

2: The Origins and History of Lead Rakes

Natural processes initially formed the lead veins about 270 million years ago. Over the last 2000 years they have been mined by people who depended on them as a source of income and sometimes wealth.

Geology and Minerals

The Bedrock - The formation of the rocks of the central Peak District is described succinctly by Ford and Rieuwerts [35]:

"The limestones of the White Peak were formed as sediment on the floor of a tropical sea in the Carboniferous period of geological time, some 310-330 million years ago, when Britain lay close to the equator. The shallow sea was warm and clear and inhabited by a multitude of shellfish, corals, sea lilies (crinoids) and various microscopic forms of life. When these died their remains accumulated as layer upon layer of shell debris which hardened with time to form limestone."

Lead Ore - The common lead ore of the Peak District is galena (lead sulphide). It occurs most commonly in veins in the Carboniferous Limestone, present as a result of mineralising fluids migrating into the faults and fissures several million years after the limestone was formed [1, 21, 24, 34-36, 46, 71]. The lead miners' term 'rake' applies to a major vertical or near-vertical mineralised vein. 'Scrins' are smaller veins. Other mineral deposits include 'flats' which are near horizontal deposits in the bedding planes between layers of limestone. 'Pipes' are irregular cavities that have been mineralised, with this often extending beyond the cavity to replace the surrounding limestone.



Small veins containing gangue minerals but not much lead ore cut through the limestone in this part of Coalpit Rake at Matlock Bath. A richer vein to the left was mined away several hundred years ago (© Paul Deakin).

In the past lead has had a wide range of important uses, including roofing, guttering, plumbing, pewter, musket balls and lead shot, and the manufacture of pigments and paints. Today, while most of these uses have gone, it is still of some importance for the manufacture of batteries, alloys

such as leaded-bronze, lead-solder, leaded petrol and as an insulator against radiation.

Other Minerals - Galena forms only a small percentage of the minerals present in the Peak District orebodies. Although lead was the most economically important in the past, several once discarded minerals have been exploited over the last 100 years. The most common of these useful minerals are:

- **Fluorspar** (Calcium fluoride) - Common uses include making hydrofluoric acid and other chemicals, anaesthetics, the fluorination of water supplies and toothpaste, refrigerant gasses, linings for non-stick pans and processing iron and steel slags. It was formerly very important as a flux in steel making.
- **Barytes** (Barium sulphate) - The main use is in heavy drilling mud for oil wells. Other uses include paint manufacture, glossy paper, barium meals and as a source of barium for the chemical industry.
- **Calcite** (Calcium carbonate) - Used for terrazzo flooring, pebbledash wall coverings and grave ornamentation.

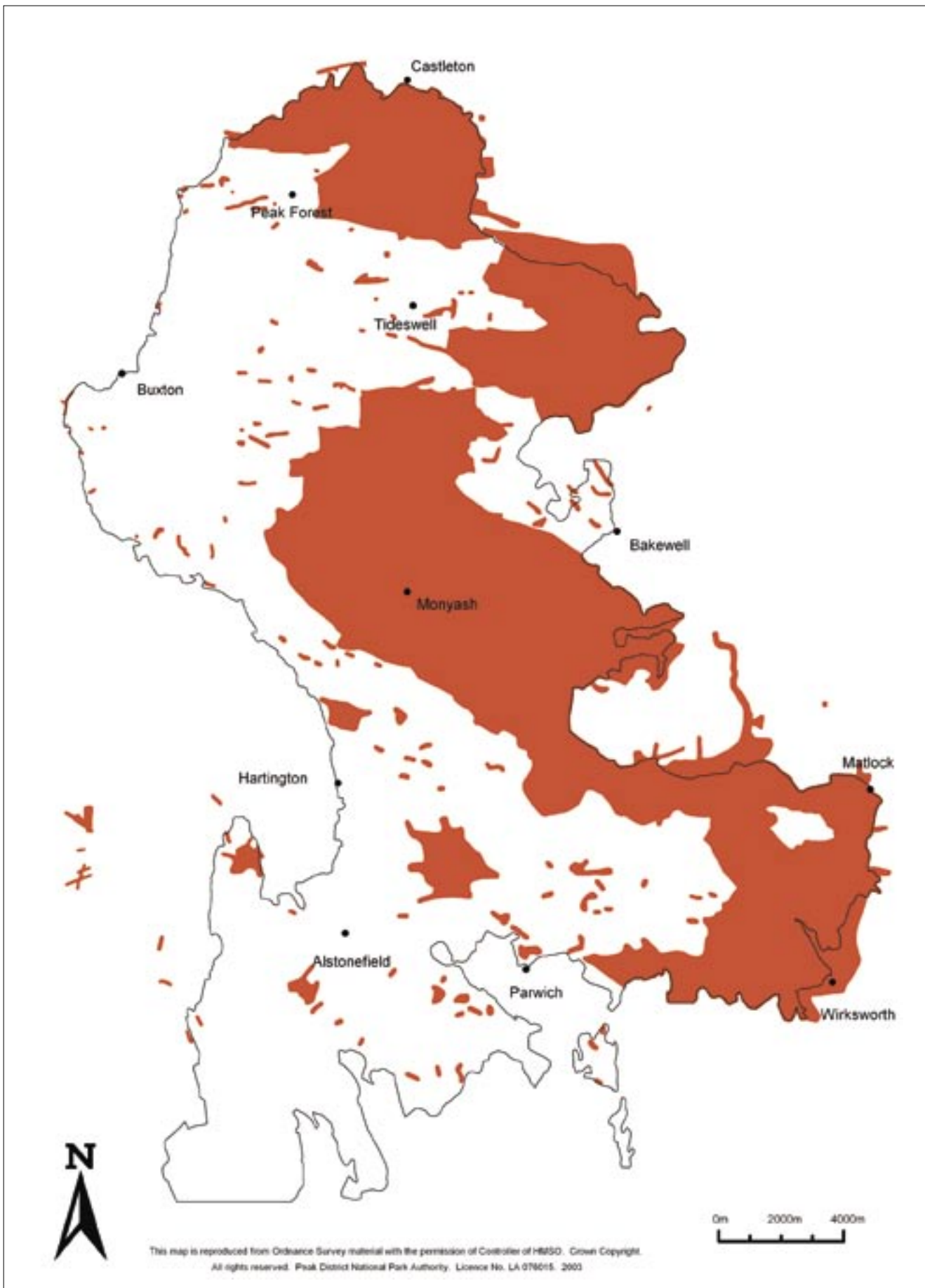
Mining History

Lead mining has been an extremely important industry in the Peak District since the Roman period. Mining was extensive in the medieval period and later reached a peak in the 17th and 18th centuries, before the industry all but collapsed in the late 19th century. In post-medieval times production was often on an industrial scale, the ore removed from deep underground with the aid of engines, and using pumps and drainage levels to de-water the mines. Mining was also commonly undertaken by miner/farmers across the orefield, who continued using simple methods to produce small quantities of ore to supplement other income [3, 7, 8, 11, 42, 44, 56, 74-76]. The lead produced from the mines was a vital part of the economy of the Peak District and was important nationally, lead being one of Britain's major exports.

Early Mining - Lead has been used in very small quantities for ornaments and ritual objects since Bronze Age times. Copper, one of the main constituents of bronze, was certainly mined at Ecton near Warslow, Staffordshire in the Bronze Age, sometime between 2000 and 1500 BC, as indicated by the recent discovery of a mining tool there which has been radio-carbon dated [12].

The main direct evidence for Roman mining in the Peak is the discovery of several inscribed lead ingots, known as pigs, found locally and as far away as Normandy. One of the main interests in lead ore for the Romans (and in later times) was that it is the main source of silver, often a small but significant component of the ore. In the Peak orefield they may have been disappointed, for the ores produced in post-medieval times were usually particularly poor in silver.

Documentary evidence for mining in Anglo-Saxon and medieval times is sparse, but enough is known to indicate lead mining was widespread and well established in the Peak. From at least the early 8th century through to the late 9th century mines at Wirksworth were controlled by the important Mercian abbey at Repton in the Trent Valley. After the collapse of the Danelaw in the early 10th century, many of the mines in the Peak were controlled by the English kings who owned large estates here. Domesday



The location of the orefield (red), centred on the limestone plateau (black line) at the heart of the Peak District.

Book of 1086 recorded significant lead production based at royal manors at Ashford, Bakewell, Matlock, Wirksworth and Crich, with a mention of further pre-Conquest production at Hope. Later medieval documentation gives a similar picture. Lead was in great demand in the 11th to 13th centuries to provide roofs and plumbing for the many cathedrals and abbeys built throughout England at this time; a significant proportion came from the Peak District.

From the medieval period onwards, and probably at earlier dates, much small-scale mining was carried out by miner/farmers, while larger ventures were worked by full-time miners. In medieval times all mines are likely to have been either surface opencasts into vein outcrops and/or underground workings that were rarely more than 30-50m deep, dug using simple methods and tools. In exceptional circumstances, as at the easily worked pipe deposits on Masson Hill at Matlock Bath, extensive underground mines existed and these are some of the largest identified metal mines of this date in Britain [10].

Distinctive small pickwork on all the visible rock surfaces indicates ancient working at the Nestus Pipes on Masson Hill at Matlock Bath. Here there are several hundred metres of pipeworkings, which were largely worked out by the 1480s, and today this is one of largest known medieval mines in Britain (© Paul Deakin).



Post-Medieval Mining - By the end of the medieval period most workable rich deposits were becoming exhausted above the water table. From the 17th century onwards, deeper and much larger mines were developed. This required investment capital for drainage and haulage, thus such mines were often controlled by the landed gentry and an emerging group of wealthy industrialists. Alongside the larger ventures, miner/farmers continued to supplement their income from agriculture by mining smaller veins at slack times in the farming year. Such mining continued to use the simplest of extraction techniques and underground workings were usually relatively shallow, entered by small shafts. Similarly, miners often had smallholdings to supplement income from mining.

By the 17th century, larger mines had become so deep that flooding of workings was a severe problem and drainage

levels known as soughs began to be driven to lower local water tables [48]. In a few instances waterwheels, both at surface and underground, were also employed for pumping. Another approach adopted at large mines in the 18th and 19th centuries was the installation of steam-powered pumping engines. Similar but less powerful engines were also used for winding ore up engine shafts at the largest and deepest mines. Other, and sometimes somewhat shallower, mines used less expensive horse-powered gin engines, which had been employed from the 17th century. Engines were essential at all mines where winding shafts were over 50-75m deep.



Some of the larger 18th and 19th century mines in the orefield needed high capital investment and had large buildings, as here at New Engine Mine above Eyam, where survivals include the 19th century horizontal engine house, now converted to a field barn, and remains of the adjacent boiler house (photographer Rebecca Penny, PDNPA).

One technological advance, which was eventually adopted by mines of all sizes, was the use of gunpowder for blasting. In the Peak District this was first used in the 1660s [9, 58], and had become common by the mid 18th century at latest. The use of gunpowder allowed ore to be extracted more efficiently, and shafts and levels to be driven through hard limestone far more easily.

These developments led to a great increase in lead output in the 17th and 18th centuries in the Peak District orefield. This was also linked to advances in smelting technology and changes in attitudes towards industrialisation that went hand in hand with a demand for the mined product. However, in the 19th century remaining sources of ore to be obtained at a profit became scarce and competition from other orefields such as in the Northern Pennines led to a decline in the importance of the Peak District mines. All mines in Britain found it increasingly difficult to compete in the second half of the 19th century as rich reserves were exploited elsewhere in the world, flooding the market and lowering the price that local lead could be sold for.

Lead mining in the Peak went into terminal decline in the second half of the 19th century. With the exception of the rich Millclose Mine at Darley Bridge, which worked until 1939, little profitable work was done from the beginning of the 20th century onwards. From the early 20th century to the present, lead mining sites have been extensively reworked for minerals thrown away by the lead miners, known by them as gangue. Those of economic worth are primarily fluorspar, barytes and calcite, while lead ore is still a valuable by-product.

Miners and Society - The formal organisation of the lead mining industry included a complex series of mining laws and customs, which directed how mining was to be carried out [7, 35, 56]. As with any industry, many local traditional terms evolved associated with Peak District mining. These include such strange terms, picked here at random, as bing (high grade ore), bouse (undressed ore), cackle mackle (inferior ore), foudenheads (small picks), knocking (breaking ore) and woughs (the walls of a vein).

The laws and customs were first codified and set down on paper in the Quo Warranto of 1288 [47]. By this date they were obviously ancient and may well have evolved in late Anglo-Saxon times if not before. The region was divided into areas of mining activity known as Liberties. On royal estates, which were extensive, the Crown has now held the lead mining rights and royalties for over a thousand years. Over recent centuries these royalties due to the Crown have often been leased out. Outside these areas there were a number of private Liberties where somewhat different mining customs often applied.

Lead mining in Derbyshire has been overseen by the miners' Barmote Courts since medieval times. Traditionally lead miners have been allowed to mine anywhere without hindrance from landowners except under churchyards,

gardens, orchards and highways. Payments were made of 'lot' and 'cope'. In addition, tithe was often paid to the church on the basis of the traditional belief that lead was alive in the sense that it grew again in old workings. The majority of income was retained by the individual miners or by the companies for which they worked, although any profit was often taken up by the costs of purchase of equipment and materials necessary to continue mining. The mineral rights for Staffordshire were all in private hands in post-medieval times and traditional miners' law had ceased to operate.

In smaller mines, the miners usually worked for themselves, often part-time, frequently in small groups. In many cases there were also non-working partners who contributed the investment necessary for materials and tools to make the mining possible. At larger mines in post-medieval times, companies of mining 'adventurers' were formed to provide the high levels of capital to develop deep mining. Here, miners were employees in all but name, although they frequently moved from mine to mine depending upon where the most money was likely to be made. Commonly pre-arranged bargains were struck, either as a price for the amount of dressed ore produced or for a specific non-ore producing task, each lasting a period of several weeks. Prior to the 19th century investors in mine companies were



Mr Eagle, the King's Barmaster, handing over a disused lead mine on Moss Rake at Bradwell to a new group of miners in 1906. They stand next to a small shaft entrance with hand windlass (PDNPA collection).

usually people in the lead trade or local landowners, who were well placed to calculate the risks involved. However, in the 19th century several speculative ventures were set up that relied on advertising for shareholders, many of whom lost their money as these mines never had any realistic chance of success. It was generally the lead merchants who bought, transported and smelted the ore who made the most money, for they did not take the risk that a mine would prove poor in ore.

At all mining ventures there was a social hierarchy. At the top were owners or lessees of the mineral rights, followed by mine owners and lead merchants together with the Barmote Court officials. Miners were held in relatively high regard and the more experienced and successful often served as jurymen at the Barmote Courts. Bottom of the list were the general labourers underground and the surface workforce.

Normally it was men who worked down the mines doing the heavy work, with boys carrying out lighter tasks. At many mines woman and children did much of the surface ore-dressing. However, men sometimes carried out the heavier work here, winding the ore from underground, helping sieve the ore and emptying buddles.



Women did much of the surface work at lead mines. At Gildereye Mine above Matlock Bath in about 1770, a woman sieves ore in a vat of water, while the men gaze into the distance (Lynne Willies collection).

Mining has always been a hazardous industry and it was inevitable that fatalities occurred. For example, men falling, drowning and being buried by roof falls were recorded in the Peak Forest Liberty where, perhaps surprisingly, only seven deaths were recorded between 1752 and 1856 [38].

Lead Production - In 1700 Britain was Europe's largest lead producer and the Peak District orefield made a significant contribution [74]. At the end of the 18th century the price of British lead did not recover from a fall and the steep decline of the industry began as rich ore sources were developed in other parts of the world.

The fortunes of any lead miner or mine owner were very dependent upon the world price of lead, which fluctuated significantly over the decades. In some years the mines wouldn't make a penny. If the miners were lucky and rich ore deposits were found, large sums of money could be made quickly. However, this was very much the exception. It was the chance of making a fortune that prompted continued work and investment. However, if all investment and labour is accounted for over the last 500 years, it is debatable whether the Peak District orefield made an overall profit.

Many small-scale mines existed, often worked only spasmodically as a supplementary income to farming. It appears that small-scale mining was commonly little more than an informal form of poor relief, or a way of supplementing income to provide beer money or small sums to purchase other inessentials. In other cases full-time miners supplemented their income with smallholdings. In the parishes of Elton, Winster and Bonsall, which had many mines, this farming connection is still clear for many of the small fields surrounding the mines contain ruined smallholding field barns built for the shelter of stock and the storage of hay.

While the last large lead mine closed in 1939, the Barmote Courts still meet annually to administer any lead production as a by-product of the mining of gangue minerals. This extraction continues to be undertaken by local people working for themselves as 'tributers' or more commonly directly for larger companies. Some people working in the industry carry on the tradition of being part-time farmers or having other second incomes.