that are common. In places a vein of magnetite cuts the quartz, but elsewhere the relation is reversed. Some pyrite was also present in some of the aqueo-igneous solutions, and its relation to the other minerals shows that it was formed after most of the minerals of the ore body had solidified.

As the later intrusions took place the earlier intrusions were enriched by magnetite and quartz, which replaced some of the silicate minerals, such as feldspar, hornblende, and biotite, of the earlier intrusions. There was a tendency for the hornblende and biotite to recrystallize in larger grains adjoining the passageways for the solutions as is shown by many specimens collected in the region.

If this explanation of the origin of the magnetite ores of this county is correct, and it seems to explain the phenomena observed better than any other known theory, the ore bodies owe their origin to ascending aqueo-igneous solutions; hence the ores should continue to great depth without any marked change in either quality or quantity. They surely extend much deeper than it would ever be profitable to mine them.

Methods of mining.—In mining the limonite ores open-cut methods predominated, but in mining the magnetite ores very little open-cut work was practicable. The dipping beds of ore a few feet in thickness which were inclosed in hard rocks necessitated shaft mining almost from the start, although some open-cut mining has been done in the region to the depth of 20 to 25 feet. Most of the shafts were sunk in the veins and were inclined to the south at angles of 45° to 55°. From the shaft, levels were driven to either side and the ore was removed by underhand stoping. In one place a tunnel was driven into the hill to cut the vein of ore 135 feet below the surface. Although the tunnel was serviceable for drainage, it was never used for removing ore, which was hoisted through a vertical shaft to the top of the mountain.

The wall rock in most mines was very firm, so that little timbering was required, even for the shafts. As the depth increased the water became abundant but was not so serious an obstacle as in the limonite mines, because of the location of the magnetite mines higher up on the mountain slopes and the greater solidity of the inclosing rocks. However, in mining limonite some water was required for washing the ore, whereas in the magnetite mines the water was purely a disadvantage.

Some of the ore when brought to the surface was cobbled to remove the leanest materials, but received no further treatment. No mill for the concentration of the low-grade ore was erected. Had a sufficient tonnage been developed no doubt a mill would have been built. It is said that the cost of mining the ore ranged from $3.50 to $4.00 a ton and it was sold for $5 to $6 a ton. Almost all of it was hauled from the mines to nearby furnaces or to the railroad to be shipped.

Most of the mines were operated by the owners, who sold the ore wherever they could. A few mines, however, were controlled by iron companies that owned furnaces and were leased on a royalty with the arrangement that all the ore should be brought to their furnaces and paid for at prevailing market prices. The royalty ranged from 20 to 50 cents a ton.