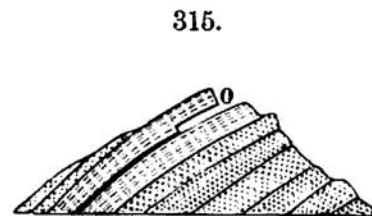
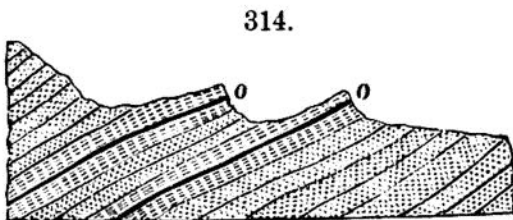


1. *The upper intersected rocks of difficult corrosion.* — These rocks are of any kinds not calcareous: as shales, sandstones, or other related fragmental kinds, or, but much less frequently, crystalline rocks.

The famous copper mines south of Lake Superior are an example. The upper intersected rocks are sandstones, conglomerates, and tufas. The igneous rock is mainly of the basaltic type. The copper is native copper containing generally 3 per cent of silver, and occasionally speckled with silver. It occupies irregular fissures and cavities in the igneous rock, especially its amygdaloidal varieties, and also occurs in the adjoining sandstone. It sometimes constitutes amygdules, has often a gangue of zeolites, or coats crystals of analcite and quartz-crystals, and thus it proves its contemporaneous origin with these materials. One great sheet of copper was 40 feet long, 6 feet wide, and 6 inches thick, and weighed, by estimate, 200 tons. The conditions show that the copper came up along with abundant moisture from some deep-seated source. In 1891, the mining at the Calumet and Hecla mine had gone down 4000 feet. It is probable that the deep-seated source was a region of veins in Archæan rocks along the line of the fissure or fissures holding chalcopyrite, the most common of copper ores.

Another example is that of the remarkable Comstock lode, Nevada, along a faulted fissure — now a deserted mining region. The igneous rock at the broad vein is of the basaltic type, and intersects a region of andesite of Tertiary age. The ore deposit extends along the contact of the igneous rock with those it intersects. The gangue is mainly quartz. The ore is largely silver sulphides with some native silver and native gold, the last nearly half the value of the products. Hot vapors ascend the opening, and during the working it made the cooling of the air with ice necessary in order to reach the lower depths; and finally the heat caused the desertion of the mine. By means of the vapors, the diabase and other adjoining rocks had become deeply decomposed to clay. The total yield up to July, 1880, was over 306 millions of dollars. (King, 1870; Becker, 1882; Hague and Iddings, 1885.)

In other related veins, the rocks cut through by the upper part of the fissure vary in porosity and in other ways; and some of the beds become impregnated with ores, while others receive little or none. Such impregnations are occasionally found where no igneous rock by which they could have been produced is in sight. The following sections, illustrating a case



of this kind, are from a report made in 1879, by Rothwell and Crouch, on a district on Virgin River, in Utah, 250 miles south of Salt Lake. The formation containing the ore-beds (*o*) is probably Cretaceous (see Gilbert's