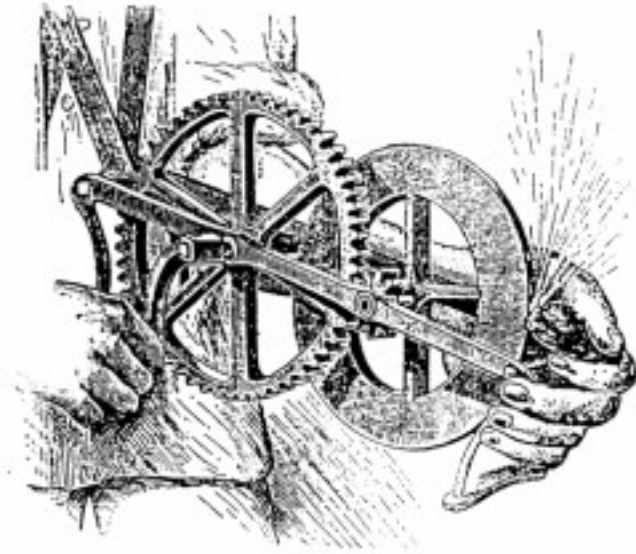


# The Carlisle Spedding Steel Mill

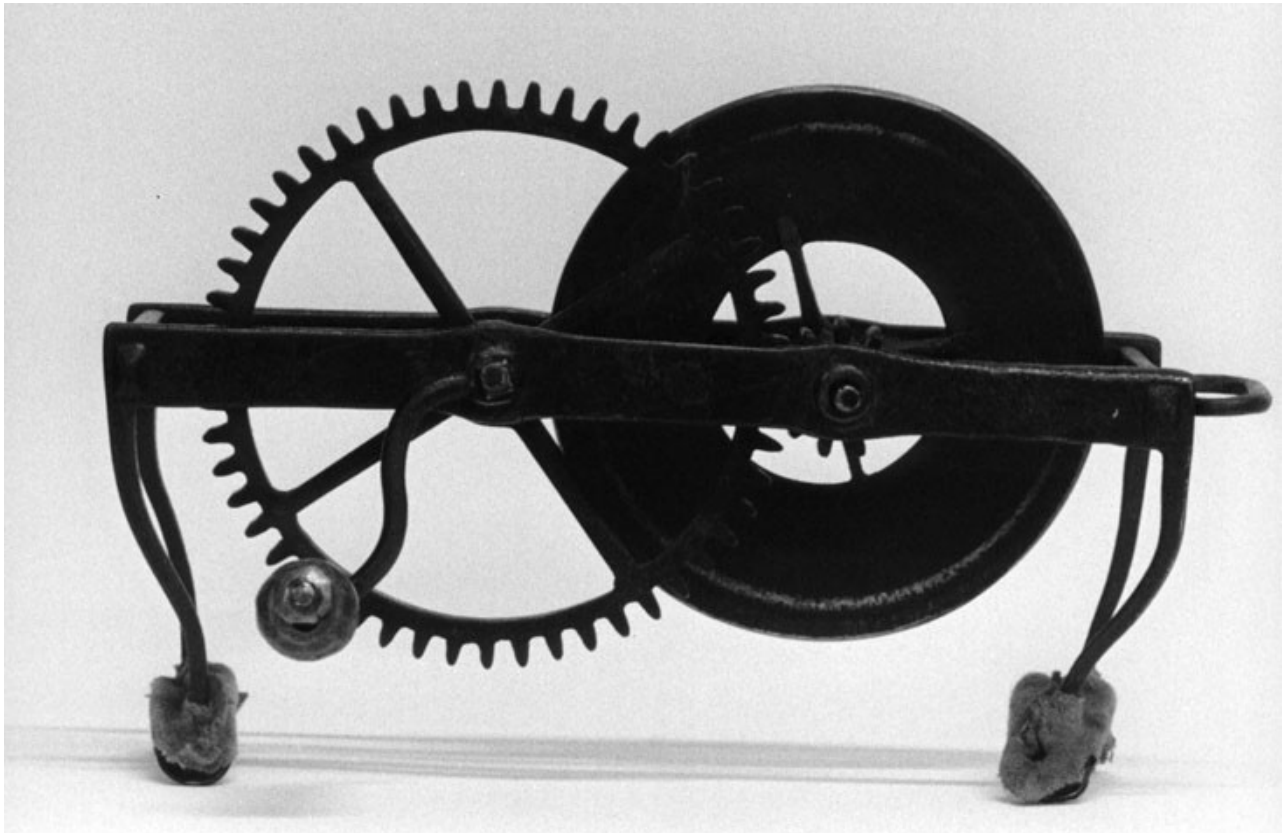
*Robert A. Kraft, Robert H. Samay and Manfred Stutzer*



*Spedding Illustration, From Roy, A History of Coal Miners of the United States*

The coal mining industry of England, in the century preceding Sir Humphry Davy's 1815 invention of the safety lamp, was one of great growth, change and increasing peril for miners. Industrial and urban development increased greatly the need for coal which pressed the coal producing centers to deepen their pits, extend their drifts and to put more men underground to meet this need. Some coal mining regions, notably the Wear and Tyne fields near Newcastle and later the Cumberland fields near Whitehaven, both in northern England, were faced with the explosive gas firedamp, or methane, found in pockets adjacent to the coal. The deeper the mine in these areas, assuming poor ventilation practices, the more dangerous the working environment due to catastrophic fatal explosions. For centuries, coal had been mined in northern England by candlelight but by the 18th Century open flames were considered dangerous and experiments in mining by the feeble light of phosphorus or putrescent fish were being tried. Fireflies in bottles and mirror-reflected sunlight were also attempted. "Blowers" or hissing leaks occurred in coal mines as gas pockets under great pressure were inadvertently opened during mining operations. In some cases these could be vented off or be allowed to empty. In others, fires or explosions could kill men, animals or damage mine equipment. Mines were sometimes intentionally flooded in order to stop a fire. In some circumstances men were said to have mined in total darkness rather than risk the chance of an explosion when they knew firedamp was present. Continuous fires underground called "Eternal lamps" were tried to burn the methane gases. "Firemen" crawling along the floor clothed in wet sackcloth with a lighted candle were occasionally used to pre-explode the firedamp before the beginning of a shift. Methane, lighter than air, would hug the ceiling. Into this world of "fiery" coal mines came Carlisle Spedding as a very young man in about 1710.

Carlisle Spedding's steel mill, a hand cranked lighting device using a shower of flint and steel induced sparks was created between 1730 and 1750 at a time when firedamp explosions in the coal mines of northern England were becoming an awesome threat. The steel mill with two bronze gears provided a rapidly spinning steel wheel against which a piece of flint was held. This produced a stream of sparks as a source of light. In August of 1737, while under

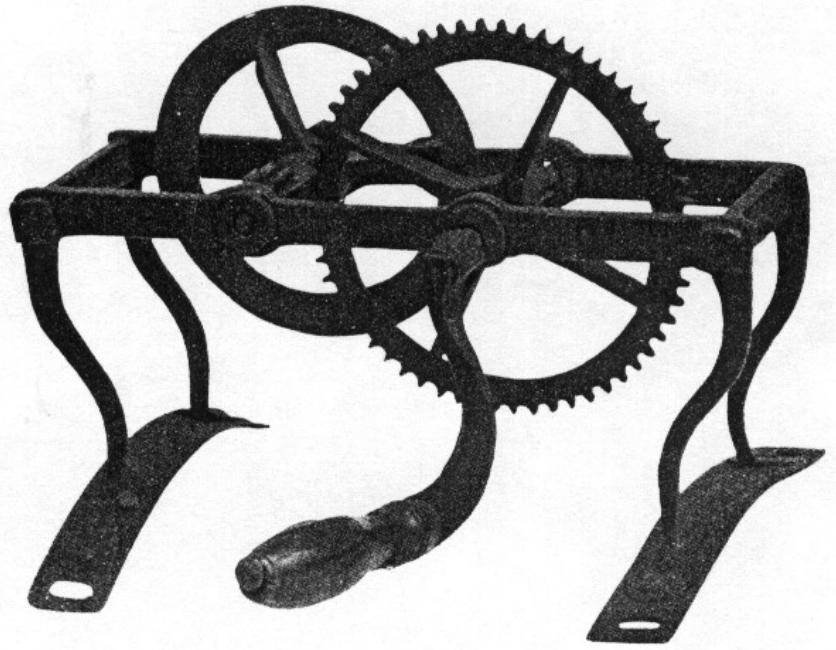


*Spedding Steel Mill, Science Museum, London.*

the supervision of Carlisle Spedding, a catastrophic explosion occurred in the Whitehaven Corpshill pit at 4:00 A.M. killing 22 men and 3 horses. The development of the Spedding steel mill may have been chronologically tied to this event. The invention and industrial application of the Newcomen atmospheric steam engine after 1711 allowed the mines to extend their extraction of coal to deeper veins with much more effective water removal. Water pumping before this was achieved by use of horse gins. James Watt's steam engine came later in 1769. The power stroke of a Newcomen steam engine occurred by atmospheric pressure when the steam in the cylinder was removed by water spray condensation. The power stroke of a Watt steam engine was made by the pressure of the steam itself. The Watt also developed a double stroke, not achieved on the Newcomen.

A gifted young man, born September 10, 1695, Carlisle Spedding was selected by the land-owner Sir James Lowther to develop the coal mining activity at Whitehaven. As a miner, he was burned in one mining explosion in his early adult years and was later killed at the age of 60 in another. Ironically his death was due to a Spedding steel mill induced explosion. Apparently inspired by others who had used flint and steel as a source of light and perhaps inspired by the wheel lock pistol which made sparks by pressing a flint against a spinning steel wheel, he developed his steel mill so that a boy could provide light to his companion miners without the use of an open flame. It was assumed, and mostly incorrectly so, that the sparks would not ignite methane in the air even at explosive levels. The steel mills were usually used in poorly ventilated dangerous areas where open flames were, by experience, feared. Those who "played the steel mills", or who knew about their behavior, could estimate the level of firedamp in the air based on the color and size of the sparks created. The sparks became brighter, more red and appeared to flow around the periphery of the wheel when increased firedamp levels were present.

Carlisle Spedding, known for his versatile engineering skills, is also credited with knowledge and mine application of the Newcomen steam engine, innovative techniques of deep mine development and the actual sinking of a shaft below sea level, out under the harbor of Whitehaven. He was also a pioneer in mine ventilation, a plan to use trapped firedamp to light city street lamps and the use of gunpowder underground to break rock. In 1721, Lowther raised his salary to counter an employment offer by the Newcomen Steam Engine Company. Later he became involved in shipbuilding, glass making, brewing and in 1752 designed and built a church in Whitehaven.



*(above) Spedding, University of Sheffield, England. Left-handed?*

These steel mills were used in England, France and Belgium from approximately 1750 to 1815 when the safety lamps of Davy, Clanny and Stephenson provided a much safer alternative to the open flame or shower of sparks. No documented evidence is available to confirm the use of the Spedding in Germany or America. No significant deep mining for coal before Davy in either country is reported. The Spedding was expensive to build (one guinea) and expensive to operate, requiring manual labor. According to Dr. Clanny, one repair mechanic was required for each six Speddings in daily operation. The authors of this paper speculate that gears in the machine would wear out or break and more important, the steel wheel needed to be dressed each day and periodically replaced due to wear. Because sparks are not created by rubbing flint against steel but by striking flint against steel, a smooth wheel does not produce the sparks of a systematically scored wheel. The wheel of a wheel lock weapon is deeply scored as is the wheel of today's cigarette lighter. The 5 to 1 gear ratio of the Spedding was probably created after great experimentation producing a steel wheel angular velocity of approximately 600 RPM, sufficient to produce good sparks. During the period of 1740 to 1815, a certain trust in the safety of this machine was widespread. This changed in about 1785 with significant erosion of this trust.

A series of firedamp explosion events occurred at the Wallsend colliery in Newcastle between October 1783 and February 1786. Wallsend was, at the time, the deepest mine on the Tyne at a depth of 630 feet. In each explosion, whether during mining activities, rescue operations or repair attempts, men were killed while using Speddings as their only lighting. It became very apparent that the steel mill would ignite firedamp. After this, the steel mill was used more cautiously but still preferred in areas where open flames were considered inadmissible. The Hebburn colliery, five miles from Newcastle, is reported to have had 100 Speddings in daily use. The conversion of mine lighting in hazardous mines to the new safety lamps after 1816 was rapid. Of interest, the same Hebburn colliery also claimed to be the site of the first

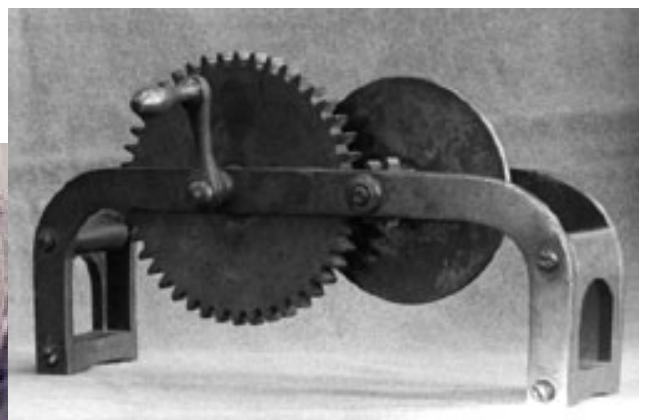
underground testing of the Davy in January 1816. During this 1816 testing of the new safety lamp concept, a miner, still working by Spedding steel mill lighting, was surprised and greatly alarmed at the approach of a Davy lamp which he took to be a candle.

Sir Humphry Davy began his research in the Fall of 1815 and reported to the Royal Society of London on November 9, 1815 describing the character of firedamp and its explosive qualities based on his studies to that date. He stated that firedamp was much less combustible than other inflammable gases and that it would not explode by red hot charcoal or red hot iron. It required iron to be white hot. These findings may help to explain the success-failure paradox of the Spedding.

Although hundreds, if not thousands, of these Spedding steel mills were used over a period of 75 years, few have survived the nearly two centuries since they were replaced. Today, the few surviving Speddings, held mostly by major museums, vary in design and construction significantly. This would suggest local blacksmith production at each colliery was the rule and that commercial production, used in the manufacture of Davy and Clanny lamps, may not have occurred for the Spedding.



*Portrait of John Buddle with First Davy Safety Lamp and Spedding.*



*(above) Brass frame and gears, steel wheel, Beamish Open Air Museum, County Durham, England. Photo by Robert Cross.*

*(left) Bergbau Mining Museum, Bochum, Germany.*

For you history buffs, the Whitehaven properties, owned by the Lowther family, the site of several pits of the Whitehaven colliery, was land confiscated by King Henry VIII in the 1530's from the St. Bees Priory at a time when the Roman Catholic monasteries were being dissolved all over England. The Wallsend colliery in Newcastle was named for its location at the eastern end of Hadrian's Wall built by the Romans in the second century A.D. For you musical buffs, Carlisle Spedding was a contemporary of Bach and Handel and had died before Beethoven or Mozart were born.



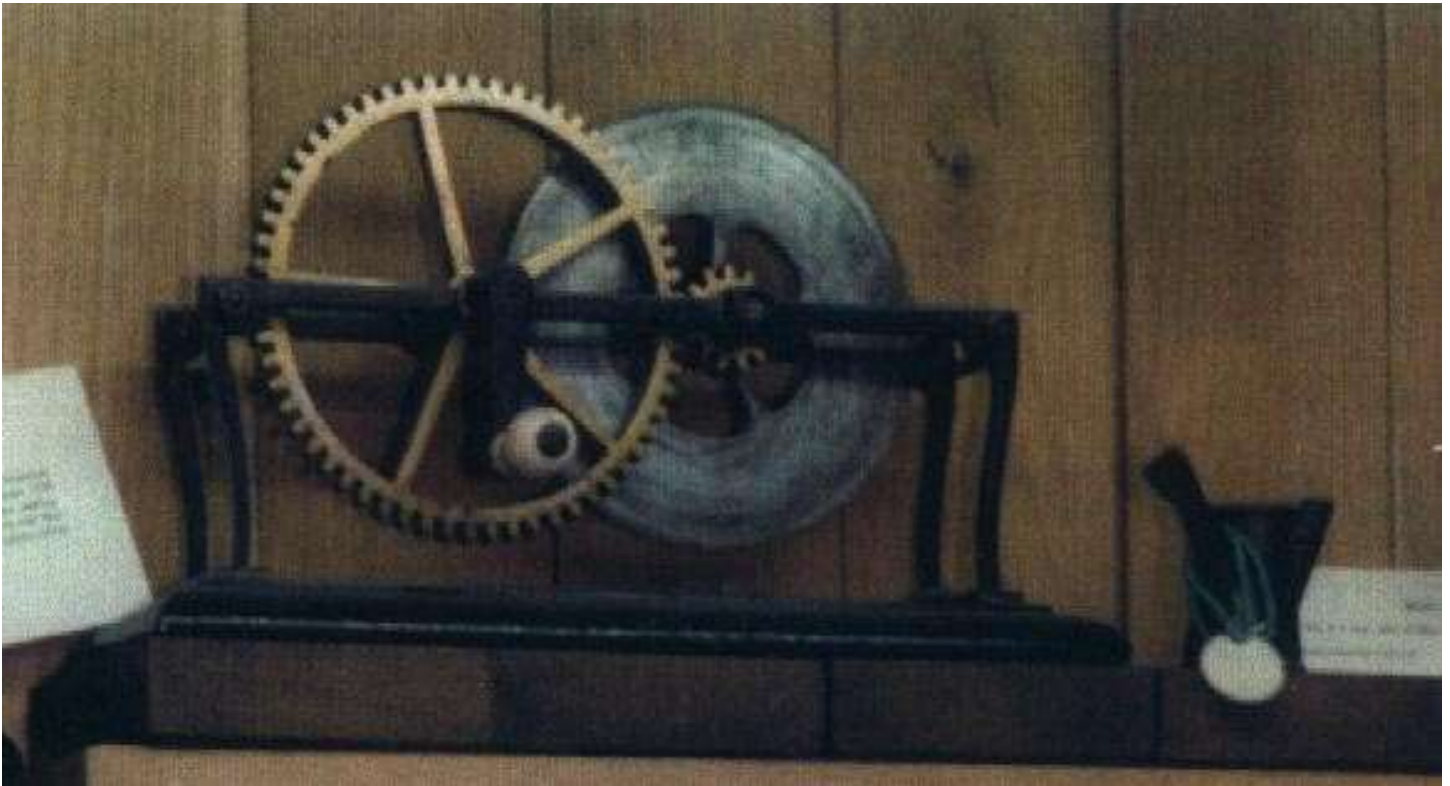
*Spanish book illustration from 1880, Spedding being used in the mine.*



*Hebburn Colliery, early 19th century illustration.*



*Wallsend Colliery, early 19th century illustration.*

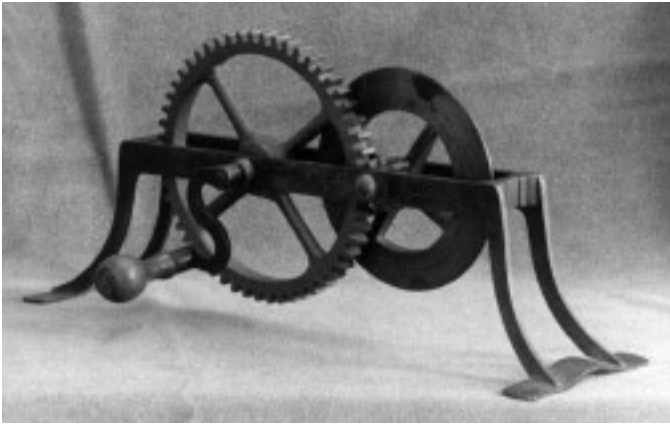


*Spedding, Newcastle-Upon-Tyne University.*

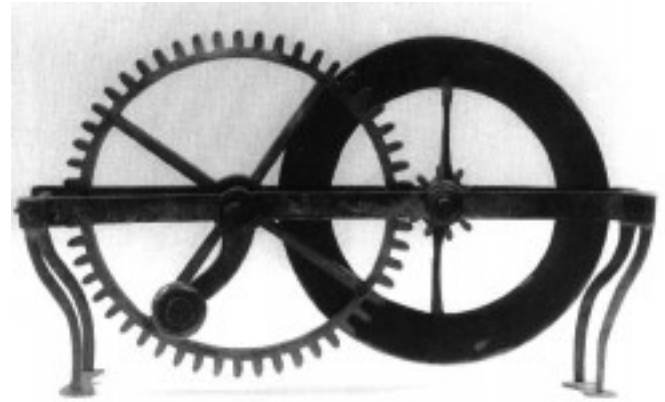
This thumbnail sketch of the Spedding steel mill reflects the troubled times of 18th Century English and continental coal mining. Although the feeble light of this ingenious machine carried with it most of the explosive hazards of open flame lighting, it may have saved many lives. It was one of the stepping stones that drove Dr. William Clanny in 1813 to plead before the Royal Society for a scientific solution to these many and frequent fatal mine explosions. Within two years, the Clanny, Davy and Stephenson lamps were beginning to offer a solution.

The Spedding steel mill was not really a lamp and it produced only a fluctuating feeble source of light with great effort. It was reported that several Speddings were occasionally used in concert at one location to produce adequate light. Historically this machine played an important role in the saga of mine lighting in that perilous period before Davy when the mine working environment was hazardous, men's lives were at stake, mine lighting options were few and the need for coal demanding. Carlisle Spedding died on August 8, 1755 in a mine explosion at Whitehaven.

**Footnote:** The California authors of this paper are in the final stages of producing a limited edition of authentic replicas of the actual Spedding steel mill in the mining collection of the Science Museum of London which the museum has owned for over 150 years. This project is proceeding with full cooperation of the Science Museum and was inspired by the late Henry A. Pohs.



*Steel frame & wheel, brass gears, Beamish Open Air Museum, County Durhan, England.*



*Hancock Industrial Museum, Newcastle-Upon-Tyne.*

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