

believe that the liquid they imprison is carbonic acid. When warmed and tested with a stage thermometer the bubbles suddenly disappear, when a temperature of about 86° Fahr. is reached, but return again on cooling.

"Now, between 86° and 88° Fahr. is the so-called critical point of the liquified carbonic acid—that is, above this temperature carbon-dioxide can no longer maintain its liquid condition, but transforms itself into a gas, no matter what the pressure may be. This has been conclusively shown by Professor Andrews, of Belfast, who thus determined the critical point of every known liquid. I am not aware of any other liquid of which the critical temperature is so low. The inference to be drawn from this is that, inasmuch as carbon-dioxide is a gas which can only be reduced to a liquid condition by extreme pressure, the quartz in which these cavities occur has been exposed to great pressure—tons to the square inch—during its formation or crystallization."

"This parallelism is found more or less developed in most of the specimens of rich quartz on some part of the slide. The quartz, Figs. 12 and 13, referred to by Dr. Henzolt occurred in small leaders coming obliquely from the hanging-wall into a large vein of block-quartz of very low grade. The appearance of the latter quartz suggested a second opening of the fissure after it was solid, or nearly so. It is brecciated on the edges, and broken up into large blocks, which seem afterwards to have been cemented together with iron-oxide and jasper carrying gold. The remarks of the late Professor Clayton on the quartz of the Drum Lummon lode are fully confirmed in the character of this quartz in the Tiger Mine. The fissure occurs in sericite-schist, broken through by diorite dykes, and the quartz is accompanied by a parallel diabase band, that sometimes entirely crowds out the quartz. Both diabase and diorite have been differently named from slides taken at various points. The limestones have been altered to marble; some of the dykes have been turned to soapstone. The country seems to be one of intense metamorphic action.

"While millions of dollars have been taken from the surface of this district in the early placer days, and all the little gulches leading up to the veins have proved rich, yet, although pockets of rich quartz of considerable importance have been found, no one has made a success in working the veins. Many companies have been wrecked on them. The average value of the quartz near the surface is about 12s. per ton, but it varies between 3s. and many pounds sterling. The quartz contains iron-pyrites, copper-pyrites, tetrahedrite, sometimes rich in gold, sometimes rich in silver, and then again barren. A depth of 400ft. has been reached, and, from the continued improvement in the microscopic character of the quartz, and the occurrence of occasional bunches of very rich ore, I am satisfied that a company with money and courage to open up a depth of 1,000ft., as is being done in the mother lode, will meet with success. The barren block-quartz, while not entirely free from vacuoles, sometimes arrayed in parallel bands, usually shows very few. More frequently the quartz is clouded with patches or streaks of iron-oxide. In the appearance of its slides it stands between rich quartz and the chert or jasper that occurs in this district in barren veins.

"The slides from Grass Valley, several mines in Amador and Calaveras Counties, California, in Sonora, Mon., New Mexico, and the newly-discovered quartz veins of Michigan, have been examined, taking the most prominent mines from which rich ore could be got. The Idaho, North Star, Empire, Allison, Tiger, Soaproot, Scorpion, Sheep Ranch, Nevill's, and Bonanza represent all the different characteristic veins of the California gold-belt. The photographs which were taken by Mr. W. H. Walmsley, of Philadelphia, clearly show the arrangement of the vacuoles and markings, more or less parallel in the rich quartz and irregular in the barren. This is so marked in some cases as to lead me to suppose that it would prove a good rule to distinguish rich and poor veins. However, the more slides that were examined the less certain it became as a positive sign. Still, there is a chance of error in the apparent exceptions. A poor piece of rich quartz may be sent to me instead of the quartz from the barren zone. No rich quartz that has been examined by me is without the parallel arrangement, more or less distinctly defined on some part of the slide, while the greater portion of the barren quartz show no such markings. The quartz of the enclosing schists does not show parallel vacuoles, but the arrangement of the minerals is parallel. There seems to be no special difference under polarised light. The rich quartz, however, is usually monochromatic, over a larger field, sometimes almost the entire slide, whereas the colouring of the poor slides shows a granular structure.

"From the examination of many rich gold-quartz specimens the conclusion was formed that the quartz was in a gelatinous condition when the gold was introduced rather than in the plastic condition of melted slag. A local circumscribed intense action must have been the cause of the deposits of rich gold pockets. In one case the quartz was covered with a rose-pink coating, where the gold was very rich; but, unfortunately, the specimen passed out of my hand before there was a chance of determining its value. The cavities between the quartz-crystals and the gold were filled with dried mud of strong solfataric smell. It would be premature to say that parallelism is a sure sign of rich ore, but if we judge from the material collected from the mines visited the indications are at least worthy of further investigation. They seem to show that the same causes which crowded the quartz with vacuoles in parallel bands impregnated the quartz with gold. If it could be proved that these vacuoles were filled with carbonic acid it might prove to be a second fact to weave into a theory of the deposition of auriferous quartz.

"Many of the slides show a peculiar formation along certain bands like streams of little disks of concentric structure. These seem to indicate chalcedonic change of the quartz. As a rule, the barren quartz has but few vacuoles, seldom arranged in lines. The dark spots shown in the slides, instead of being large vacuoles, are patches of foreign matter."

Annexed are eighteen photo-lithographs of slides of quartz. The following table gives the particulars of quartz-slides shown in lithographs:—