Hand Drilling: The Record From Western Mines

by J. Scott Altenbach

The techniques and technology for hand drilling of shot holes for blasting in hard rock evolved over the years and varied with the kind of rock drilled and the past experiences of the drillers. Their ingenuity, zeal, and financial backing no doubt contributed as well. The record left behind in Western mines is an interesting one and tells a story about the day to day work, somewhat different from that told in the accounts and old photographs of the great hand drilling contests around the turn of the century. Although machine drilling began replacing hand drilling in the last two decades of the nineteenth century, hand drilling was well suited for some situations. A good example was the small operation where output did not warrant the purchase of costly drilling and air pumping machinery Steele, 1927). It is still practiced in many third world countries.

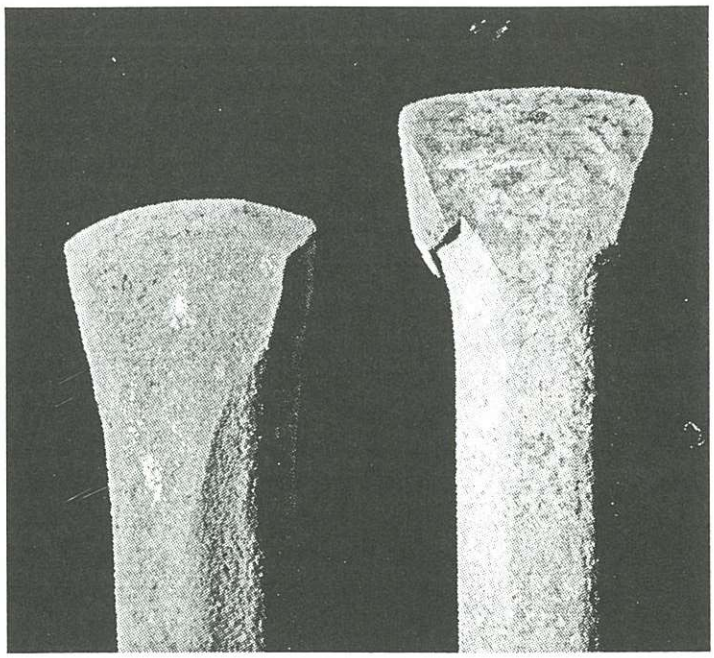


Figure 1. 7/8 in. stock starter (or bull) steels with upset ends (L) beautifully forged and sharp and (R) more crudely forged and dulled. Both cutting edges about 1 1/4 in. across. (cir. 1890).

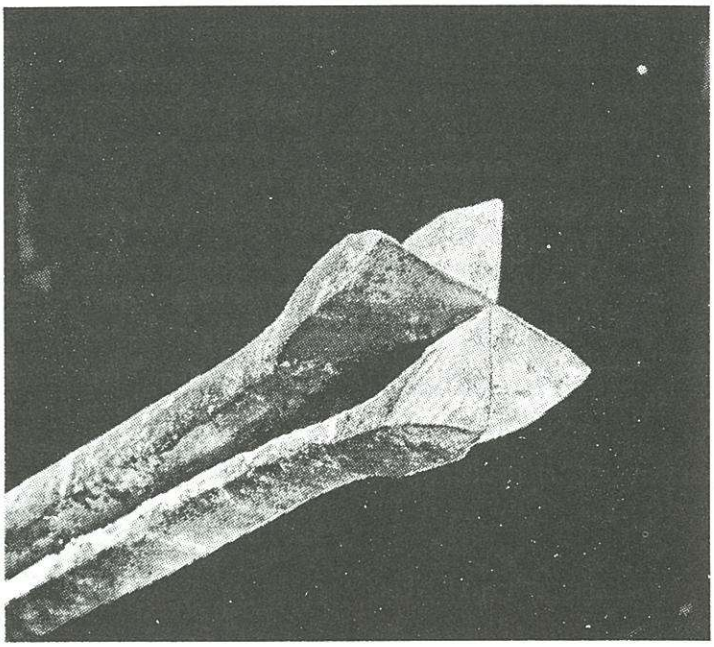


Figure 2. Steel for early pneumatic drill. "Star" or "X" bit, (2 1/16 in. cutting edge) forged from 1 3/8 in. "cruciform" steel stock. (cir. 1900)

The hand drills left, or lost, in Western mines from the 1870's well into this century were forged from solid octagonal steel stock most commonly 7/8 in. across the flat. Somewhat less common was 3/4 in. and 1 in. although the stock was available from 5/8 to 2 in. (Ihlseng, 1901). The slightly curved or straight cutting edge was a simple chisel configuration (Figs. 1, 4-8). The "star" or "X" configuration (Fig. 2), although used with the early steam or pneumatic drills well back in the nineteenth century was more difficult to forge without a "swage" and was not commonly seen in hand drills until well into the twentieth century. The forging, hardening and tempering of the chisel configuration could be quickly done by a mine blacksmith and required only forge, hammer, anvil, water and skill. In practiced hands it was a highly effective drilling tool. Moils (Fig. 3), forged from drill steel, are fre-

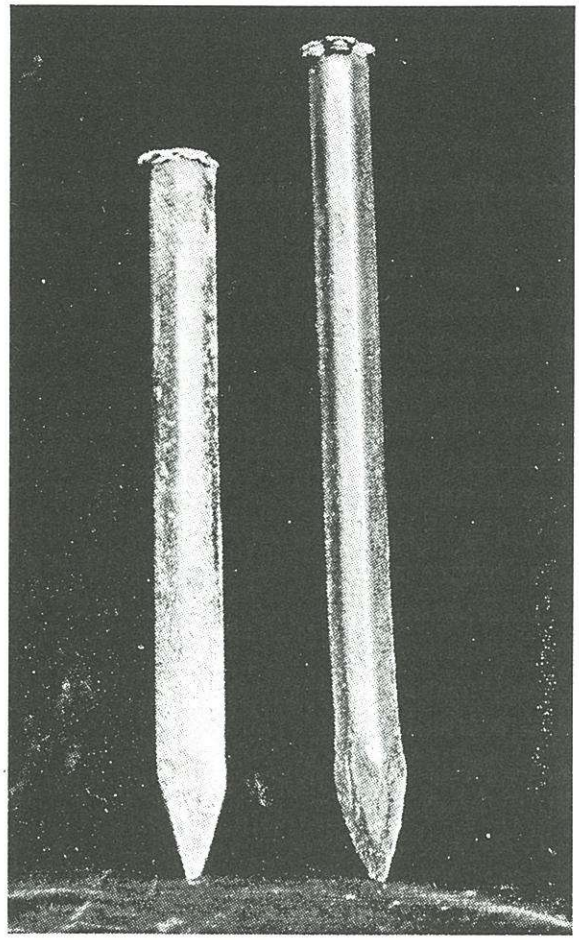


Figure 3. Moils forged from 7/8 in. octagonal drill steel.

quently found in old workings and even confused with hand drills. They have pointed, pyramid tips and were used to chip away rock in forming depressions for timber, called hitches, (Ihlseng, 1901) or for chipping thin seams of ore.

Hand drilling, at least in contests, was qualified as single jacking (single hand drilling), where one man held and turned the steel, changed it at intervals and struck with about a four pound hammer (single jack) or double jacking (double hand drilling), where one man (the "shaker" or "holder") held and turned the steel while another, the "hammersman" struck with a heavier eight to ten pound hammer (double jack) held in both hands. In contests, double hand drilling was further qualified as "straightaway" where the hammersman struck for the full 15 minutes and "change where the two men traded roles, and changed drill steel, at one minute intervals. In day to day practice over an eight to twelve hour shift, I suspect the fine qualifications were somewhat blurred.

The curved edge on the "bull" or starter steel was suited for starting the hole and was sometimes "upset", that is the end diameter of the shaft increased before the chisel bit was forged (Fig. 1), and sharpened, by hammer alone. The upsetting allowed more steel to be worked into support for the cutting edge as opposed to simply flattening out the drill end. The workmanship on many qualifies as genuine folk art. The chisel bits on successive "changes" became narrower (by 1/32 in. to over 1/8 in.), generally less curved, and the steel longer (Fig. 4). Preferences varied and some entire sets of steel had uniformly curved (Fig. 5), or sometimes uniformly straight (Fig. 6), cutting edges. Although mining textbooks from around the turn of the century qualify reasons for more or less curvature of the cutting edge, I suspect the experience of the drillers and blacksmiths dictated the cutting edge configuration. When the cutting edge dulled (more important the sides of the cutting edge), the progress slowed and worse, the drill was prone to becoming stuck or "fitchered" in the hole. Al-

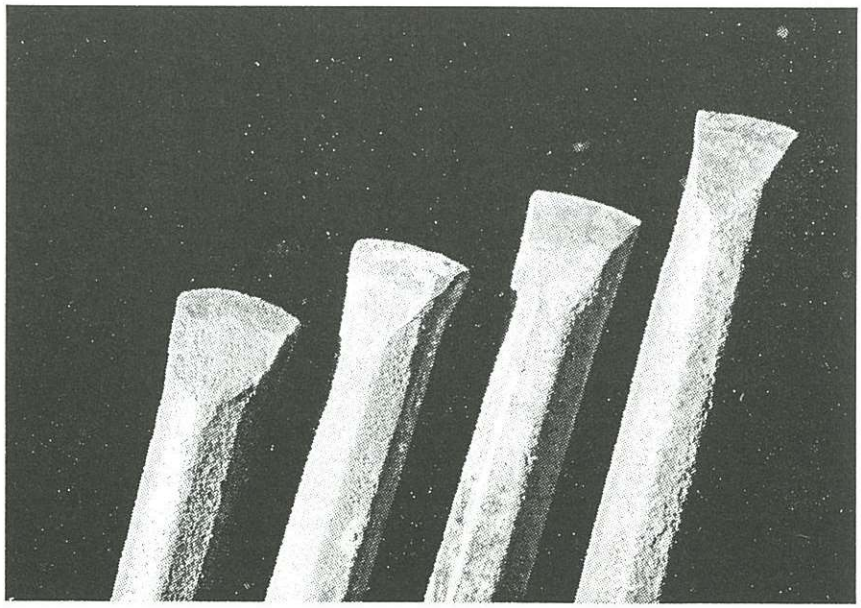


Figure 4. A set of four 7/8 in. stock drills found together in old workings. L to R. starter steel (1 3/16 in. cutting edge) and three changes (1 1/8 in., slightly over 1 1/16 in., and 1 in. cutting edges) (all cir. 1880).

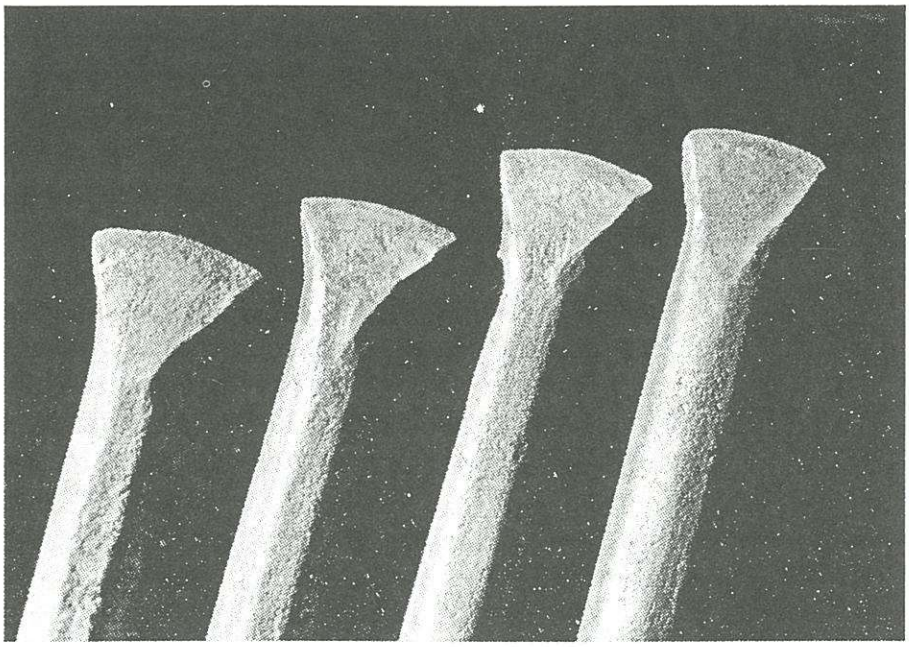


Figure 5. A set of four, 7/8 in. stock, drills found together in old workings. All have slightly curved cutting edges. L to R. starter steel and three changes. (cir. 1890).

though steel was changed at one minute intervals in the drilling contests, the entire set of steels to drill one hole, occasionally found together in old workings, are often dulled to nonfunction (Fig. 7) and comprise only three to six "changes" (Fig. 8). The depth of hand drilled holes certainly correlates with rock "drillability", the size of the heading and probably the ratio of drillers to blacksmiths. Eighteen in. (as observed from the edges of blasted holes on the rib and back in old workings) is common, 24 in. less so and 30 in. is unusual.

The evidence in old workings in arid regions illustrates many holes were drilled slightly upward (e.g. trim holes on the rib which did not necessarily have to be). The dusty fine drill cuttings could steadily be removed from these holes by vigorous pumping of the steel as it was turned (about 1/8 turn) between hammer blows or by periodic scraping with a hole spoon or a swab stick (a sharpened, green stick that was pounded on the end to create a "brush" which would remove drill cuttings, see Fig. 9). The greater the inclination, the easier the cuttings fell out. However, lifter holes had to be drilled slightly down as did at least one of the holes in a three hole pyramid cut (a cut is the group of holes in the center of the face which are shot first and which blast out a cavity to which successive holes break when shot). Two of the holes in a four hole pyramid cut and all the holes in a shaft or winze sinking round were drilled down. Dry cuttings in a down hole will slow progress after only a few strokes if not removed (Ihlseng, 1901; Peele, 1927). The options are to remove them every few strokes with a hole spoon or a swab stick or to drill wet The evidence from many of the old workings suggests that down holes were typically drilled wet and again, there were options. One is to use a "little" water and lift the steel between hammer blows enough to make the cuttings into a thick mud that will stick to the

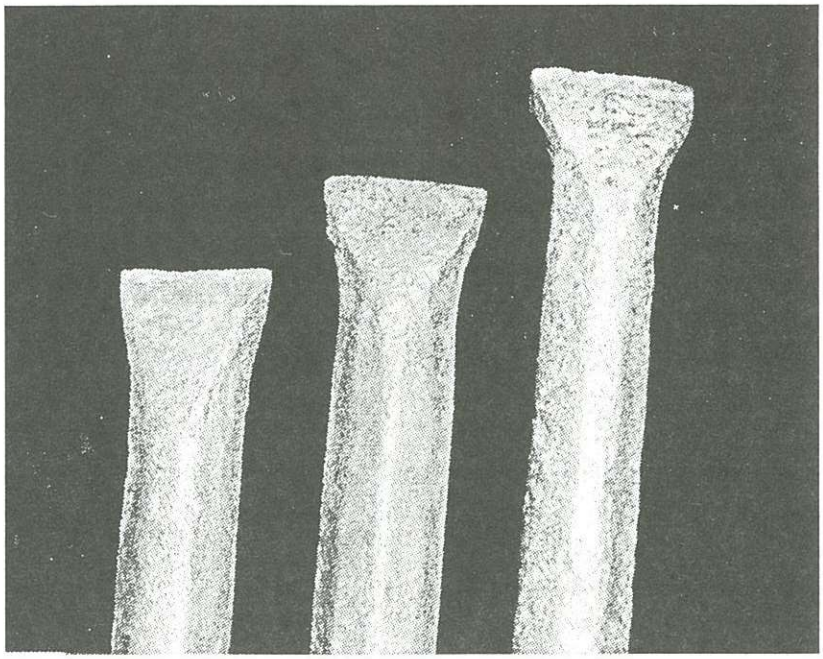


Figure 6. Set of three, 7/8 in. stock, drills found together in old workings which have straight cutting edges and no upsetting before forging. (cir. late 1890's)

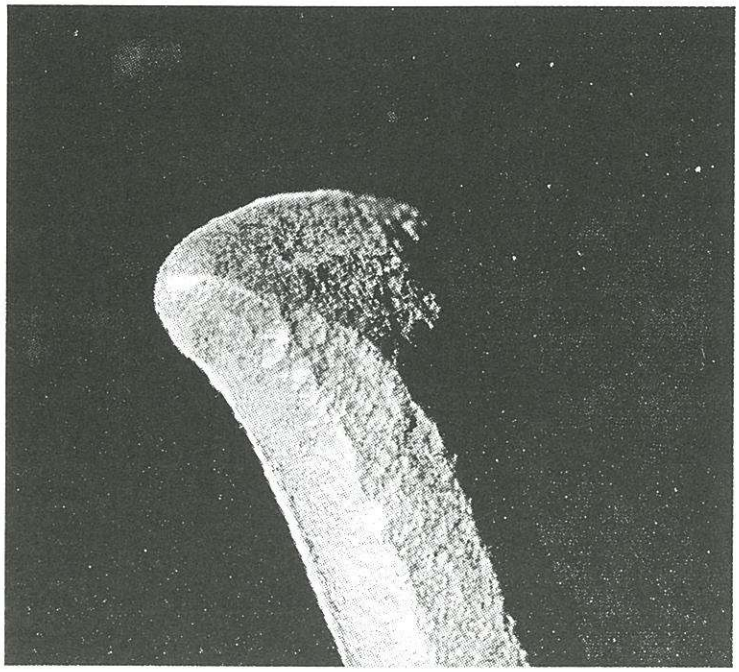
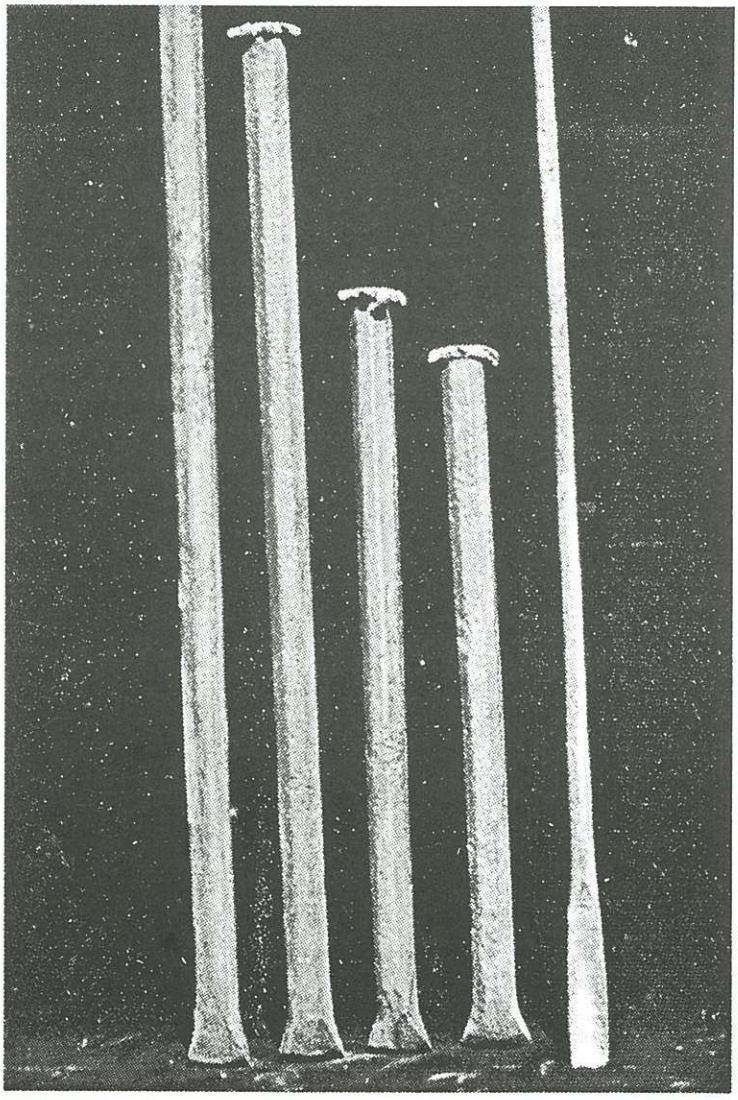


Figure 7. Starter steel, 7/8 in. stock, with 1 7/16 in. cutting edge, probably upset before forming, and badly dulled. (cir. 1890).



steel. The steel was withdrawn at frequent intervals and the mud scraped or knocked off. Some care was required since the mud will quickly thicken into a cement that will fitcher a steel quite nicely. This option may well have been a near requirement in dry mines in dry regions where water had to be hauled great distances to the mine or deep into the workings. Another option is to use "more" water and pump the steel between hammer blows enough to mix and continu-

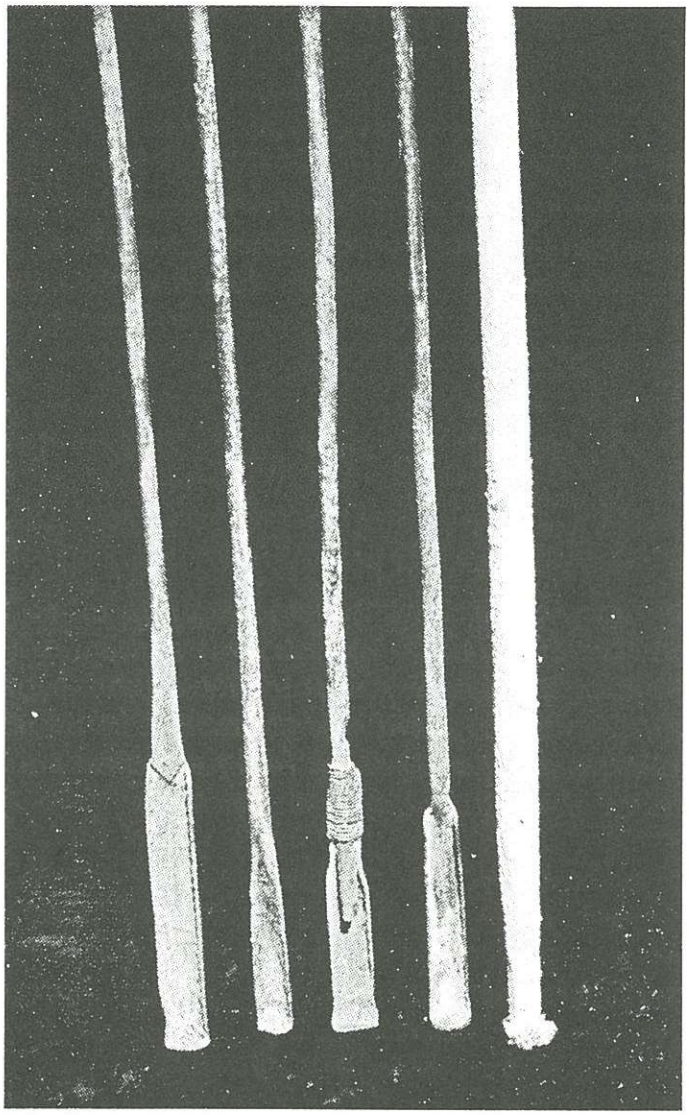


Figure 8. R to L. Hole spoon and full set of four drills found together in old workings. Steel changes are 7/8 in stock and 14.5, 16, 21 and 31 in. long. (cir. 1890)

Figure 9. L ot R. Four hole spoons and a swab stick (made from a 3/4 in. round wood stick and white from drill cuttings). Ends of the hole spoons have been forge welded to the handles. Third from left has been broken and repaired with wire. (cir. 1880-1900).

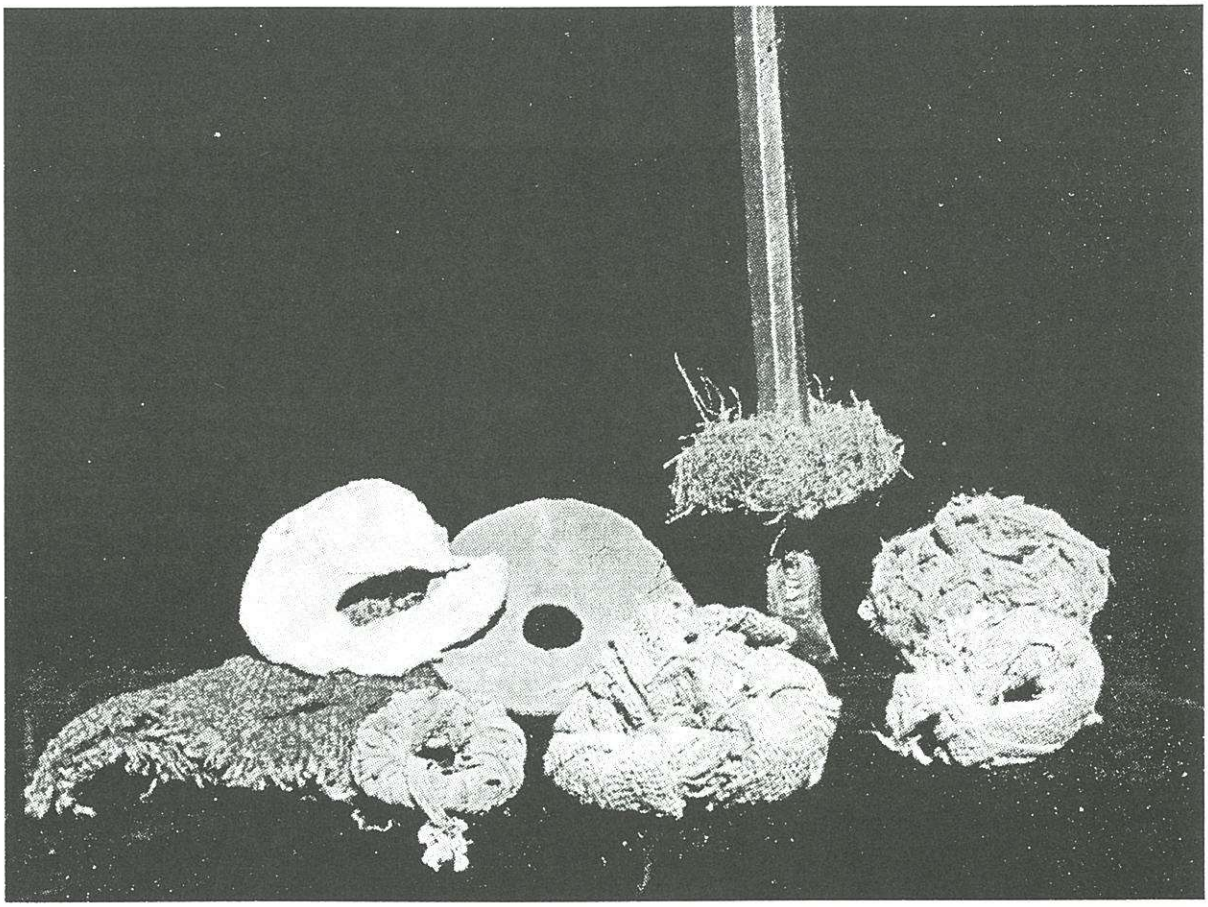
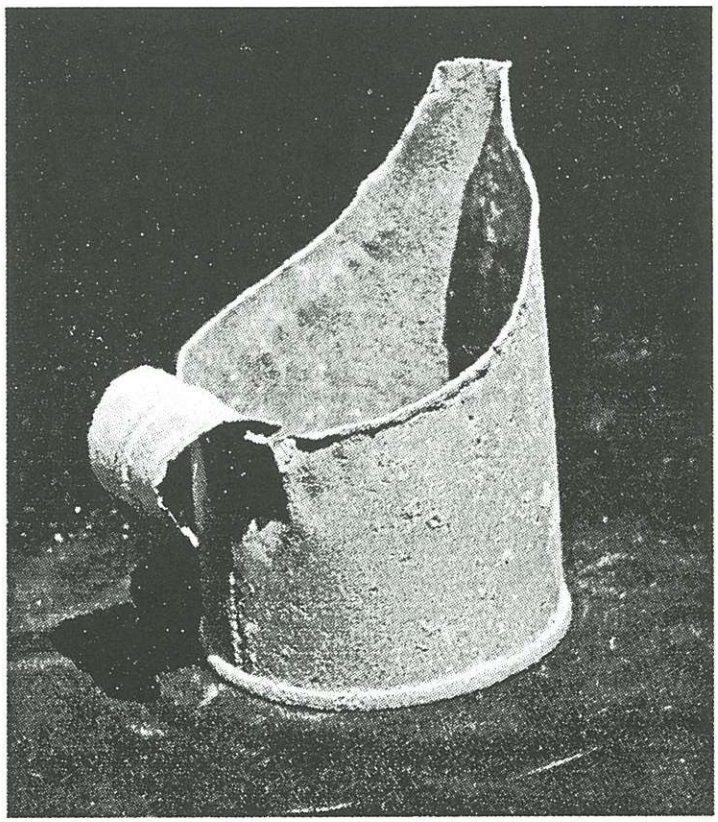


Figure 10. "Puddler's equipment". Clockwise from Left. Splash guards made from flat burlap, leather, flat red rubber, hemp fiber (on 7/8 in. steel) rolled burlap, coarse cotton fabric, rolled burlap, cotton fabric. (all cir. 1880-1890)

ally eject a thinner mud. This is the technique generally used in the old time, as well as modern, drilling contests.

The splatter of wet drill cuttings for 15 minutes in a hand drilling contest is "manly" and tolerable but would be less so for an entire shift. A nearly universal innovation, evidenced in the old workings and described in nineteenth and early twentieth century correspondence school books on mining (ICS Reference Library #149), was the use of splash guards (Fig. 10). Made from rope fibers, rags, burlap, flat rubber, canvas, leather, grass or almost anything that could be slipped over the steel at the hole collar, they minimized the splatter and loss of precious water on the first few strokes if you went the "little" water route. If you went the "more" water route, they minimized the splatter on every stroke. Little "pitchers" cut from old cans (Fig. 11), found in the workings, were very likely used to pour water into the holes as they were drilled. The example shown is a superb design which will

Figure 11. "Pitcher" cut from a can, 3 7/8 in. high. (cir. 18801890)



pour water into a declined hole on a vertical face or direct it perfectly into a vertical hole. The syrup cans found so commonly in old workings very likely served a similar function, as well as to transport water to the working area. Swab sticks or hole spoons were used to give the hole a periodic or final cleaning before loading.

When you first heft the four pound single jack (Fig. 12) it seems oddly out of balance and the handle seems fragile in comparison to modern hammers. You realize after you use it that it was not designed to be swung with furious, rapid blows but steadily, letting the mass of the more steadily accelerated head do the work. The delicate handle is likewise designed to allow the hammer to spring back from the steel after impact to minimize the effort required in the recovery stroke. Again the mining textbooks of the time (ICS Reference Library }149) describe how the experienced single hand driller could be distinguished from the novice by the way he used this spring to his advantage and did not rapidly tire.

Although typical double jacks, or double hand hammers (Fig. 12), are occasionally found in the old workings, more common are hammers of intermediate length and weight. These are often 4 to 8 pound hammers with handles between 16 and 24 inches. Too long, and often too heavy to be of use in single hand drilling, they are perfectly suited to double hand drilling in the low, narrow headings where use of larger hammers with longer handles would be nearly impossible.

The old time drillers must have been unimaginably tough by today's standards (try swinging a four lb. hammer at a sustained 50 blows a minute for several hours) but they had to have their tricks to do what they did, hour after hour, day after day. At the rate the old mines are being blasted and backfilled in the name of liability gin the guise of public safety), the tangible evidence of the skill and innovation of the nineteenth century miners will be entirely gone in a few short years. We would do well to reflect and appreciate, before we forget forever.

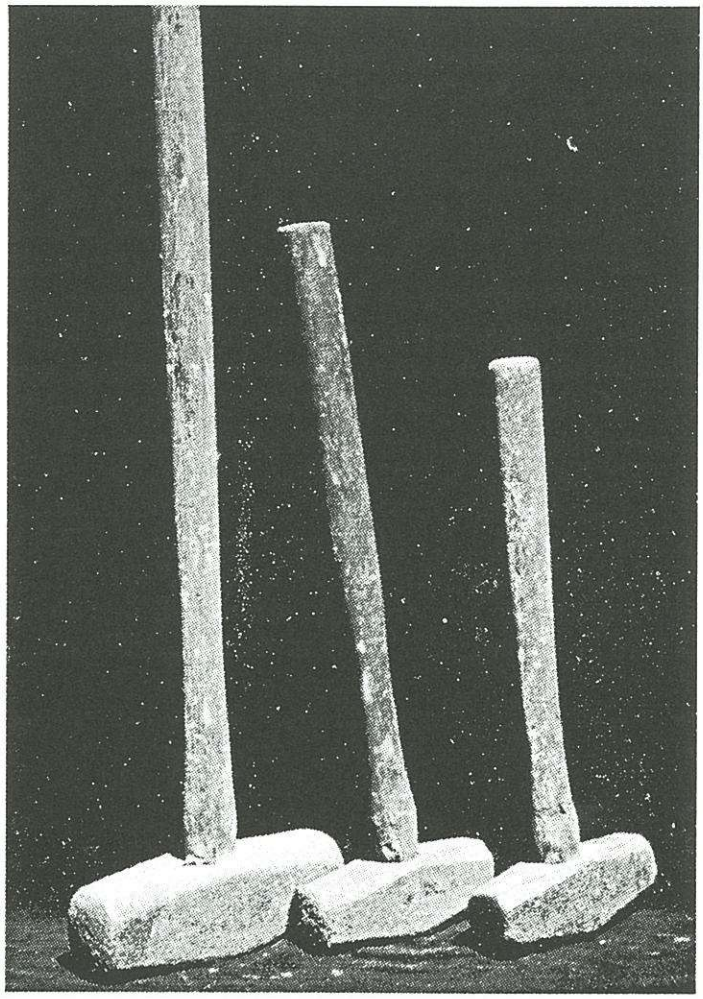


Figure 12. L to R. Ten lb double jack w/ 32 in. handle, 4 lb double jack w/ 16 in. handle, 4 lb single jack with 12.5 in. handle. (cir. 1880-1900)

References

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