioned. (Kirkham 1964). The payment of tithes on lead ore was greatly resented by the miners, and again Bess of Hardwick was involved in disputes concerning Ashford Manor. (Kirkham 1965).

Mining on the Greensward vein continued throughout the seventeenth and eighteenth centuries, with an apparent upsurge in the mid eighteenth century, through the driving of Whale Sough and the draining of the Hubberdale Pipe which is quite near to the north west end of the vein. The mine, along with other leadmines in the vicinity, lay on an area of open common, waste land, that was enclosed after the Enclosure Act of 1777. (Kirkham 1963). Horse Lane, which crosses Greensward Vein, was an old packhorse route that became part of the Hassop - Newcastle-under-Lyme Turnpike passing through Longnor and Leek. It is often referred to in records as the Leek Turnpike. The Turnpike Act was passed in 1765 and many of its Trustees were wealthy potters e.g. Josiah Wedgwood. This was a very important road, as the supply of chert from Bakewell needed for runners and pavers in the old type of potters' panmills was transported along it. (Dodd and Dodd 1980).



Plan of the area.

There appear to be many records available for research concerning the eighteenth and nineteenth centuries, the latter part of this century being particularly well documented from when James Farnsworth took over the Title in 1870. Research continues into the history of this, hitherto, unknown lead mine, lying very close to Magpie Mine, and with an equally intriguing story to tell. Research continues regarding three accidents below ground, a case of attempted murder, two fires at the mine, litigation in the Small Barmote between Partners, consolidation of the Greensward Title with titles of other mines in the area, and the search to find where the pumps and the two engines originated from.

GREENSWARD MINE. SK163673

Attention has recently been focused on an open shaft which Nellie Kirkham refers to as the New Engine Shaft, about 220 yards south east of Horse Lane, and has become familiar as the Greensward Mine, although entries in the Barmasters' Record books gives a much greater range to the title than the field in which the New Engine Shaft is situated.

The winding shaft to the east of the New Engine Shaft preceeded the sinking of the New Engine Shaft. The basis for this is the discovery of an inscription '1802' in the workings at the shaft bottom (Westwood survey 1994). From this date onwards there are Reckonings for Portoway Company for Greensor Rake 1803 - 1843 (SCL. Bag.393). For want of workmanship the ground was dispossessed and given to Thomas Alsop on 13th November 1843. Namely 20 taker meers from the founder in an easterly direction, the founder being a pair of possessions commencing from the east wall of the Leek Turnpike Road (Horse Lane) and along the liberty boundary wall and terminating at the fence that divides the Liberties of Monyash and Bakewell. (D.R.O. B/L 18) It is in this section of the vein that the New Engine shaft is sunk and where in 1976 "Operation Mole" discovered the remains of a "pump".

In a westerly direction thirty meers of ground as takers from the founder were allocated over the Leek Turnpike Road. James Longson, the Assistant Barmaster, records in his Memorandum Book that the ground allocation westwardly stretched over six fields nearly to the far wall of the sixth field. (D.R.O. B/L 18). Measurement of the meers takes this nearly to the far wall of the field, which is the next on from the field where the O.S. triangulation pillar is.

At the O.S. triangulation pillar there are signs of a gin circle. However, Nellie Kirkham has marked signs of an old shaft as "Engine" on her field maps, further east than the trig. point. This winding shaft she recalls (Kirkham field notes), has the signs of an old gin circle, the shaft (c.1768) being 432 feet deep. (N.B This is the reason why she calls the engine shaft that contains the pumps the New Engine shaft, because records show that there have been earlier "engines" at different shafts on Greensward Mine). Accepting the depth of the New Engine shaft as being the 60 fathoms recorded by the Geological Survey (Green 1887), then the bottoms of both shafts are on the same horizon, plus or minus a few feet. Very likely this is close to the water table. Measurements taken (Westwood survey 1994) in the "1802" shaft also indicate that there is a possibility that the bottom of this shaft is also on the same horizon as the bottom of the New Engine shaft.

Descent through the ginging of the New Engine shaft is truly a revealing experience. The craftsmanship is superb, and the fact that it is in such a pristine condition bears witness to the skill of the artisan who built it over a century ago. The stones are thinner than normal and well set. When looking upwards against the sky

it is significantly oval in shape (Nellie Kirkham made pointed reference to this in her field notes). If the ginging was not built by a Cornishman it must have been a man well trained in the Cornish manner. One cannot help linking this with the John Taylor influence in the area around Monyash, Sheldon and Alport in the 1840s.

The title was taken on the 2nd April, 1870. James Farnsworth took over of the Greensward Vein and bought the mine from John and George Goodwin of Monyash. The New Engine shaft was then only 13 fathoms deep (78 feet) to the bottom of the sump. There could have been an engine on the shaft at that date but this is very doubtful. There was certainly no set of pumps installed below ground. We know this because of the charge of attempted murder of the men in Greensward mine by John Goodwin on the 23rd April, 1870. At a Court hearing at Bakewell, Thomas Bonsall, a miner from Monyash appearing as a prosecution witness, stated that "the mine has a shaft of twelve fathoms and a sump of six feet under which he was working" (D.L.S.L. High Peak News 7/5/1870). Thomas Bonsall appearing in Court at a later date said that he began work at the mine on the 22nd April, 1870. "I went down the shaft and fixed a rope over a beam, by which I went down. The rope was hung from the top down the lower shaft, and I was working on it when the stones and timber came down with a rumble". He also stated that "The pit had not been worked for a number of years". (D.L.S.L. High Peak News 14/5/1870). A year later (15th June, 1871) an accident occurred to a miner called Jacob Boden, foreman for Messrs. Farnsworth and Birkett, "he was in the chair and going down the shaft, somehow it got fastened in the conductors by the side of the shaft. Whilst he was thus standing he stepped on to one of the stays, having hold of the rope with one hand. The engineman at the pit mouth was still lowering, as he thought, the chair, the rope thus becoming slack, when suddenly the chair fell, pulling Boden down with it. The unfortunate man had only been employed at the pit for a week. Dr. Knox, of Bakewell, was called, and dressed the unfortunate man's wounds". (D.L.S.L. High Peak News 17/6/1871 and Derby and Chesterfield Reporter 3/6/1871 - source R. Flindall). (Incidently the exact reporting is reprinted in the Derby and Chesterfield Reporter from the High Peak News of the previous week. It would appear that news was rather stale when it was finally printed!). This is the first indication of a winding engine on New Engine Shaft at Greensward mine. It was later replaced around 1884 by a portable winding and pumping engine (D.R.O. 504B/L28/22).

We are still researching the origins of this equipment. We know that such equipment was hired to the mine by Isaac Watt Bowden or Bolton, Engineer, of Ashton-under-Lyne, Lancashire, in June, 1884. The records of the Ashford Liberty, Small Barmote Court of the 20th May, 1885 in an Action of Title over the Great Green Sward mine (James Farnsworth as Defendent) clearly shows the surname of Bowden. However, in personal conversation with Dr. J. Rieuwerts, we discovered that Dr. Rieuwerts has in his possession a book that belonged to Isaac Watt Bolton, J.P of Ashton-under-Lyne with a photograph in it of the gentleman, taken in Eyam churchyard in 1874! We believe, therefore, that Bolton is the correct surname for this Engineer. (N.B. The authors would be most grateful to receive any information concerning where records could be found concerning Isaac Watt Bolton. Especially for his firm for 1884/85, as this information could give us clues as to the origin of the winding and pumping engine, and the pumps at Greensward Mine).

Consent for consolidation of Farnsworth's titles was approved by the Barmote Court in 1886. These included Gank Hole in Lathkilldale as well as the Great Greensward Mine on which vein the New Engine shaft was sunk. Almost immediately James Bacon sold them to James Farnsworth's wife Caroline and his son Samuel James (a junior). Ashford Liberty, Small Barmote Court proceedings of the 20th May, 1885 in an action of Title for Great Green Sward Mine, with James Farnsworth as Defendent, called as Plaintiffs' witness Cubitt Taylor, Mine Agent of Monyash. In his examination he states "The mine has been standing from latter end of January (1885). No work has been done in the bottom, no ore got since November (1884)" (D.R.O. 504 B/L28/22). James Farnsworth lost the verdict, and judgement with costs were given to the Plaintiffs (Thomas Hampson Brown, Thomas Lees Holden and William Arthur Leak). James Farnsworth lost his shares in the mine (4/24th's) and was no longer a partner in the mine. He did not deliver up the possession of mine as ordered by the Small Barmote Court, and a Warrant dated June 11th, 1885 was executed requiring him to give possession of the mine to the Plaintiffs. (D.R.O. 504 B/L 28/24). Working did continue after this since there was another accident in this shaft in November,1884. A miner named Taylor from Monyash, received serious injuries by being struck on the head by a heavy chain whilst standing at the bottom of the shaft. One of the men at the shaft top was working at a heavy chain which slipped from his hands and fell down the shaft. (D.L.S.L. High Peak News 22/11/1884 and Derby Mercury 26/11/1884 - source R. Flindall). We conclude that this accident, at a time of low prices and the disputes, taken together, caused the final stoppage of work at the mine, and the abandonment of the pumps.

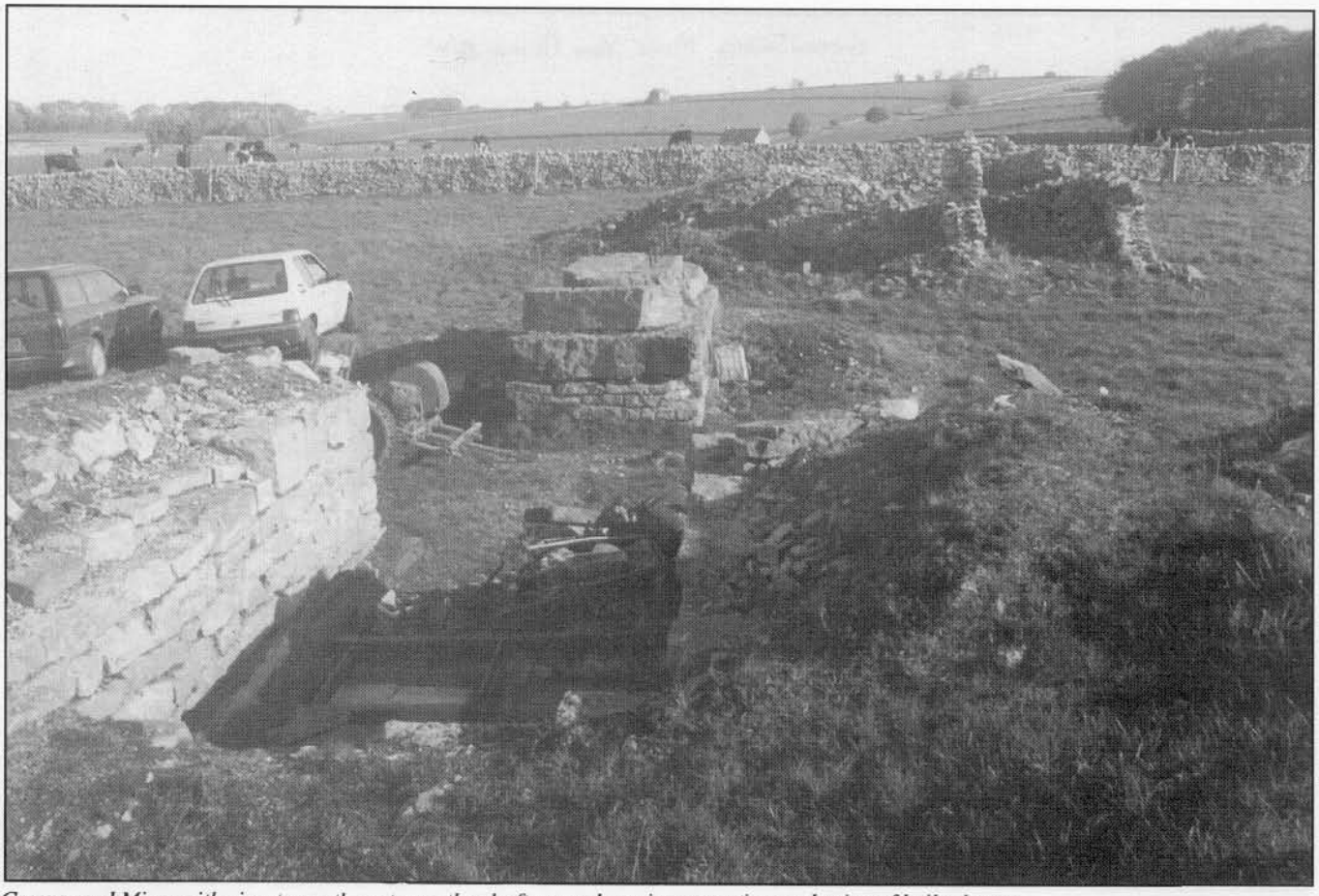
HISTORY OF RECENT EXPLORATIONS

No-one knew of the existence of the pumps that remain below ground, until Operation Mole Mines Research and Exploration Group discovered them, when they descended New Engine Shaft during the drought of the summer of 1976.

Nellie Kirkham first explored the surface of "Greensa" as she called it, in July 1945, (field notes) when she was researching an old mine plan "The Range of Hubberdale Pipe" by George Heywood, 1768. She comments on seeing a shaft in a ruined building, and described it as a very good oval shaft and it to be a winding shaft. She states that the engine bed is very well built, also the walling round the shaft, some of the slabs very large indeed. As well as these remains of mine buildings which she saw, there is also the ruin of the boiler house, which must have been in a far better state of preservation fifty years ago when she saw it, because she described it as having a stone exterior lined with fire bricks and mentions a chimney. The site of the mine in 1945, is pretty well how it remains today, apart from further deterioration of the boiler house, which our present research shows was probably built around 1870/71.

Over the years Nellie Kirkham continued to visit the mine, recording her comments, noting references to it in her records. Many records from which she obtained information about Greensward were in private collections to which she was given access, quite a few of which have now been placed in Public Record Offices. She wrote about the boundaries of Sheldon (1963) and Hubberdale Pipe (1964) and mentioned Greensward in both of these articles. Her field notes show that eventually she had a very detailed knowledge, both about the history of the mine, and surface features that she saw and recorded, some of which today no longer exist. But she was unaware of the existence of the pumps which remained underground undiscovered until it was rediscovered in 1976.

In her field notes Nellie Kirkham records that in 1962 Eccles Caving Club made a descent on a "Greensa" shaft on the north west end of the vein, but nothing more was explored. The authors have checked with Brian Saville of Eccles Caving Club, and Eccles Caving Club certainly did not descend New Engine Shaft, nor did they know of the existence of the pumps.
During 1976 Operation Mole Mines Research and Exploration



Greensward Mine, with view to north east over the shaft mound, engine mounting and ruins of boiler house.

Group investigated various mines and shafts for Tarmac Ltd. The firm held the lead title to Greensward and requested a report on Greensward Mine. When the first member of "Op Mole" descended the New Engine Shaft and found the rising main, this was the first indication that there was a Cornish-type pump remaining *in situ*, at an approximate depth of fifty four fathoms (324 feet) below the surface, resting on a stout wooden platform. The group only had a very restricted time to explore and photograph the shaft and pump, as Greensward Mine lies on private land and access in 1976 was then very difficult. It is understood that the upper pump was exposed, the water level being below the platform, but not as low as during the present explorations of 1995. It is very interesting to compare "Op Mole's" photographs with those taken in 1995, everything seems to have remained virtually the same, both below and above ground.

In 1994 Rick Westwood, a Chesterfield caver requiring a project to work on, asked John Wilmot of "Op Mole" for a suggestion. John suggested Greensward Mine, because of the pumps, and directed him to Doug Nash of "Op Mole". Doug gave Rick the information that enabled him with fellow cavers to locate and explore the mine. His account of the subsequent exploration and survey (Grade 1) are included in the Exploration section of this article. Whilst carrying out this exploration shaft tops were secured with grids.

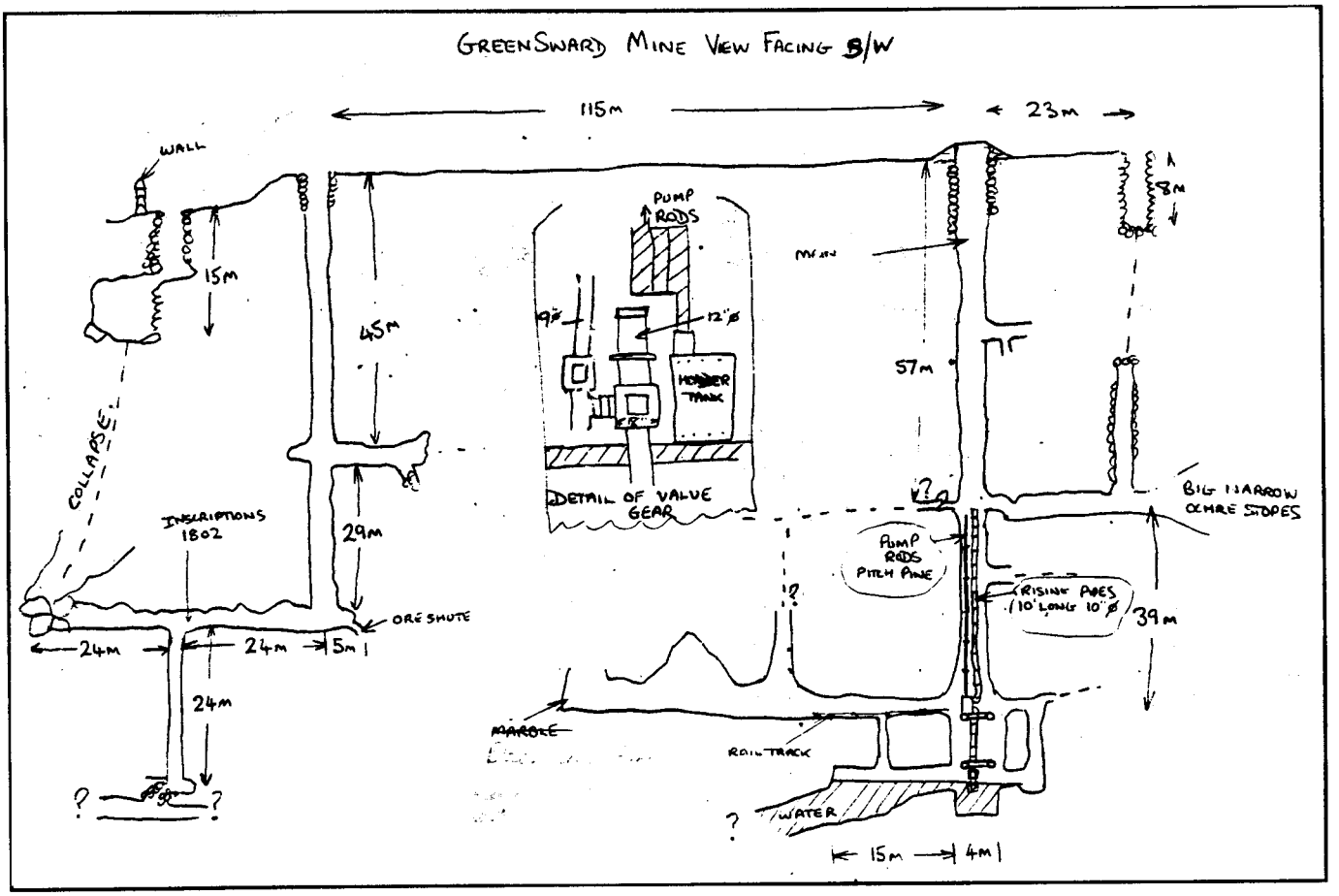
The 1994 exploration and then the summer drought of this year 1995 which considerably lowered the water table below ground, gave "Op Mole" the incentive to carry out the present 1995 explorations which form the basis of this article.

"Op Mole " erected their winch over the New Engine shaft of Greensward Mine in late summer of 1995. Members and many guests (including P.D.M.H.S. members) were able to descend and examine in detail the Cornish-type pumps which remain almost intact, after being installed below ground over a hundred years ago. A large section of the rising main and pump rod have been removed, but some part remains in the lower section of the shaft attached to the plunge pump. Apart from Millclose Mine near Darley Dale, it may have been the last Cornish-type set of pumps to have been installed in a Derbyshire lead mine. This is most unusual because it doesn't seem to have been a rich mine, certainly not rich enough to warrant spending money on such a pumping system. Lead mining was in decline from the 1860s onwards. Engines from the mines were being dismantled and sold and moved out of the area to the coal mining regions surrounding the Peak District. It is certainly unusual for such an engine and pump to have been erected and installed in the mid 1880s. After the end of the present explorations, New Engine shaft was capped to save the pumps for the future.

THE PUMP SYSTEM

At surface, about 12 metres from the New Engine Shaft, there are the remains of a boiler house and chimney, an engine-mounting block with post-1858 Whitworth type bolts still *in situ* and, a couple of metres from the shaft, a depression which probably had the mounting blocks for an angle bob. It is evident that the engine was dual purpose for winding and pumping, of a horizontal type, which actuated the pump rod through a connecting rod and an angle bob variation of a bell crank lever, with a dog-clutch to operate the winding drum.

No remains of the rods and pipework can be seen at surface, but they are found at some 60m down the shaft (see below). The plunger pump is found at a depth of approximately 54 fathoms (98.7 m), resting on a stout wooden platform. Considering it has remained in situ for over a century, it is very well preserved. The



Sketch-section of Greensward by Rick Westwood.

lift-pump below the platform does, however, exhibit more evidence of being periodically submerged in water.

The installation is an adaptation of a Cornish bucket-lift and plunger-force pump system, in that the 'H' type valve box normally bolted to the base of the plunger barrel, is replaced by two single clack valve boxes placed side-by-side. From the sump the water is drawn through a single clack valve by the bucket-lift pump and shed into a cistern resting on the platform through a short wooden launder, now mostly rotted away. This part of the pump is traditional. A short connecting pipe from the bottom of the cistern, passes the water through the first valve box at the base of the plunger barrel. On descent of the plunger, the water in the barrel passes through the second valve box and up the rising main towards the surface.

The complete installation makes full use of a very limited amount of room in the chamber, giving easy access to the doors on the valve boxes for valve maintenance. There is also a purpose built swan neck section of the rising main, which carries the main round an overhang in the roof of the chamber into the shaft. It all looks so well engineered that it is difficult to imagine it being a second-hand job lot. It seems to be purpose built to fit in the confined space, and leave sufficient room for the free passage of a cage.

If the plunger is eight inches in diameter and the stroke is about three feet, then the output would be somewhat less than 4,000 gallons per hour at ten strokes per minute. Once the water table influx stabilised, this rate of pumping should have been adequate to keep the mine dry.

THE EXPLORATIONS

1994 Exploration (Extracted from Rick Westwood's account).

The field contains four shafts (see plan of Greensward above). The first, a climbing shaft, has dressed stone stemples, "a fine example", however, it is blocked at intermediate level.

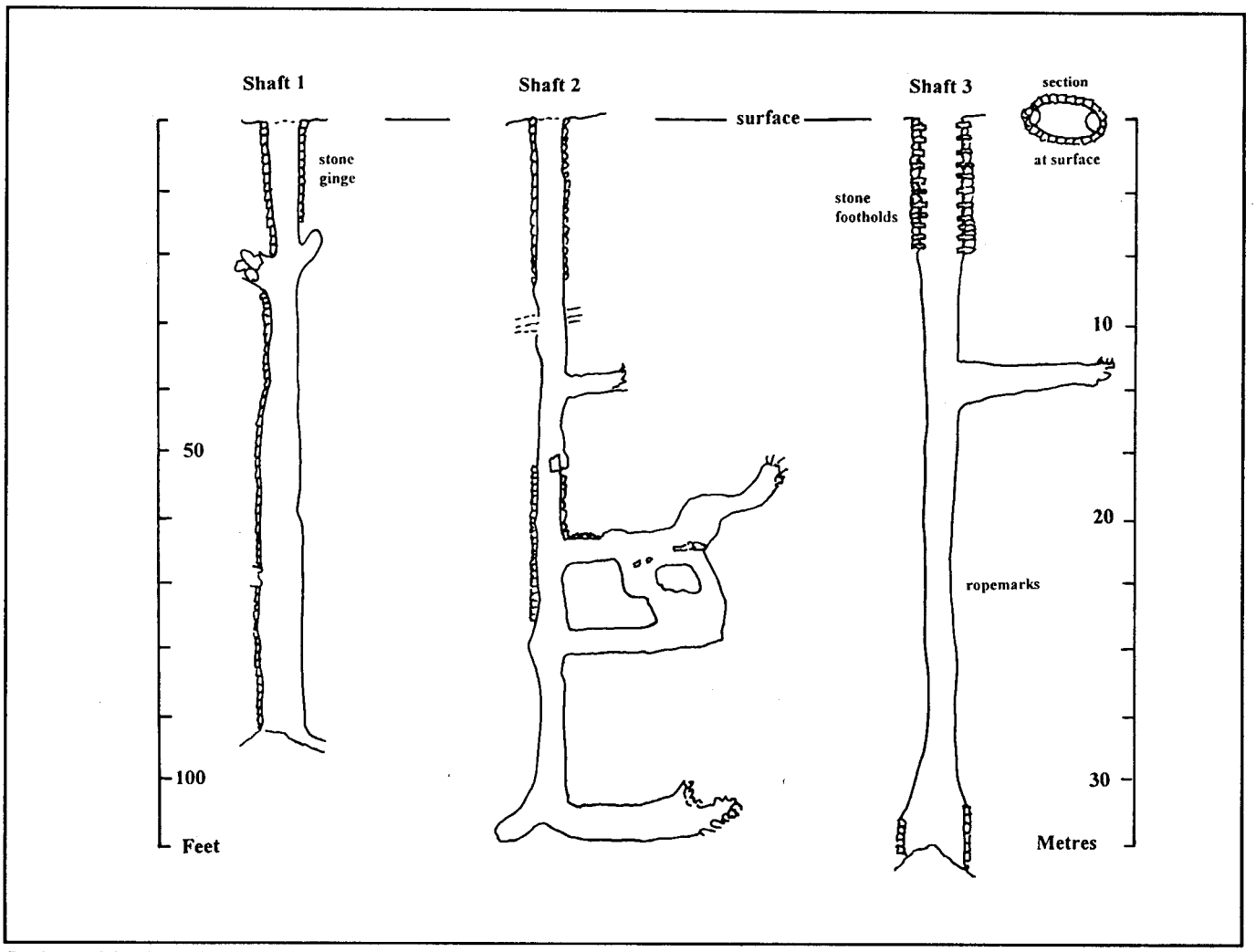
The next is the main drawing and pumping shaft, oval in the Cornish style and 360 feet deep. There is a level-off at 200 feet, leading to high but very narrow stopes. Here the bottom of the first shaft can be seen going up.

Just below this level in the main shaft, the pump rods (pitch pine) and water pipes are seen, the pipes being 10 feet long, each fastened with two large bolts on an oval flange. These continue down to the plunger pump at 320 feet and its wooden platform. Here is a chamber 7 feet x 10 feet wide x 20 feet deep (approximately). This carries on down 20 feet where the chamber floods and a flooded level trends NW/SE.

Other "vague" levels lead off the main shaft but the unstable nature of the mine has not allowed their exploration yet. A level at 320 feet (south east) is 236 feet long and has a track laid running for approximately 50 feet leading to an internal upward shaft (a rise). This level finishes where black limestone is seen, and the lead vein is narrow. There appears to be no ochre.

There are a few artifacts left underground, but the wooden platforms are heavily covered with debris from above.

South-eastwards, a further 340 feet over the surface, shaft No. 3 is found. This is another winding shaft 147 feet, broken and descending for another 100 feet to a level trending south east. Inscriptions there date from 1802 onwards. Another internal shaft



Sections of the three shafts in the Willow Shallows Plantation, south east of the New Engine Shaft, by Geoff Hardy and Ian Robb.

80 feet going down (a winze) led to a tight squeeze to lower workings. Evidence of modern digging is in force here, but due to a collapse of deads, exploration could go no further (this point is lower than the normal water level, when even the plunger pump is covered, accessible only in dry summers). After the 80 feet internal shaft (a winze), a huge collapse occurs, which by my reckoning connects to the surface via the 4th shaft, close by the field wall. This shaft appears to be a climber to the 3rd shaft.

1995 EXPLORATIONS

"Op Mole" erected their winch and telephones on the New Engine shaft for four Sundays, the 10th, 17th, and 24th September, and the 8th October, giving members and guests the opportunity to descend the shaft and closely examine the pumps.

Paul Deakin took the underground photographic record of the pumps which illustrate this article, on the 17th September. Dave Warriner and John Peel carried out the shaft survey on the 24th September. Roy Buckley, John Wilmot and Lynn Willies went down on the 24th September and 8th October for assessment and discussion regarding the origin of and working principles of the pumps. During these discussions at the level of the plunger pump, a very distinctive bed of dark limestone was noted. See also Rick Westwood's survey (1994), and the reference to 'blackstone' Dr. T. Ford and Nellie Kirkham (Kirkham 1964). The *Memoirs of the Geological Survey* (Green 1887) record, in addition to the reference to the pumping engine at Greensward Rake, "The Ashford Black Marble is said to occur at fifty two fathoms depth". Mine minerals - at the plunger pump level samples were taken out of the vein. Examination revealed that the vein stuff consisted of a loose matrix of decomposing calcite with barytes. In interstices very minute crystals of clear fluorite were coated on a face of barytes. The general feeling was that the mine had not been highly productive in galena.

1995 Underground Mine Exploration Report by Geoff Hardy of "Op Mole".

At the bottom of the open section of the shaft is found a mound of rubble supported on the pump rods and plunger pump. By sliding through a hole a small chamber is entered which contains the pump and cistern. Watermarks on the wall seem to indicate the normal water level to be about level with the top of the pump-plunger. The floor of the chamber is almost entirely covered by a platform of wooden planks ten to twelve inches wide and two and a half inches thick. A hole at the south end of the platform gives a view of the main supporting timbers, two stacks of square wooden beams three deep and aproximately twelve inches square. Beneath the main platform a series of ladders (wooden sides with iron rungs) connects first one platform and then another before the shaft is flooded. A pump pipe continues down the shaft with another two valve boxes, and is supported on unshaped wooden stemples about six inches diameter and a series of chains.

To the south of the shaft a two foot six inch by four foot high level crosses a hole in the floor (possibly used as an ore chute), before climbing over a pile of collapsed deads and entering some small stopes, where it finishes in a forefield after about one hundred and

twenty feet. The vein is four to six inches wide consisting mainly of barytes with some calcite and a small amount of galena.

To the north another level heads off, three to four feet wide and five feet high. This leads after a few feet to a twenty foot winze after which the continuation is blocked by fallen packs. At this point it is possible to see through the collapse into a high narrow stope with blackened walls and packs of unstable deads. The vein in this area is about nine inches wide, consisting mainly of barytes, calcite and a very small amount of disseminated galena.

The winze is about twenty feet deep and about three feet round at the top, which consists of loose limestone ginging supported by unshaped timbers three inches in diameter forming a square. At the foot of the winze a level leads north, but is blocked by a fall of roofpacks after only a few feet. To the south a four foot by six foot high level, leads back into the downward continuation of the main shaft which opens out again at the level of a third platform. Near the entrance to the chamber an inscription is clearly carved into the east wall about one foot above floor level. It reads " JB 1884".*

The platform is still safe enough to stand on and gives a better view of the main platform's under-side. It can now be seen that the platform contains an opening about three foot six inches by two foot six inches, through which a cage could pass. The guiderails are still in place between this and the water level. The water level is about one foot six inches below the platform, and the shaft can be seen to continue below water for another two feet where it is blocked by a mixture of rocks and broken timbers.

Another level leads from the third platform to the south and after passing under the hole from the level above, leads to a short flooded section. Here the passage opens out slightly into a small stope before, after a small climb, it ends in a forefield after about fifty feet.

The Three Shafts in the Willow Shallows Plantation by Geoff Hardy and Ian Robb ("Op.Mole") descended on the 8th October.

The first shaft is two feet nine inches long by one foot six inches wide, oval at the surface and tapering out lower down. The rough limestone ginging continued for eighteen feet and after passing a small clay filled cavity to the south, a pocket of unstable rocks is encountered to the north at twenty four feet. Below this the north side is filled by a packwall whilst the south wall contains a dirty vein of barytes and calcite two to six inches thick.

At about fifty feet down the packwall becomes more open so that you can see through into a void filled with waterworn rocks, mud and flowstone. The walls are heavily waterworn and fluted such that the shaft appears to have been sunk adjacent to an infilled natural swallet This continues to the bottom of the shaft at ninety six feet where it enters what apears to be the top of a natural chamber filled with clay. The shaft is sunk through pale grey limestone containing chert nodules, and the only sign of mineralisation apart from the thin vein to the south, is a few pockets near the shaft bottom containing crystals of calcite and fluorite. No attempt appears to have been made to drive into the boulder filled area to the north.

The second shaft has a circular ginged collar two feet four inches in diameter. This continues to twenty five feet depth where limestone is entered. At thirty feet a series of thin shale bands are encountered, and then immediately below them a small hole looks into an unexplored chamber or passage. Digging would be required to progress here.

At forty feet a short level heads off to the south, ending in a collapse after eighteen feet. An unstable rock was then encountered which almost blocked the shaft. It may have been possible to go past this but it was decided it was too dangerous and after a determined effort which proved how stable an unstable rock can be, it was found possible to dislodge it only for it to jam at an even worse place a few feet lower.

With the addition of a few more rocks to act as chocks, GH managed to squeeze past the obstruction and at sixty two feet another level ran off to the south. A hole in the floor gave access to a level at 80 feet whilst an awkward step up to a short catwalk, gave access to a short climbing passage ending in a boulder choke.

At one hundred and ten feet the bottom of the shaft is encountered with a pocket to the north, and a short level to the south ending in a collapsed roof pack. Again the only mineralisation to be seen is a four to six inch wide vein of barytes and calcite, with very little lead and no ochre. The vein infill has been washed out and replaced by silt in many places.

The third shaft is larger than the rest being oval and four feet long by two feet wide. The ginging contains unusual climbing stones** sticking out and continues to twenty feet. At thirty feet deep rope grooves are encountered, and then at forty feet a level heads off to the south, only to end in a collapse after twenty feet.

The shaft continues with further rope grooves to one hundred and fifteen feet, where it widens out with packwalls to the north and south and a muddy floor with no way off. A pool of water is present and the bottom of the shaft appears to flood in wet weather. Does this make it unlikely that any deep shafts really do exist in this wood?

The limited extent of the accessible workings and the degree of collapse underground is not suprising since the surface of the wood contains numerous run-in shafts and collapsed hollows. It appears to have been worked using a large number of small shafts of limited extent possibly on a series of small veins, and it may be that the vein splits up in this area, as there is no sign of either vein or further workings to the south of this wood.

It is worth including some of Nellie Kirkham's field note-book comments (January 1954) here: In the belt of trees on Greensa Rake (Field 597), I could only see one open shaft, about halfway along the belt of trees, the top very run-in, but as near as one can get to it, it looks like a drawing shaft. Near the south end a ruined coe still stands. From mine plan Range of Hubbadale Pipe, Weedon (she later calls them Wheeldon) and Bonsale shafts fall at about at the south part of the belt of trees. There have been many shafts in the tree belt. Another note (undated) says - Belt of trees of possible Bonsale shafts is now called Willow Shallows Plantation, and the little coe is said to have been a smithy booth.

*"J B 1884". These initials may be those of James Bacon of Youlgreave, to whom in 1884 James Farnsworth sold the titles to a number of veins under the name of Mycross Mines, after being given the titles a month earlier. (Kirkham 1964).

**Stones projecting from the sides of shafts for climbing seem to be a peculiarity of this area. Similar climbing stones are recorded in the shaft that Eccles Caving Club explored on the north west end of Greensa vein in 1962 (Kirkham field notes). Stones protruding from each side of the shaft in turn, appear to have been used in a climbing shaft at Magpie Mine, Sheldon (Brown and Ford 1971).

Surface exploration by Roy Buckley and Margaret Haywood on the 20th September.

At the time of our exploration, when approaching the area of "Willow Shallows", we met two farmers with a tractor who were loading stones into a trailer, amongst which were noticed stone lintels. We explained that we were looking for signs of a drain running down from the New Engine shaft on Greensward mine, permission was given to us to walk over their fields. They told us of other open shafts on their land which "Op Mole" could descend. They also pointed out the position of a large hole which had been filled in by Derbyshire County Council's Highway Authority, as it partly intruded into the grass verge on the north side of the highway (the Bakewell to Monyash road). It exhibited all the signs of being a soakaway. In the vicinity (Field No. 328 O.S. 25" sheet, 1922 Edition, Derbyshire Sheet XXIII-13) we found what appeared to be the remains of a buddle and tiered lagoon. Nellie Kirkham (field notes) makes no mention of this washing floor, but mentions seeing a drainage channel going downhill in the direction of this washing floor (Field No 297) from the New Engine shaft at Greensward mine. We decided that the stones (containing lintels) being removed by the farmers were probably the remains of a coe, or larger building associated with the washing floor, as they lay so close to the washing floor. Had we gone a day later we would have missed this evidence. We concluded, therefore, that the water from the rising main would be used as house water, e.g. water for the boiler and water for dressing treatment.

In the arguments between James Farnsworth and John Goodwin of Monyash, when James Farnsworth first took over the Title to the mine in 1870, and John Goodwin was committed for trial for the attempted murder of the men in Greensward Mine. "Mr Farnsworth told him (John Goodwin) to leave the place or he would push him and a vat into the dam" (D.L.S.L. High Peak News 14/5/1870). There was obviously a dam on the surface of the mine before the shaft had been driven deeper and any engines or the pumps installed. A few years later once the second engine and pumps were installed and working drainage of the water from the mine would be diverted down the field, as described by Nellie Kirkham (field notes), to the dressing floor prior to eventual dispersion down the sink hole, filled in by the Highway Authority, on the border of the Bakewell/Monyash road.

On the 22nd of October Roy Buckley and Margaret Haywood measured the 32 meers westwardly from Horse Lane to check on a discrepancy between the six fields referred to by Longson, the Deputy Barmaster in his 1843 *Memorandum Book*, which he measured and allocated to Alsop in 1843, and the present four fields on the ground. The farmer stated that one wall had been taken out between the third and fourth fields and there are indications that another has been removed between the first and second fields from Horse Lane. They could not find any trace of the gin circle mentioned by Nellie Kirkham (field notes) on the north-western part of the vein near to the O.S. triangulation pillar, where Nellie Kirkham's field map indicated it to be. It was, however, noticed that there was a total absence of mine tips and spoil. Measuring westward up to the O.S. triangulation pillar, there were heaps of cobbles of white chert. They seem to have been segregated for some purpose.

They also noted that from the top of the 1802 shaft, looking eastwards along the rake, a linear feature was visible going from the rake down the dale towards a "soakaway". On 13 December a further examination suggested this was an old drainage channel similar to the old drainage leat described by Kirkham.

CONCLUSIONS

In conclusion, we were asked by members of "Op Mole" (ourselves having been original members of the Group) on the Group's behalf to research and write this article. When we first started researching for this article there seemed to be a dearth of information. However, once we started it was discovered that there was a mass of records so that research is continuing into the history of the mine.

ACKNOWLEDGEMENTS

Many thanks to all "Op Mole" members (past and present) for their support both above and below ground. Rick Westwood of Chesterfield and his fellow cavers including S. Thompson, T. Howard and J. Wilmot for the 1994 exploration which gave us the incentive to carry out the 1995 exploration. Thanks also to Rick for his report, part of which, along with his survey has been included in this article and also for helping to cap the shafts; Doug Nash of "Op Mole" for his very great help and support in supplying a vast amount of information from "Op Mole" records including Nellie Kirkham's unpublished field records; Geoff Hardy of "Op Mole" for the survey and reports on the New Engine Shaft and "Wheeldon Shafts"; Roger Flindall for newspaper and other references which gave us many clues; Dr. Jim Rieuwerts and Dr. Lynn Willies, both of whom have been most helpful with information and references; Paul Deakin for the photographic record; Dave Warriner and John Peel for the shaft survey. Margaret Heywood for help in measuring the 1843 Meer Possessions on the Vein; the Archivists and staff at Derbyshire Record Office and Sheffield Records Office, also the Librarian and staff of Derbyshire Local Studies Library who were extremely helpful. Much appreciation and many grateful thanks to the Magpie Cottage team for their help, support, materials and many cups of tea. Our very grateful thanks to the farmers on whose land the vein lies, who gave their consent for access, for us to erect our winch to descend the New Engine Shaft, and descend other shafts on the vein, also to walk the surface of the mine, namely Messrs Frost Brothers and Mr. Cantrell. Finally, a great big thank-you to the anonymous friend who loaned us the computer which enabled us to produce this article.

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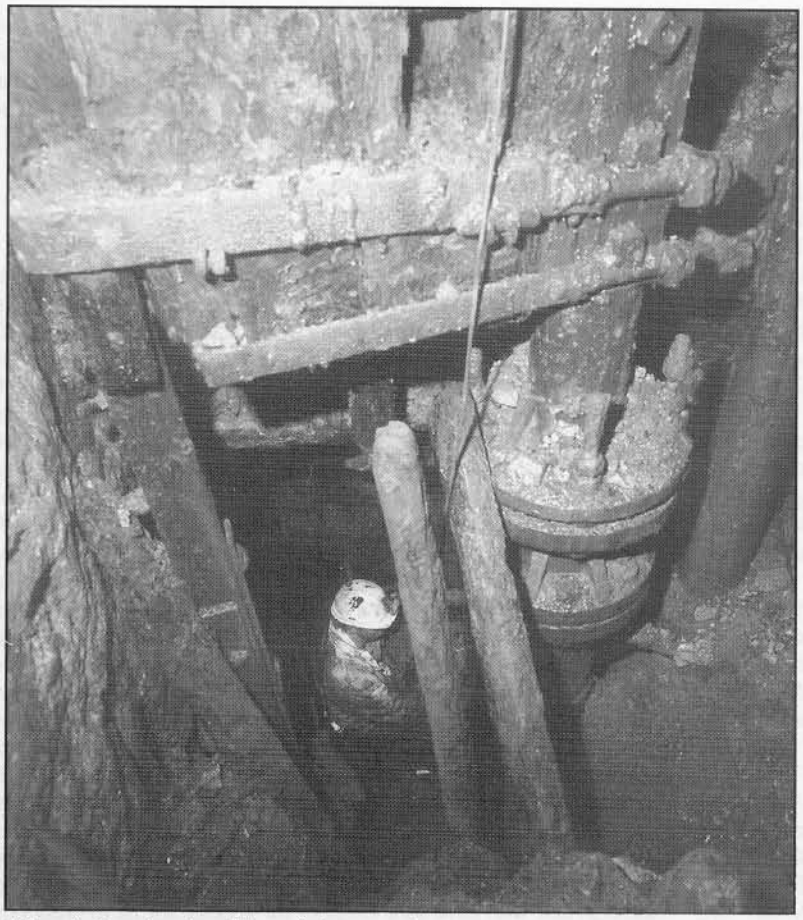
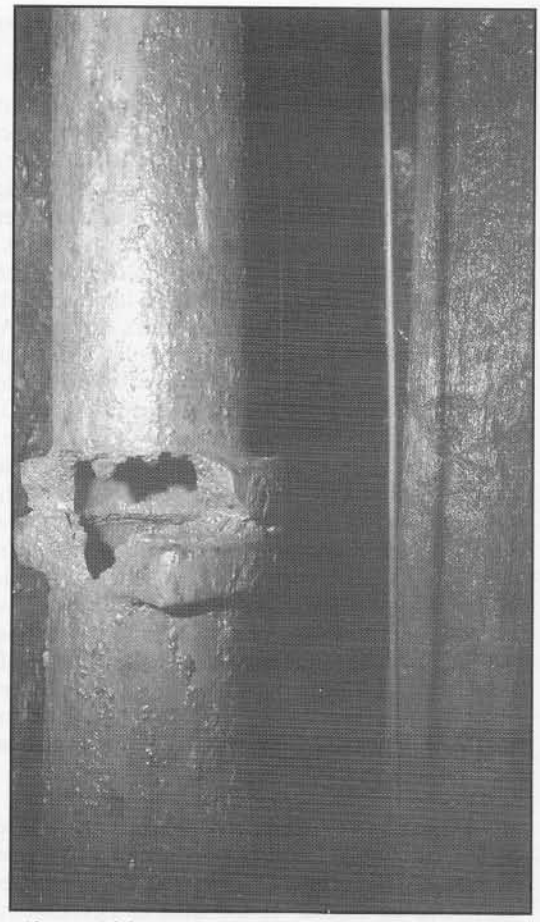


(Above) Crosshead and top of plunger pole.

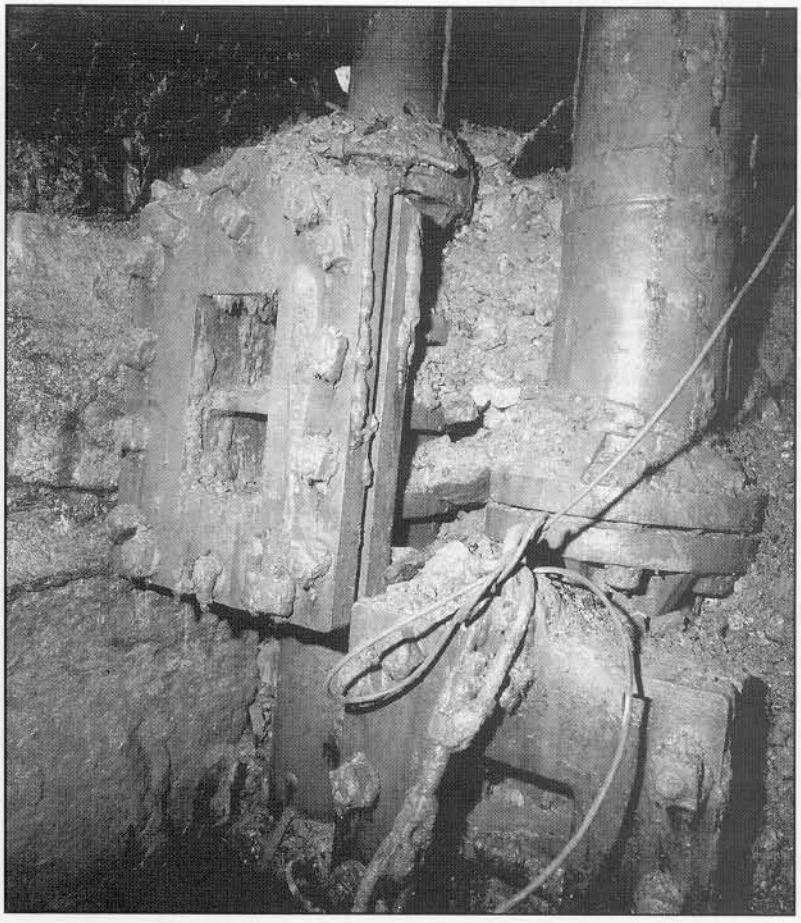


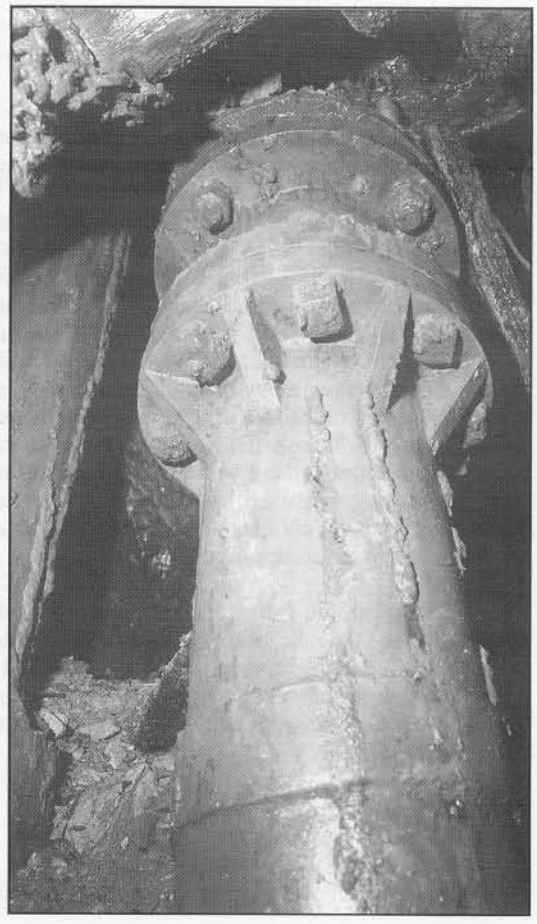
(Above) Rising main (broken flange) and pump rod.

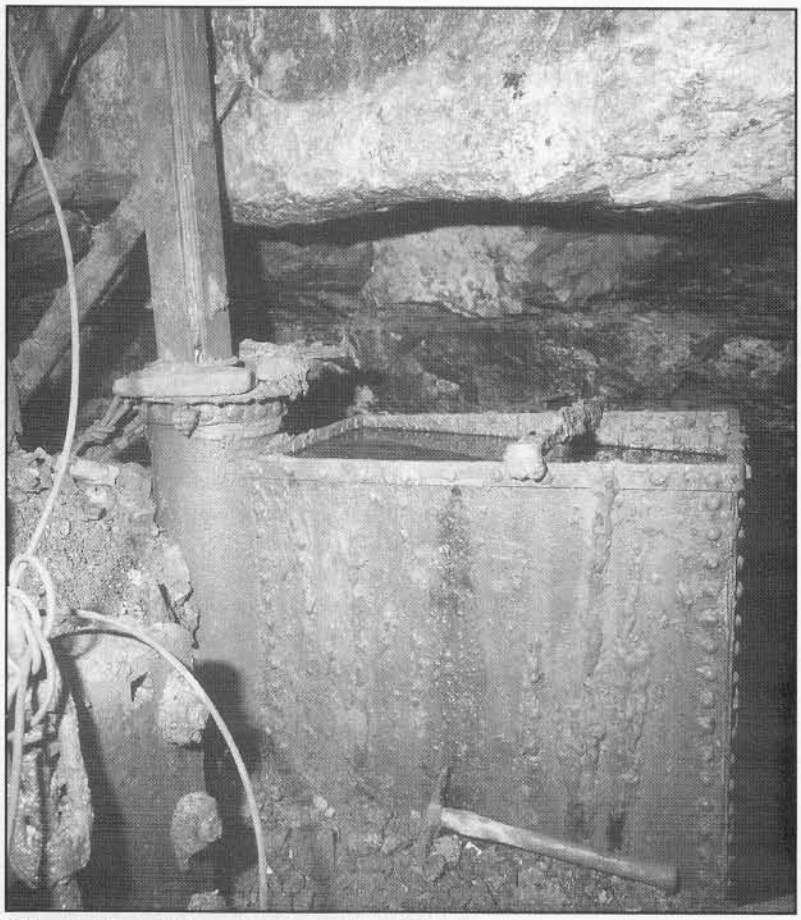
All photos by Paul Deakin.

Side-by-side clack valve boxes of the plunger pump.

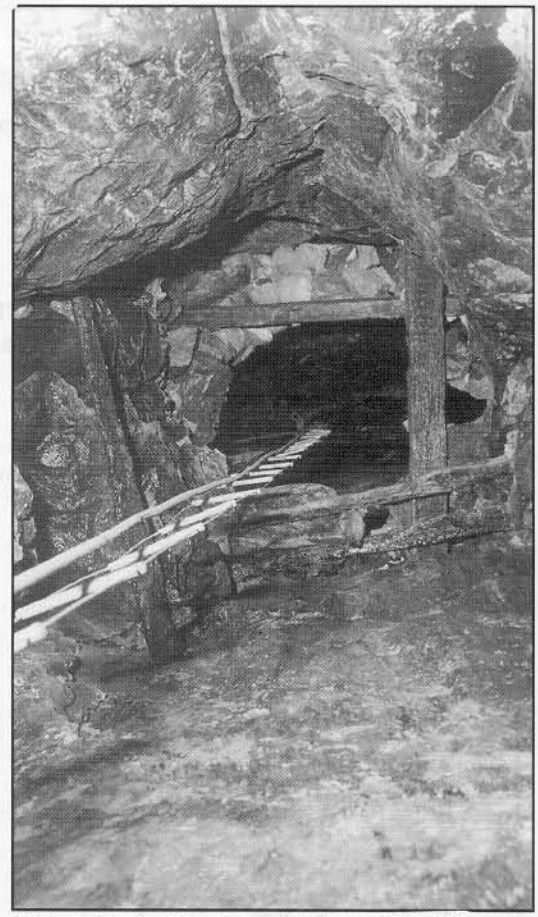
(Below) Plunger cylinder.







(Above) Wrought iron cistern and top of lift pump.

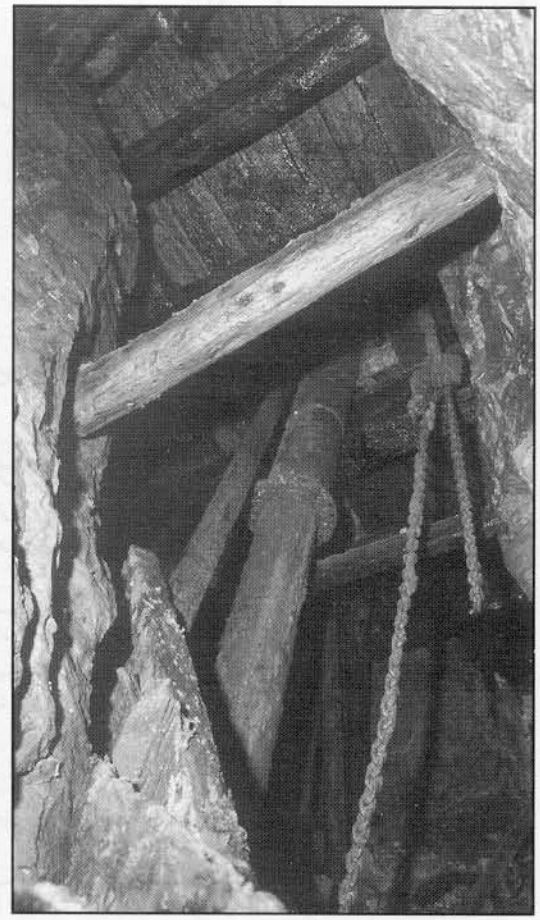


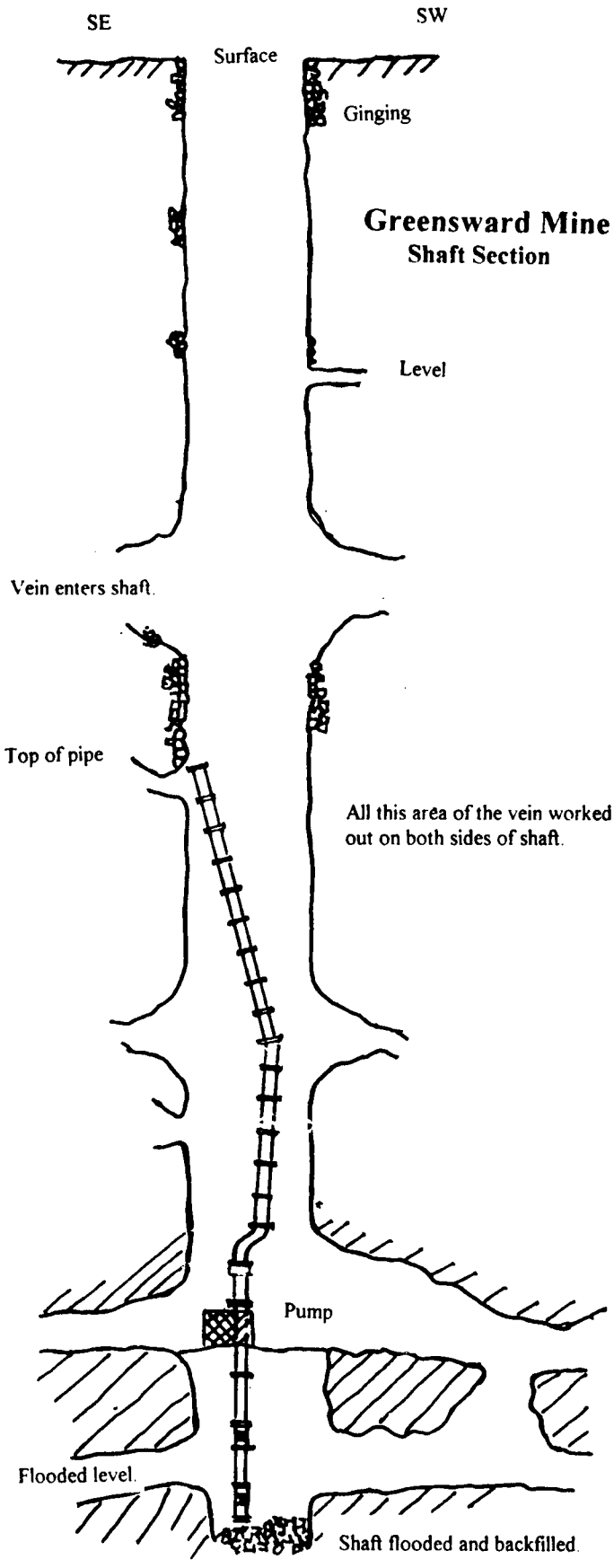
(Above) Underside of the winze west of the lift pump.

All photos by Paul Deakin.

(Below) Top valve box of the lift pump.

(Below) Underside of the plunger pump platform.





Note: the horizontal scale is exaggerated for clarity.

Bearings were taken throughout the shaft on the 120° bearing and on the 210° bearing (magnetic) and will be referred to as the SE and the SW for clarity.

All depths and sections in the shaft were taken in metres and the pump-pipe (rising main) and the pump rod were measured on the survey. The horizontal scale is exaggerated.

Depth and cross-sectional measurements are in metres.

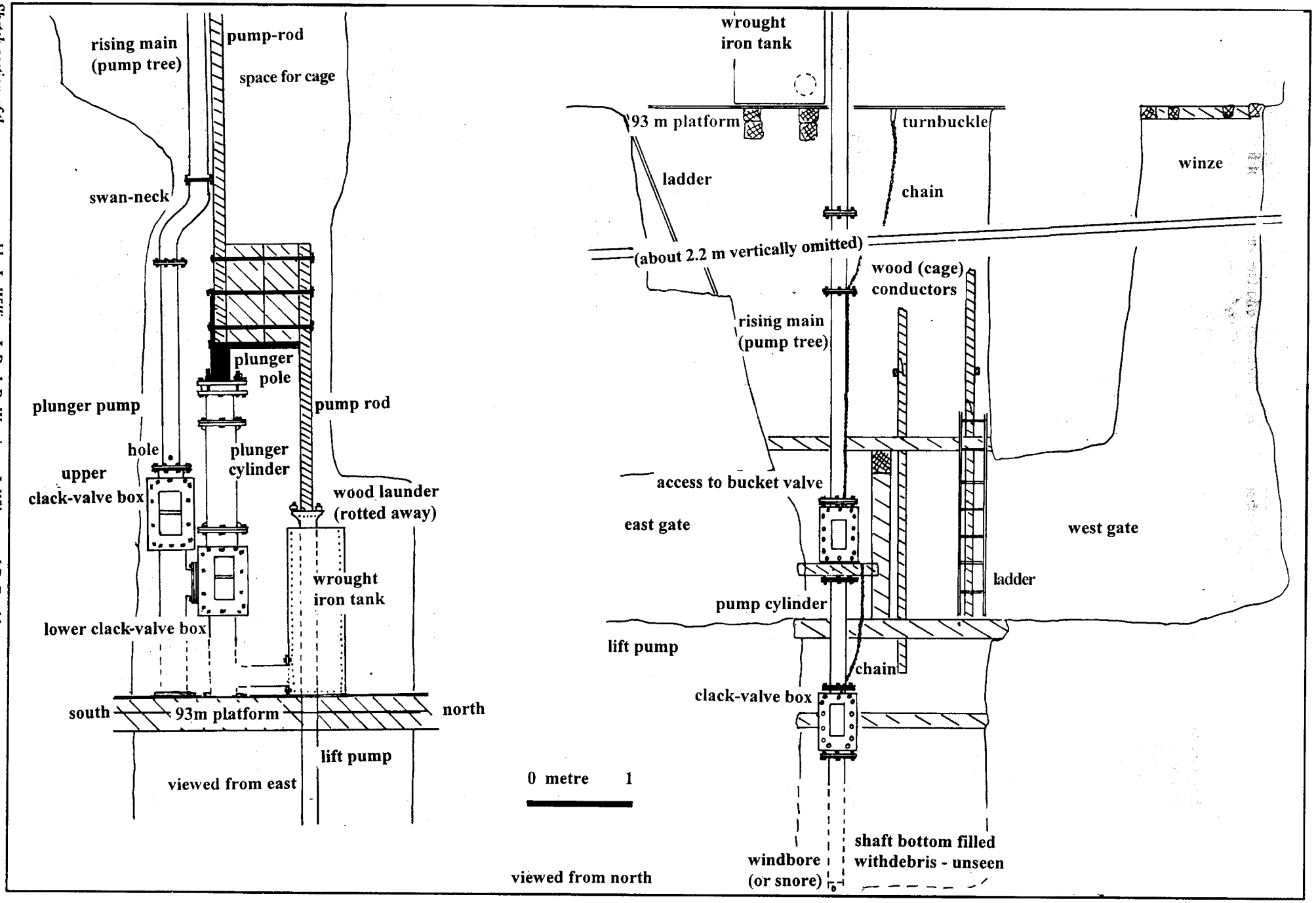
Surface cross-section: 1.70 SE x 1.00 SW

5.2	End of the ginging. 1.9 SE x 1.2 SW
12.8	Timber square work and toadstone in the vein. SE wall dry stone wall in the vein down to 15.8.
15.8	End of pack on SE wall.
23.8	Shaft is ginged all four sides down to 27.0
25.3	Level off the shaft at 255° and turns right after 3m. Not followed.
29.0	1.9 SE x 1.2 SW
38.3	Shaft widens and vein runs into shaft due to hade. Vein about 1.0m wide. 1.9 SE x 2.2 SW
39.0	Vein open to NW.
45.0	Vein in shaft completely. 2.2 SE x 1.9 SW.
50.0	Shaft size is back to normal dimensions and is open on both the SE and SW directions. 1.9 SE x 1.9 SW. Vein is dry-stone packed on the SE wall.
53.0	NW wall vein has not been worked.
60.0	Top of pump-pipe. Vein open to the SE,.
65.0	Start of the pump rods and timbers across shaft supporting ginging. 1.8 SE x 1.6 SW.
71.0	Packed wall in the vein to the SW.
73.0	Splice plate on the pump rod.
79.0	Vein open to the SE.
82.0	Vein open in both directions with travelling way not followed. Also splice plate on the pump rod. Pipe is leaning to the NW and one of the flanges has been broken-off completely with part of the pipe.
85.0	Splice plate on the pump rod.
86.0	2.5 SE x 1.1 SW. Vein packed in both directions from the shaft.
93.0	Broken flange on pipe.
96.0	End of the vertical pump pipe and start of the swan neck pipe to sump.

The vertical pump pipe in the shaft was found to be 155mm bore and each pipe was 2.74m long. Each flange was found to be oval in shape with two bolt holes in each flange. The flange is 380 mm long and 254 mm wide and 45mm thick with the bolt holes being 45 mm in diameter. The bolts were HRH 32 x 140 mm. The pump rod was 150mm square and the rod was spliced on both sides. Both plates were 2.134m long and 100 x 16mm in section. On one face the six bolts started 75mm from the top of the plate and then at 38 mm centres with six bolts used. On the other face the bolts started at 150mm then 455mm, 305, 305, 305 and 455mm centres.

Survey of the New Engine Shaft of Greensward Mine by D. Warriner and J. Peel.

Sketch section of the pumps measured by L. Willies, J. Peel, D. Warriner, J. Wilmot and R. Buckley.



APPENDIX: Survey of Greensward Mine (New) Engine Shaft Pumps, Sheldon (Ashford South Side Liberty) SK 163673 on 24 September 1995. Measurements by John Peel, David Warriner and Lynn Willies and on 8th October: by Roy Buckley, John Wilmot, Lynn Willies.

The preceeding figures and plates show the long section of the shaft together with the detailed external construction of the two pumps. Detail of the very bottom of the pumps was not available due to the water and debris in the bottom of the shaft, so the windbore (the "sucker-pipe") of the lift pump was not visible.

DESCRIPTION OF THE PUMPS AND PUMPWORK

There are two sets of pumps, the lift pump for raising water from the bottom of the shaft to a rivetted wrought-iron tank and a plunger pump for lifting water from here further up the shaft, possibly, into a side level though there is no evidence of this other than that the pump pipes do not, today, reach the surface. The tank and plunger sit on a timber platform at about 93 m. depth, with below, at about 98 m., a further platform to service the lift pump valves. Though not seen, the bottom of the shaft is unlikely to be more than about three or four metres below this lower platform.

The shaft and timberwork

The upper part of the shaft, above the plunger pump, varies in size, but is very small for the purpose, sometimes no more than 2 x 1.2 metres. The top section is sunk through rock, but the vein is seen in several places, causing the shaft in such places to be wider, and to be secured with stone ginging and timber. The larger dimension is along the vein direction, which at the plunger platform ranges 120°/300°. It appears similar to many 18th and 19th century horse-gin shafts, with a fine oval ginge. In the shaft above the plunger pump chamber, shallow socket-holes show that stemples have formerly been placed in the shaft, and since there are more than would be needed for the rising main, this suggests either the shaft was divided by a timber brattice, or possibly, in view of the remains lower down, conductors for a cage, for which there is also documentary evidence.

The shaft, just above the plunger pump platform, is opened out to form a small chamber, below which the shaft has been sunk to a slightly larger size, about 2 x 2 metres. The plunger pump chamber is made within the rock just to the south side of the vein. Working in the vein has formed a passageway about 3 m long to the west of the chamber which leads to a climbing winze down to the lower platform. Most shot holes in the shaft, and those in the adjacent level in the vein east of the chamber, are small (c. 20mm diameter), again similar to those common in the 18th century and first half of the 19th (as seen at nearby Magpie in workings of known date), whilst those of the chamber (and at a level east from the lower platform) are about 25 mm diameter or slightly more, typical of the mid and late 19th century. They all appear to be less than 30 cm. deep, indicating hand-drilling. A few of the wider holes were also noted in the upper part of the shaft and appear to be associated with minor widening or removal of obstructions.

The platform in the lower part of the shaft is today reached from the small winze west of the shaft (see photograph), but formerly a ladder also gave access from the east side, where at both platforms, levels have been driven eastwardly, and probably there was another access at the west side of the cage conductors. The vein is here hading slightly to the north, which resulted in the chamber, still within the rock, being slightly wider than the plunger pump chamber above. Working of the vein gave access west to the bottom of the winze, and east to a passage under a back-filled, timber-supported stope, which rises to form the floor of the level above. The plunger-pump platform can from here be seen to be supported on two large cross-timbers, one under the tank and one under the pumps, each support made up of two 250 mm square beams one on top of the other and about 2.2 m. long, let a small way into the walls. Except for where the conductor rails passed through, the other parts of the floor are on thinner cross-timbers, 150 x 100 mm, floored with 150 x 50 mm planks. The supports for the lower platform were not examined. Except for the braces which held the wooden conductors, arrangements below the lower chamber were not visible.

The lower platform gives access to the door pieces of the lift pump at the upper valve door level with slightly less easy access to the lower door, and has remains of permanent ladders, which led to the plunger pump platform above, in two stages within the shaft itself. The shaft is spanned by rough timber beams, 15-20 cm diameter to secure the pumps, whilst lighter timbers (about 100 x 50 mm) survive braced by the walls on at least three sides to form a frame holding wooden conductors or guide rails in place for a cage. The lighter timbers are secured to each other by large wrought iron staples. The conductors, each 100 mm x 60 mm timber are held vertically to the next by a short, bolted, lap-joint, though the method of securement to the frames is not clear due to their partial collapse and the debris. Marks on the conductors show they had been used. The measurements that were possible suggest a cage of about 600 x 1200 mm (2 x 4 feet) would be the largest external size possible, and a rather smaller length is likely. There were no arrangements visible to show how it was loaded, but a strip of flat-bottom rail was found at the lower platform which suggests a rail track was used.

The winch chair, when weighted, appears to suggest the vertical position of the upper part of the shaft was above the plunger pump (especially useful, of course, for manoeuvering the heavy parts on a rope) and it appears that the guides necessary for winding in the tight conditions were at the west side of the shaft, and slightly inclined west from the vertical as they passed through the plunger pump chamber *en route* to the lower chamber and shaft sump.

The rising main and reciprocating rods

Part or all the rising main from the plunger pump is still in position in the shaft, though its supports have rotted and it has bent and slumped so that it touches the opposite (west) wall of the shaft. It is about 15 cm diameter internally, and the pipes are fastened to each other by an unusual design of an oval flange held by two end bolts only. At its lower end, a "swan neck" section with conventional 8-bolt flanges connects it to the top of the upper valve box. The wooden rod or "spear" which took power to the pumps also rises in the shaft, but the remains are less in height than the rising main. It was originally about 150 x 150 mm square, and connected by plates 2.4 m (8 feet) long to the round section of the plunger pole. The rods are joined to each other with 12.5 mm thick iron plates on all four sides, bolted at 300 mm intervals. The two pairs of plates at each joint are vertically offset by 150mm. The length of the lowest rod, assuming it was tapered throughout the length in the joint beneath the plates, is about 16.6 m. The connection of the rods for the two pumps is considered below.

The lift pump

The lift pump has two (box-like) door pieces and covers placed in-line, with below a section of pipe, mainly hidden by water or debris, which would be the wind-bore or snore with its "pepper-pot" strainer in the sump. This was unlikely to have been more than three metres long. The door pieces gave access to the lower clack valve placed in a taper in the door piece, and to the upper clack valve which would have been carried on the piston. As it was not strictly necessary to have two doorpieces, this was obviously considered to have been more convenient for attending

to the valve as opposed to lifting out the whole rod and piston. Both doorpieces were closed by bolts, but were also suspended on chains, the uppermost apparently held by a long adjustable screw suspended from the platform above, the lower to a chain placed around the pipe just above the upper doorpiece, secured by a turnbuckle to the door below. The cylinder between the two door-pieces was, flange to flange, 1.3 m, suggesting a maximum possible pump stroke of around 1.1 m. The lift pump is slightly inclined within the shaft but keeping within the northerly hade of the vein, thus keeping the relationship with the vein suggesting it was intended the shaft would be later sunk deeper. The uppermost of the two pipes above the doorpiece is made of rivetted iron: all others are cast. It is of slightly greater external (and internal) diameter than the lower pipe, and would be much lighter, which would have been helpful if sinking the shaft further was anticipated.

The top of the pump pipe or "tree" rises just behind (west of) the wrought iron tank on the plunger pump platform, and discharged via a (now largely rotted away) wooden launder head into the wrought iron tank. The splayed-out top of the pipe to which the launder was attached was rivetted to the pipe below. The necessary wooden pump rod (100 mm x 100 mm approximately) which enters the top of the pipe, branches off the main pump-rod as shown in the diagram and photograph, with a crosshead formed by two substantial blocks of timber between the two wooden rods held by wrought iron clamps. It is reinforced above the pipe by iron plates fastened as on the main spear described above.

Because of the large amount of debris, and our reluctance to disturb material which may be strengthening or bracing the shaft above timber support of dubious merit, the drawing of the plunger pump had to be done from two sides, from the west at the top and the east for the centre and base, whilst a large part of the the base was obscured by debris, and not visible, except that the pipe leaving the tank was partially visible from below. The view as drawn is thus a composite, as though viewed from the east side.

The wrought iron tank was some 1.53 m high and 860 x 530 mm. in plan, with the plates rivetted together, and provided with a small overflow hole some 50 mm from the top on the south side. The connection to the plunger pump was from the side near the base. The detail of this remains conjectural because of debris, but is likely to be very similar to that shown in the diagram.

The plunger pump seen from the east side is dominated by the two door pieces, one placed higher than the other. The doors were not flat plates, but obviously had a section inside which clamped directly on to the pipe, possibly to reduce the area exposed to the high pressures. The doors covers were bolted on, except for one missing bolt. A small length of chain with a turnbuckle hanging fom the right-hand door showed how the door could be suspended during opening. No chain was connected to the left door piece, suggesting the other chain was switched over when necessary.

The right-hand (north) door piece was surmounted by the plunger cylinder and stuffing box, into which the circular iron plunger on the end of the main pump-rod operated. Its diameter as seen above the stuffing box was about 200 mm. The stuffing box had longer bolts to allow tightening of the gland. The length of the plunger pipe shows that the vertical reciprocating motion of the pump rod would be less than a metre (which would clearly be the same for the lift pump also). The two door-pieces were connected via a pipe leaving the left side of the right box, joining via a flange joint and tee to the pipe below the left (south) box. The upper part of the door piece had a flanged connection to an "swan-neck" piece to place it below the main section of the rising main going up the shaft. A hole crudely formed above the valve box on the rising main was presumably to empty the pipe for repairs, and was probably plugged using a taper and compressible material, and was perhaps further secured by a clamp. A circular clamp was placed at the first flange-joint above the left door piece. Its function may have been to cure a leaky joint.

DISCUSSION ON THE PUMPS

Being able to see nearly all the detail of a set of lift and plunger pumps in the installed position is a rare experience. A lift pump from Wills Founder at Winster is displayed in the Peak District Mining Museum, but the example here has significant details different in its installation. No one appears previously to have described an installed plunger pump and, although both types of pump are well illustrated in catalogues and books on mining technology of the period the actual problems of installation are only understood by examining an actual installation, especially, as here, when workings of an earlier period have to be adapted to a later technology, requiring some degree of adaptability from the engineer. Probably these pumps were installed c.1880 in workings largely made during the 18th and early 19th centuries. This is not necessarily in conflict with the documentary evidence of the shaft being sunk after 1871: it may either have been a re-opening, or have been sunk to meet exisiting workings below, which was the practice followed at Magpie in 1823-24 (Willies *et al* 1980 p.9) for example.

That the pumps had a very short-period use is suggested by the shaft below the plunger only being sunk a very short distance before abandonment.

The short stroke of the (probably 8 inch) pumps is clearly consistent with a small horizontal engine at surface operated via a crank, flat rod and an angle or tee-bob at the shaft head, which is also suggested by the shaft-top arrangements. The set-up appears a fairly conventional one in the sense of a lift pump for the shorter bottom lift, and a plunger for the longer upper lift. This allowed a better balance to the system, each stroke-direction delivering power, and reducing or eliminating the need for a balance bob. The lift pump was capable of working in mucky conditions and was more useful for further sinking. The valves could be repaired in case of flooding by withdrawal of the piston and by hooking the lower clack valve up the pump pipe from above. The plunger is more efficient for long lifts, but could only be repaired if the valve boxes were accessible, so had to be above the normal water level, or at least at a level which gave sufficient time for repair. Previous examinations by the "Op Mole" team suggest the shaft is flooded in normal summers to a level around the wrought iron tank on the plunger pump platform. The plunger pump was a little unusual because it had an outlet from the side of the door piece, unlike the more "usual" "H" piece illustrated in Cornish foundry catalogues where the tee-off is at the rear. Catalogues also suggest a more usual arrangement for the plunger pump was to have a windbore standing in the tank rather than emerging from the side. Together this made for a more bulky layout than might have a more "conventional" system in the very constricted conditions of the shaft, which suggests second-hand equipment was used. There would be plenty around in the 1880s.

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Lynn Willies.