Deposits of argentiferous galena and other silver minerals are, when oxidized, altered with the formation of native silver, chloride of silver (cerargyrite), bromide of silver (bromyrite), iodide of silver (iodyrite), and various other minerals.

The typical unaltered condition of gold in nature is in association with iron pyrites in quartz, and the effect of surface oxidation on such a deposit is first to convert the iron pyrites into hydrated oxidized iron minerals which permeate the quartz and turn it into a rusty brown mass. The next stage is the gradual leaching out of the iron minerals by the action of surface waters, while the gold, which was originally in the iron pyrites, mostly remains, though it may have been partly dissolved in one or more of several ways. Sometimes, especially in the Rocky Mountain region, gold occurs in the form of telluride instead of in iron sulphide, and in such cases superficial oxidation causes the telluride to be oxidized and the gold to be set free from its combined state. When such deposits as those described are eroded, the particles of gold separate from the quartz and are concentrated in the streams as placer gold.

In tin deposits, the typical mode of occurrence of the metal is in veins, dykes, or country rocks in the form of the oxide known as cassiterite. Cassiterite is not easily affected chemically by surface influences, but for this very reason its concentration is most markedly affected by surface alteration, for in the erosion of tin-bearing deposits the masses of cassiterite are broken up and carried off mechanically by surface waters, to be deposited somewhere else in the form of gravel beds, instead of being dissolved and possibly disseminated.

Superficial alteration like that already described in various deposits occur also in many others, such as antimony, bismuth, mercury, aluminium, nickel, cobalt, chromium, tungsten, molybdenum, and many rarer deposits, but the changes already described show the general features of the subject.

As soluble chlorides, and sometimes other haloid compounds, are common in surface waters, chlorides and the allied salts are not at all uncommon as alteration products, especially in such cases as that of silver, where the chloride, bromide and iodide are comparatively insoluble compounds, and are not leached out. For this reason, such ores of silver are found to a greater or less extent in almost all silver districts in America, Europe and elsewhere. The occurrence of such compounds in very large quantities in certain arid parts of America is probably due to the action of saline compounds, derived from wholly or partly dessicated lake basins, on the pre-existing ore deposits of the region. This transition to haloid compounds is not confined to silver ores, for similar compounds of copper and other metals also occur.

Rock Drills.*

It is observed that Andre, referring to rock drills in his work on "Coal Mining," states concisely the requirements of a good rock drill, as follows :—

1. A machine rock drill should be simple in construction, and strong in every part.
2. It should consist of few parts, and especially of few moving parts.
3. It should be as light in weight as can be made, consistent with first condition.
4. It should occupy but little space.
5. The striking part should be relatively of great weight, and should strike the rock directly.
6. No other part than the piston should be exposed to violent shocks.
7. The piston should be capable of working with a variable length of stroke.
8. The sudden removal of the resistance should not be liable to cause any injury to any part.
9. The rotary motion of the drill should take place automatically.
10. The feed, if automatic, should be regulated by the advance of the piston as the cutting advances.

Having assented to these requirements, the catalogue continues : The power of a rock drill is in direct proportion to its diameter of piston. It is of the greatest importance that a drill of proper size is purchased for the work it is to do. It is impossible to determine by figures that a rock drill of a certain diameter of piston will be best suited for a particular piece of work. This can only be learned by experience.

It is a common thing to see rock drills of too small a size used in work where a larger drill would save money. We have also seen large drills used where small ones should be. It is a common thing for salesmen inexperienced in the rock drill business to advise the purchaser to buy a drill of a smaller size than will be best suited to his work. This is sometimes done by salesmen and manufacturers of experience, but whose interest in effecting the sale binds them to the real interests of their customer. It is easier to sell a small drill because the price is lower, and many men who have been tempted by the low priee have purchased smaller drills than they should have, and some are to-day using them satisfactorily, but are really losing money, as a large drill might do more work in the same time and at the same expense in labour and fuel. It is like putting a boy to do a man's work. It costs as much to feed the boy, but the man accomplishes more in the same time.

There is distinct tendency of late years among the most successful and experienced quarrymen, miners, and contractors toward the use of heavier and more powerful machines than were used for the same work only a few years ago. A light drill is, of course, the choice of the drill runner, because he thinks it will be easier for him to move around, and many quarrymen insist upon having a light machine, for precisely the same reason. A drill too small for the work it has to do is never a paying investment, and the slight difference in first cost between a small drill and one of proper size should never be allowed to influence the matter, as this small difference will, in many cases, be made up every week in the difference in work done. Again, experience shows that the larger machines are much more durable and economical in repairs, not as apt to break down, and will outlast several of the smaller ones at the same work.

On the other hand, large drills should not be used for shallow holes of small diameter in soft rocks, where the time taken to move the machine is out of proportion to the time it takes to drill the hole. Many are using rock drills, as they think satisfactorily, when a larger or smaller, or a different pattern of machine, would be a surprise as to its greater capacity. Good machines are sometimes condemned when the only trouble is in their being unsuited for that particular work.

There are many kinds of bits in use, each having its specific value when applied to certain kinds of work. Obviously the best bit for use is that which is the simplest in construction consistent with efficiency. It may be stated as a general rule that the single-edge bit should be used everywhere that it is possible to apply it, so great is its simplicity. It cannot be used with percussive drills in hard rock because the blow is so strong that the edge will not stand. Here is where double-edging comes in to advantage, for, having plenty of power behind it, we may distribute that power over two or three edges, and thus gain an advantage.

A straight edge, when used for hole drilling, brings most of the work upon the outside points of the bit. These points turn around through the largest circle, that which limits the diameter of the hole ; and, besides, they have to break up the stone at the wall, where it offers the greatest resistence. The taper or curve eases this condition of things by changing the bottom of the hole so that it has no sharp corner.

Sandstone has a singular effect on drill bits. Though sandstones are usually soft the bits cannot be finely pointed, but, on the contrary, should be flattened. A bit with a knife edge when used in sandstone will have its edge sharpened like a razor, the faces of the bit gradually becoming concave. This is natural, because, as the bit embeds itself in the grit of the rock, it is rubbed as though on a grindstone. The stone is uot usually hard enough to dull the sharp line of the edge, so that the more this bit is used the sharper it gets. It cannot, however, be used very long, because the point or outside ends of the bit become flattened and dulled, and what is a still greater objection, the ends become tapered. All this arises from the hard work and the great rubbing experienced at the walls of the hole.

The most successful sandstone bit is undoubtedly that with the flat edge. This bit is nothing more than a flattened-out piece of steel, with no more edge to it than there is to the side of your finger. It is sometimes called the stub bit. Exact dimensions of this bit cannot be given that will apply in all cases, but the most popular dimensions are about 1½ inches length of face, and from ⅜ to ⅝ inch in width. The cutting face should be square and rectangular. The bit should be kept thin to insure fast cutting, but, if a cornered hole results, thicken the bit a little. It is usual to simply dress it up by heating it and hammering it to square edges, the chief work having to be done upon the outside ends in order to keep them square and up to gauge.

There is so much metal in the sandstone bit that it is not rapidly worn away by the grit. It is, therefore, a common thing to see one of these bits in use for half a day, drilling a great many holes in different places, without having to be sent to the shop. When starting a hole it pounds upon the rock like a bass drum, and an inexperienced looker-on would naturally suggest a sharper edge.

There is no question about the advantage of the flat bit in sandstone, so far as the blacksmith work is concerned. It will actually put in a hole faster, and it does it because, when drilling sandstone, the process is not a chipping, but a crushing one. Marble, or any other hard crystalline substance, needs a sharp edge to throw a chip, whereas sandstone will crush.

Prior to the use of the percussive drill there were few, if any, drill bits which had much value above that with the single edge. Even in artesian well boring, where the blow is heavy, the single edge bit has held its place against many patented bits. The single-edged bit is generally flattened or grooved at its centre for the purpose of discharging the cuttings. As the centre of any bit performs but little work, it may be readily cut away without reducing the efficiency. Besides the single-edged bit, the +, × and Z bits are the only really important bits in use with percussive drills.

The + bit is the most popular percussive drill bit in use. It seems to be a happy medium in that it accommodates both the drill runner and the blacksmith, though we are quite sure that, were the blacksmith's wishes not consulted, the × bit would replace it almost everywhere. Out of several hundred enquiries recently sent out among mining and quarrying men as to which bit was preferred, the + or the ×, opinions differed largely, but the weight of evidence was in favour of the + bit.

It may be stated as a general rule that the × bit will do good work in any kind of rock where the + bit is used, but the + bit cannot be used to advantage in some rock where the × bit gives satisfaction. Another rule is, that the + bit had better be used wherever the rock will admit, for the simple reason that it is more readily dressed by the blacksmith.

The two bits are very much alike in that they have the same extent of cutting edge, but they differ in that the edges in one case cross at right angles, and in the other at acute angles. As the bit, when at work, turns round after each blow, it is obvious that in the case of the + it may strike four times in the same place while turning the circle, while with the × it can only strike twice in the same place. A + bit, when turned one-quarter of the circle, or 90°, may embed itself in exactly the same groove that had been made by a recent blow, and, if this striking in the same place is frequent, and the rock is soft enough to admit of rapid drilling, the hole will become rifled, that is, it will not be round. Anyone who has much to do with drill holes knows that a rifled hole is a great nuisance. As the × bit has only half as much chance to strike in the same place as the +, it offers only one-half the opportunity to rifle the hole. It is a common thing for percussive drill manufacturers to receive complaints that "the drill will not put in a round hole ;" the invariable remedy is to change the bit, and, as a general thing, the × bit is the thing to use.

In the blacksmith shop, the + bit is invariably preferred. In using the dolly the blacksmith finds that by turning it one-quarter it fits the bit, and, owing to the rectangular and uniform construction of the bit, he has no difficulty in keeping it at gauge, while with the × he must turn his dolly one-half of the circle, and in doing so the bit must either be turned around, or he must send his helper on the other side of the steel. It is because of this very condition of things as illustrated in the blacksmith shop that the × bit when turning around in the hole is less liable to strike in the same place, and drills a better hole. Persons using the + bit and having difficulty with rifled holes can try the experiment by simply knocking the flanges of the bit together in the blacksmith shop, while the steel is hot and after it has been dressed. If they find that this bit will drill a more satisfactory hole, they had better throw away their + dolly and send for an ×, the blacksmith to the contrary notwithstanding. In trap rock, granite and other uniform rocks the + bit does good work and drills a round hole because the rock is uniformly hard, and the drilling is consequently slow.

The Z bit is designed and used to a moderate extent in soft rocks, or in work where seams and soft places are found in the line of the hole. This bit is sometimes modified by having the middle edge straight across, thus making an ⊐ instead of a Z, but there is little preference between the two, and either one is bad enough for the blacksmith to dress.

A matter which frequently receives too little attention from the drill runner is the keeping of the bit in the proper shape. Generally speaking, they should be as thin and sharp as they can be made without breaking or sticking. It is a common thing to run × or + bits till they are battered or worn so blunt as to make cutting out of question ; it is then a matter of brute force. Two or more sets of steels should be used, so that a sharp set is always available without waiting for the blacksmith. Always remember to keep the bits dressed for as small a hole as will do the work ; there is just four times as much rock in 2 inch holes as there is in 1 inch; an eight of an inch difference in the size makes quite a difference in the drilling time. The size of the bit or its sharpness affects the speed every time a blow is struck. When a drill is striking 200,000 blows per day these little differences count up to a great deal every day, to say nothing of months or years. A great point is to keep the machine pounding every possible minute of the time ; lose as little time moving and changing as possible. The rule is to have the bits as thin as possible up to where they begin to make cornered holes, in which case the remedy is to thicken the bit $\frac{1}{16}$ inch or more. If the + bit rifles the holes, try the × shape. If the drill sticks, it is a thousand to one that the trouble is with the bit, or in the hole, and not in the machine. See that the corners are dressed well back where the side of the bit touches the wall of the hole, so that the rubbing surface is small. A dulled bit often takes twice as long to get down as a sharp one, and a good driller can accomplish twice as much as a poor one by

* Excerpted from the new catalogue of the Ingersoll-Sergeant Rock Drill Co., which contains a large amount of practical information respecting the use and care of rock drills.