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WALTER SYLVESTER - POTTERIES INVENTOR AND HIS FAMOUS INVENTION: THE SYLVESTER.

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Abstract: Pressure arch theory is used to illustrate the need for withdrawing props from the potentially dangerous waste area in a coal mine whilst the collier remains in a place of safety. In 1895 Walter Sylvester invented a device to achieve this which undoubtedly saved many lives. However, with mechanisation this versatile tool was inappropriately used and it gained a reputation for causing accidents. It fell from favour and this once common device has disappeared from modern coal mines for ever.

PRESSURE ARCH THEORY

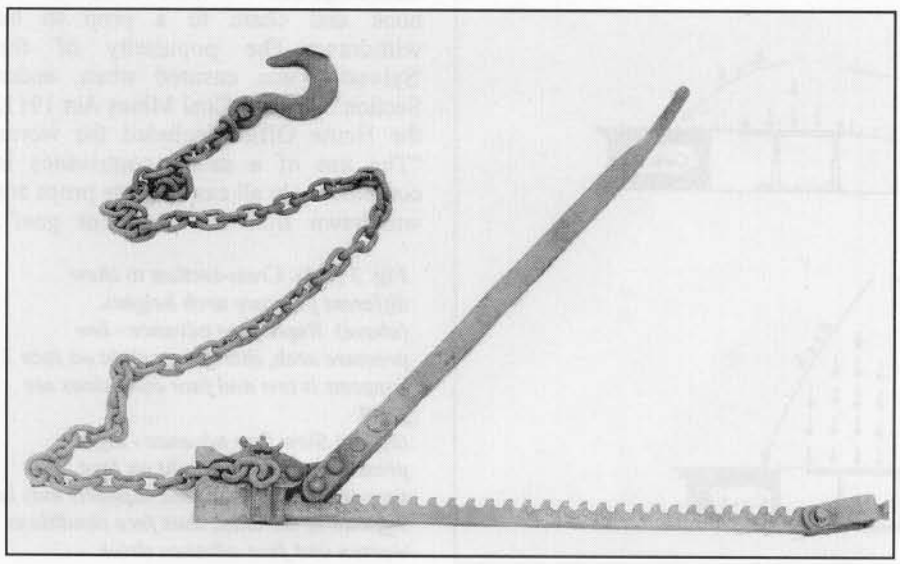
It is a popular misconception that underground mining supports take the whole weight of the strata up to the surface plus any houses or other structures built upon it! It should be obvious that, for anything but the most shallow workings, this strata load would quickly exceed the strength of the strongest of timber or steel supports. So, taking roadway supports as an example, what do the supports actually do? The commonly accepted *Pressure Arch Theory* states that the strata load from the surface is taken by the nearest points that can support it, i.e. the solid strata either side of the roadway, thus forming an arch shape, called the pressure arch (see Fig. 1). The roadway supports only have to take the strata load within the pressure arch. This load will depend on factors such as bed separation and strata shearing, pressure arch shape, but particularly pressure arch height.

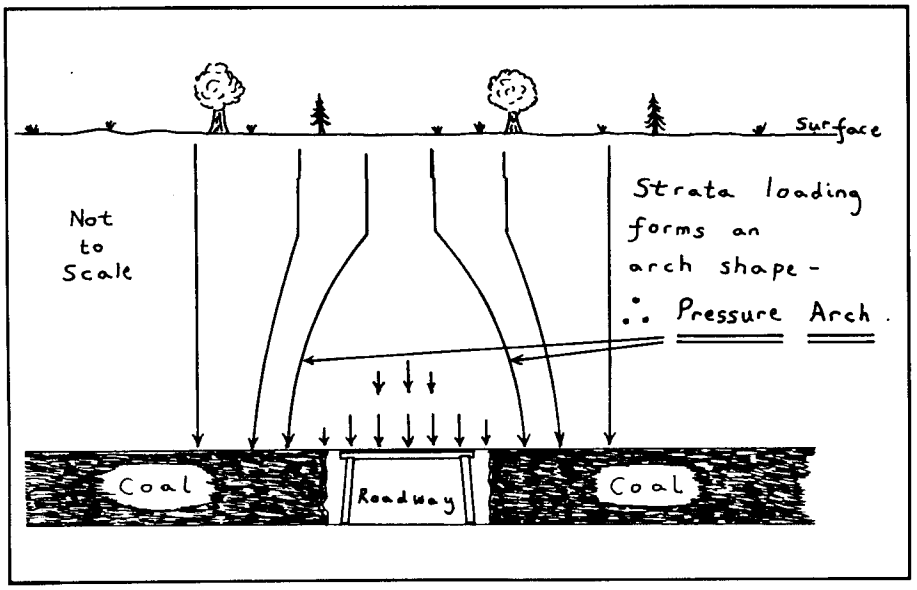
Turning to a longwall coal face; where strips of coal, typically 200 yards in length, are cut from the face allowing it to advance, it can be seen that the points able to support the pressure arch are the uncut coal directly in front of the face and the consolidated waste some distance to the rear (see Fig. 2). A modern coal face will have self advancing powered supports to provide a safe working area for men and machines, being advanced after taking off each cut of coal, allowing the roof to break down into the waste gradually. It follows that a low pressure arch is preferable to a high one as the actual load, taken by the powered supports will be less (see Fig. 3). This will be achieved by rapid face advance. It is an interesting problem that if the face advance is slowed by poor roof conditions, then this reduction in advance will itself cause the roof conditions to deteriorate. The ultimate result may be to lose the face altogether. On a modern mechanical face persons are prohibited from going behind the line of powered supports: it follows that little can be done to encourage the roof to break more quickly and hence consolidate sooner, again taking the weight off the supports, although modern powered supports are capable of taking a considerable load.

THE NEED

This was not the case back in time when face support was achieved by prop and bar systems. A line of solid 'breaker props' or solid wooden chocks (see Fig. 4) would encourage the roof to break quickly and cleanly directly behind the face. We now reach an anomaly - these props or chocks, once they have done their job, would then be in the way, preventing the next strip of roof from falling; hence they must be removed. It might be added that the colliery proprietor was keen to reuse as much timber as possible and, human nature being what it is, a collier requiring timber would be reluctant to travel the face and perhaps go some distance outbye to carry it in when he could see some a few yards away. Thus withdrawing timber from the waste would appear to be in everyone's best interest. The problem was that the waste was a very dangerous place with a "fall of roof" being imminent to say nothing of the dangers of gas. For example in 1908 Mines Inspector William Pickering reported "a miner knocked out a prop; a stone weighing one ton fell on him. The deceased, a clever and experienced miner, relied on his own quickness for escape. Many a fine miner has been killed in this way. Wild animals cannot escape a 'dead fall' trap and animals are infinitely quicker than human beings". In the Northumberland and Durham coalfields the mine deputy had a duty to provide timber for the workmen on his district, Mines Inspector John Atkinson (Emery, 1992) reported that fatalities amongst deputies "were higher than among the workmen they were there to protect". Whilst the press and the public expressed concern about deaths from explosions Fig. 5 clearly shows that fatal accidents in the "fall of roof and sides" category greatly exceeded any other cause. The Mines Inspectors were rightly very concerned about this and it was against this background that Mines Inspector William Atkinson recorded in

Plate 1. The Sylvester.





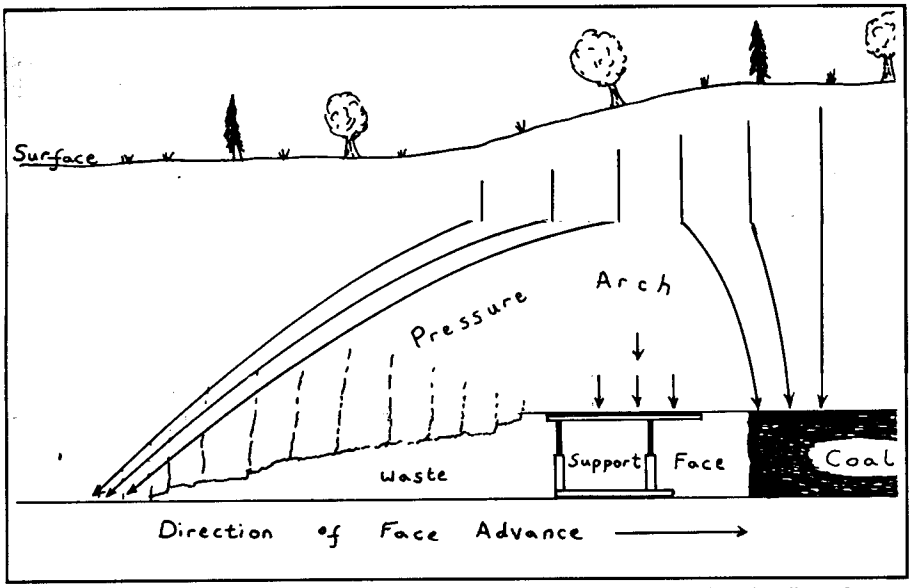
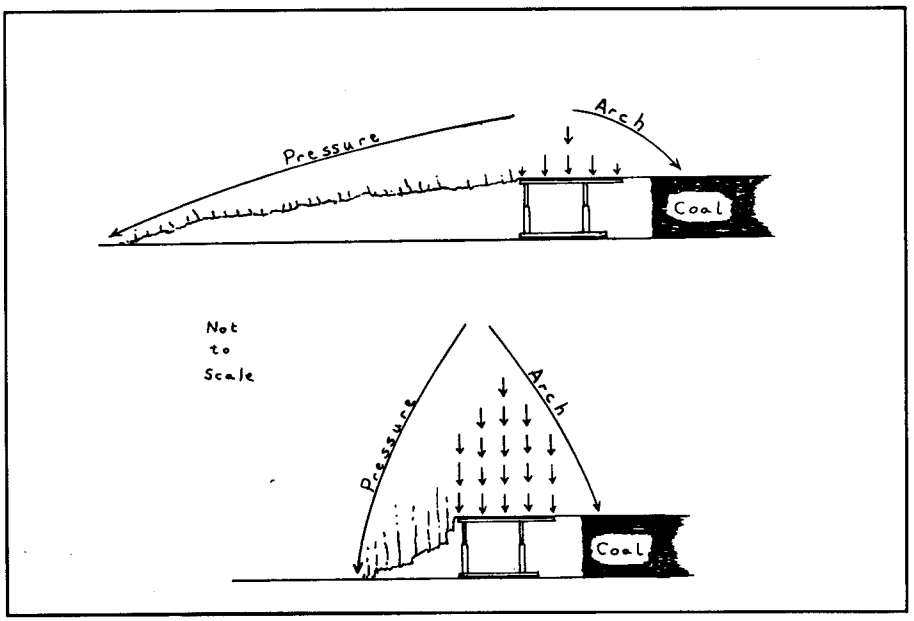


Fig. 1 (top). Cross-section above a mine roadway. Most strata and surface loading above the excavation are taken by the solid coal ribsides, therefore the roadway supports only take the weight of the detached strata within the pressure arch.

Fig. 2 (above). Cross-section above a mechanised coal face. Most strata and surface loading above the excavation are taken by the solid coal in front of the face and the consolidated waste to the rear. Therefore powered supports only take the weight of the detached strata within the pressure arch, which moves forward as the face advances.



1896 "My attention has been called to an ingenious implement by Mr. W. Sylvester of Tunstall by the use of which accidents while withdrawing timber appear likely to be reduced".

THE INVENTION

Although he described himself as "a Staffordshire Miner" it is believed that Walter Sylvester had commenced work in the 1880s as a timekeeper at the Institute Pit, Chatterley Whitfield Colliery, North Staffordshire (personal communication from J. Worgan, J. Jack and W. Jack) . With the active encouragement of E.B. Wain, the colliery manager, he invented a ratchet device which proved enormously successful for lifting, as a jack, or for pulling. It is the latter which is considered here. His invention was used extensively in this country and abroad and bore his name being called a 'Sylvester' (although in his own North Staffordshire coalfield it was colloquially called a 'Walter'). Such was its versatility that its use was not restricted to mines, although there is no doubt that this is where they were most common, and it had a variety of uses. The original specification (patent number 9396, dated 13th May 1895) calls it "an appliance . . . for lifting or drawing pit wagons, railway trucks and rails, tightening wires and cables, withdrawing pit props and other similar purposes". It was an improvement on previous devices in that it allowed considerable leverage to be applied; more than four times that of the traditional 'ringer and chain' (commonly called a 'dog and chain' or in Shropshire a 'dragon bar') (personal communication from I. Brown). The ratchet allowed the operator to rest after each exertion and it utilised a length of chain of any desired length so that the operator could work from a place of safety (although he would, for example, have to go into the waste to first attach a hook and chain to a prop to be withdrawn).The popularity of the 'Sylvester' was ensured when, under Section 52 of the Coal Mines Act 1911, the Home Office included the words "The use of a safety contrivance is compulsory in all cases where props are withdrawn from the waste or goaf".

Fig. 3 (left). Cross-section to show different pressure arch heights.
(above) Rapid face advance - low pressure arch, therefore weight on face supports is low and face conditions are good.
(below) Slow face advance - high pressure arch and weight on face supports is high and face supports may be difficult to advance, thus face conditions worsen and face advance slows . . . . .

Whilst the term 'safety contrivance' is a loose one, there is no doubt that the Inspectorate were reluctant "to admit any other device than the Sylvester machine as complying with the meaning of this expression" (inquiry into the death of H. Maddison, timber drawer, at Murton Colliery, County Durham, January 1927).

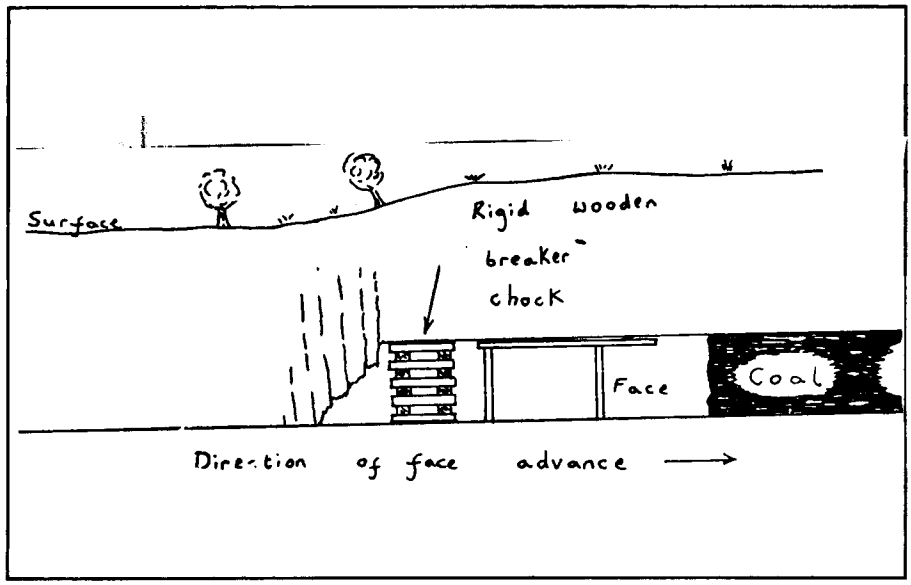


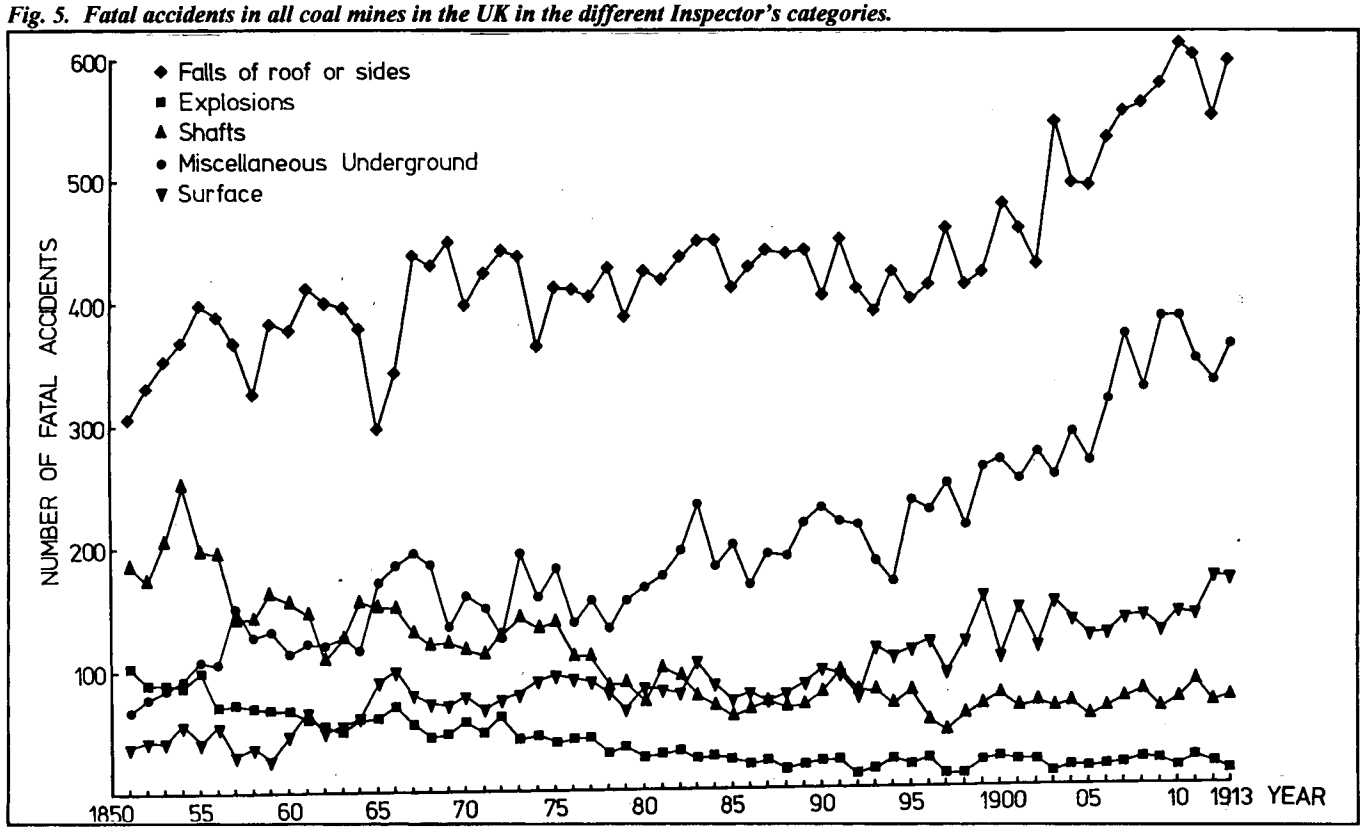
Fig. 4. Cross-section above a prop and bar face. Wooden chocks encourage the face to break cleanly and early, therefore reducing the weight on the face supports - therefore face conditions are good.

OPERATION

To see how it works in detail we can examine Sylvester's patent of May 1895 (an earlier patent Number 15,363, 13th August 1894 the previous year was not proceeded with). Plate 1 illustrates the notched bar or ratchet and Fig. 6 the actual patent 'b' (commonly called the 'sword') was about a yard in length, a short chain and hook rigidly fixed to its left hand end would be fixed to a staker prop or similar to secure it. The slide block (commonly called the 'box') would be slid onto the right hand end of the ratchet. A long length of chain 'y' would be attached to the object to be pulled (in the case of a prop preferably wrapping the chain around it to give a twisting effect) and slotted into the shaped recess on the slide block (as any link could be slotted in the distance to the prop was not critical). The block would be slid along the ratchet to tension chain 'y', then, applying leverage to lever 'g' the block is forced along the ratchet tightening the chain. After every notch gained the spring loaded catch 'c' engaged with the shaped teeth, allowing the next bite to be taken. Hopefully, the prop would be released before the slide block reached the end of the ratchet bar; if not; a release can be pulled which lifts the spring and catch and, turning the release at right angles, holds the catch out of engagement, the block can be slid back along the ratchet.

It is believed that Sylvester's device was first tried out at Chatterley Whitfield Colliery (personal communication from J. Worgan, J. Jack and W. Jack) and Sylvester purchased colliery land in Pinnox Street, Tunstall, to establish the Scotia Works factory to commence their manufacture. From before the First World War, Trade Directories put him as "Mining Tools Manufacturer", but prior to the Second World War the name "Scotia Works and Garage" begins to be used. They were then described as "General Engineers" and were dealers for Reo and Dennis motor cars and Excelsior motor cycles. Even though the motor trade continued to expand; 'Sylvesters' were still made and it remained a family business until it closed very suddenly in the early 1970s, although other companies did also make them (see Plate 2).

Fig. 5. Fatal accidents in all coal mines in the UK in the different Inspector's categories.



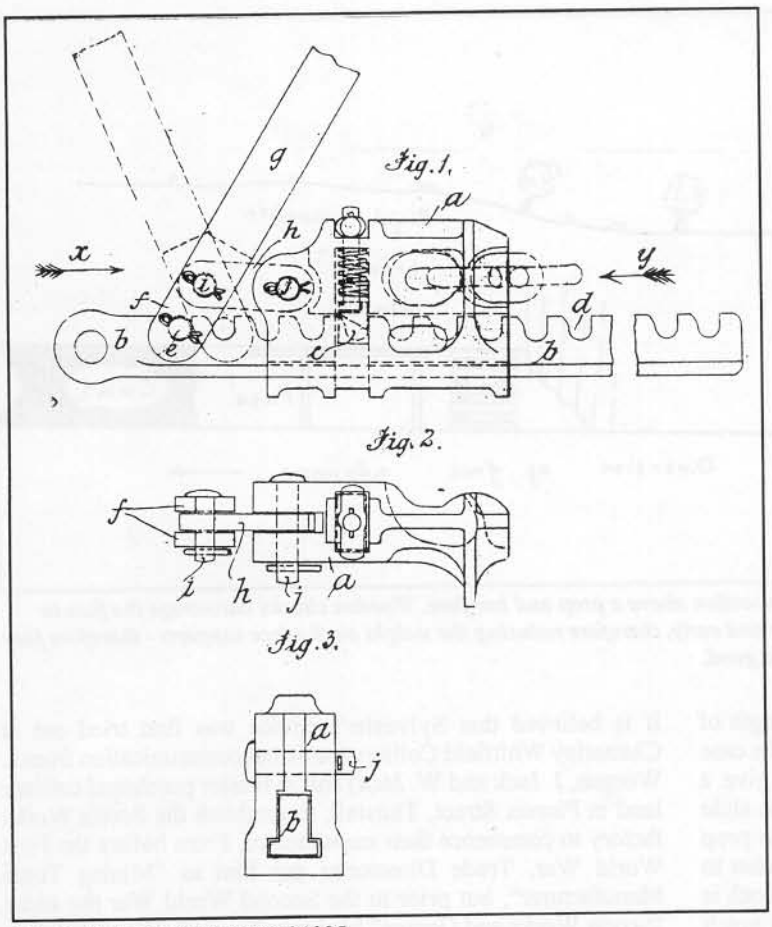


Fig. 6. Sylvester's Patent of 1895.

ACCIDENTS

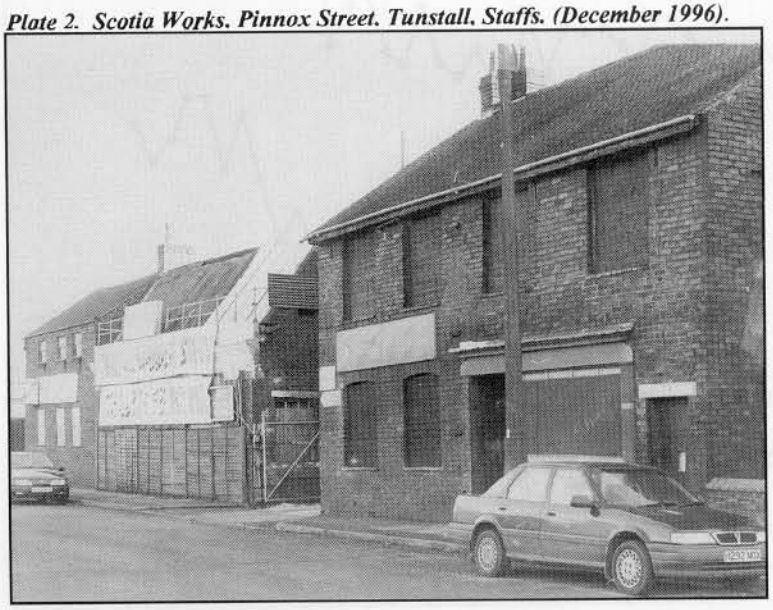
Thus it may truly be said that 'Sylvesters' saved many lives and prevented many serious accidents. They continued to be used when props and bars gave way to mechanised mining, but like all tools they are open to mis-use and abuse, and in their turn they gained a reputation for creating accidents. Brian Langdon, Chief Inspector of Mines, said "As regards accidents, I can recall numerous ones involving two men operating the Sylvester handle, one pulling and one pushing, when the inevitable happened - the handle flies. In such circumstances, the man in front i.e. pushing - was struck by the flying handle when invariably injuries were sustained about the head" (Personal communication from B. Langdon).

The 'Sylvester' was heavy to carry about the pit (although 'lightweight' versions were made) and there was a vogue to produce them in aluminium alloy, however, these became notorious for the ratchet teeth suddenly stripping off - often with disastrous results. These disappeared when it was realised that aluminium was capable of producing an incendive spark capable of igniting inflammable gas. Whilst ideal for pulling dead weights along the ground, 'Sylvesters' were potentially dangerous when used for lifting loads or particularly for applying tension. A very common use was to secure the tail end roller of a conveyor belt with two 'Sylvesters'. They could be pulled back very tight to tension the belt and make it grip the drive rollers at the front end. The problem arose when the 'Sylvesters' had to be released. The belt exerted considerable force and relieving this safely was an exciting task fraught with danger. Thus "A Prescription for the Reduction of Underground Accidents" (National Coal Board, 1978) contained the prohibition "No Sylvester to be used for securing trunk and gate conveyor tension ends as from 31st March, 1978." Whilst their general use was not prohibited by the Inspectorate it was a commonly held view that they were completely banned and their use rapidly declined. The National Coal Board stopped purchasing them and the last manufacturers consequently stopped making them. It is believed that none are currently being made. (Personal communication from Bradney Chain and Engineering Company Limited, West Midlands).

CONCLUSION

Thus the 'Sylvester' pulling device was initially a very useful tool; when used for pulling props it brought the workman out of a potentially dangerous environment and put him in a place of safety. It continued to be used for a variety of tasks, but eventually gained a reputation, perhaps undeserved, as being a dangerous device and it fell from favour. There will not be many colliers who have never used one, and consequently the name of the inventor is as equally well known as his invention. Indeed, they both featured in a play concerning famous Potteries products and people produced by the local Victoria Theatre - and there can't be many mining tools or inventors that you can say that about!

Plate 2. Scotia Works. Pinnox Street. Tunstall. Staffs. (December 1996).



ACKNOWLEDGEMENT

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