The results of his investigations he recorded in "De Re Metallica," first published in 1546; and here he minutely describes the methods of mining of that day, the methods of raising the ore, of dressing it, of smelting, assaying, surveying, etc.

In turning over the pages of this book, it is curious to note how very like, in many respects, the methods of to-day are to those of three and four hundred years ago. The crucibles, cupels, and scorifiers used in assaying, are almost identical with those of to-day, and the balances for weighing the buttons, though clumsy, embody the principles of our modern balance. The primitive hand-jig used then is still used in Cornwall and other places. Pumps, furnaces, even the surveying instruments, contain the rudiments of those which are employed at the present time. In sinking shafts and driving tunnels, however, the miner of the olden time was probably more primitive than in any other particular, and the methods used were so laborious that what they really accomplished seems all the more wonderful.

Rock-drills and dynamite were not dreamed of then, nor even drilling by hand and blasting with gunpowder; for though the latter was invented in 1320, it was not used for mining until 1613. So the only tools at the disposal of the miner then, were the hammer, the pick, and the gad. The latter was, or rather is, for it is even now in use, a pointed wedge, which is sometimes provided with a handle like a pick.

The method of operation consisted in inserting the point of the gad in crevices in the rock, striking with the hammer, and in this way dislodging fragments of rock. Of course it was not difficult as long as the rock was soft, slaty, or intersected by cracks and joint-structure, so that it could be easily disintegrated.

When, however, the rock was tough, compact, and had no crevices or cracks where the gad could be inserted, then the miner of four centuries ago was obliged to to make them; this he did by a peculiar and laborious system called "fire-setting."

Every one knows, how, when a fire has been built against a rock, fragments are split off by the heat. It was upon this principle that fire-setting depended. A large pile of wood was built against the face of the rock which was to be removed. The wood having been ignited, the miners left the mine until it had nearly burned out; then, re-entering, they threw cold water against the hot rock, cracking it in all directions.

When the air of the mine had cooled off and become fit for men to work in, they went at the cracked rock with pick and gad, and repeated the whole operation when the loosened portions had been dislodged, and solid rock was again reached.

The difficulties which were fought against in the use of this system, are a great testimony to the perseverance of the ancient miner. The progress of the work would have been intolerably slow in these days. The smoke and gases from the fire, confined underground, produced, of course, a frightfully vitiated atmosphere, and the noxiousness of this was increased if the ore happened to contain arsenic, antimony, sulphur, or other volatile substances.

The only means of ventilation were to have a couple of men wave a cloth over the mouth of the shaft, or else a ventilator constructed from a barrel — upon the same principle as a wind-sail — was used. In ancient times slaves and captives were compelled to work in mines, and horrible stories are told of their sufferings.

This system of fire-setting is a very ancient one, and was for many centuries the only method of extracting ore from the solid rock. Diodorus, in an account of mining operations in ancient Egypt and Ethiopia, speaks of its employment, and Pliny and Livy also mention it. It is said that fire-setting was used in Japan, for driving long tunnels, to within very recent times; and the ancient copper pits at Isle Royale, in the Lake Superior region, contain heaps of charred wood, and furnish other evidence that the same method was practiced by the pre-historic people of this Continent.