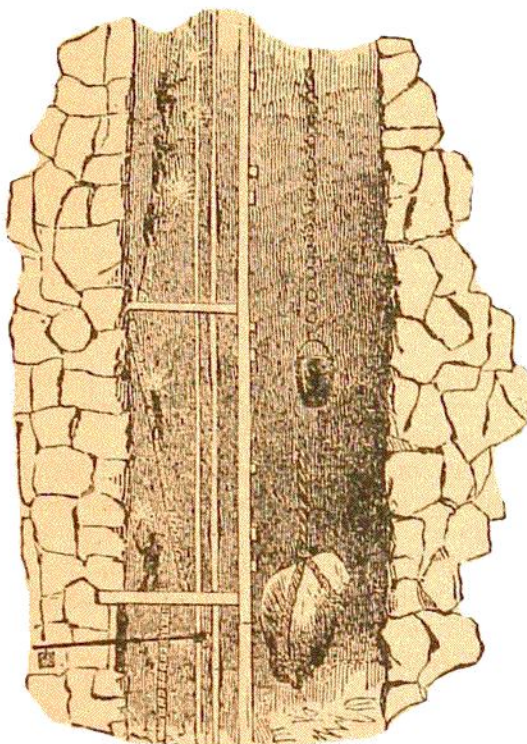


proper distance from the surface. It is designed as the thoroughfare through which the ores are brought to the surface, and ingress and egress are afforded to the miners. The simplest mode of conveyance is by means of a windlass mounted on the shaft, to which two buckets are attached by a long rope and made alternately to ascend and descend in the pit.

Fig. 415 represents three lodes traversed by an adit level. Three shafts are also represented. Fig. 416 shows the interior of a shaft.

As the work progresses, horizontal galleries are excavated at different levels, striking the lode at different points, and connecting with the principal

Fig. 416.



shaft. These are called *cross cuts*; and by means of railways the ores are conveyed to the shaft, where they are drawn to the surface by the simple windlass, or a *whim*—a contrivance employing horse power—or by a steam engine.

Sometimes, for purposes of ventilation and the readier working of the mine, pits are sunk from one level to another, without being directly connected with the surface. These pits are called *winzes*.

*Methods of attacking the Rock.*—These vary with the nature of the rock. If it be soft, pick-axes and shovels may be used. If it be hard, but traversed by seams, steel wedges or *gads* may be used to split off large fragments of ore. Most usually, however, the rock must be excavated by blasting with gunpowder. When the rocks are soft, or there is danger of sliding, walls of stone or frames of timber

must be constructed, to preserve the openings and galleries.

*Extraction of Ores.*—The materials excavated to form the galleries may be largely composed of ores, but these form a very small part of the valuable fragments which must be preserved. After the ore has been removed, the worthless rubbish may occupy its place, and thus the valuable portions be easily obtained at the different levels. When the progress is from a higher to a lower level, the operation is called *stoping*; but if the progress is upward, the opening is called a *rise*.

Fig. 417 exhibits the excavations in the Huel Crofty Copper Mine in Cornwall. The perpendicular excavations represent the shafts and winzes, and the portions shaded black represent those parts of the lode which have been removed by stoping. The levels in this mine, like most of those in Cornwall, are ten fathoms apart.

*Mechanical Preparation of Ores.*—When the ores reach the surface, the valuable portions are picked out and prepared by various mechanical operations for metallurgic processes.

*Crushing.*—Many ores are prepared for smelting by *crushing*. The fragments are brought beneath two large cast iron cylinders, revolving in contrary directions, and kept in place by a heavy weight. After being crushed, the ores pass over a sieve, which separates the fragments of different sizes;