MINING.

FAULTING IN VEINS.

Written for the Engineering and Mining Journal by S. F. Emmons.

(CONTINUED.)

Fault planes do not, however, always run across the bedding planes, but may be nearly or quite parallel with them, and are then often called thrust planes. Such faults are less easily detected than the former class, and hence, as accurate and detailed examinations become more frequent, their proportion will probably increase. Faults are found of every degree of magnitude, from the great faults which form important orographic features and have displacements of thousands of feet, down to those which are so small that they can only be detected by the microscope. Whether slickensided or polished surfaces can be found upon their walls depends, as I have said, upon the nature of the material of these walls, whether it is of a character to receive a polish in the first place, and whether conditions are such as to preserve it in the second. If Mr. Church has never seen such surfaces on bedding planes, it is not because they do not occur in nature, nor are they confined, as he seems to think, to steeply upturned beds. I will cite a few instances.

The great porphyrite mass, or laccolite, of Gothic Mountain, in Colorado, which rests upon nearly horizontal black shales of the Cretaceous, has been moved on its base (how much there is no means of determining), and if one cares to climb its steep slopes about 700 ft. above the town of Gothic to the contact plane between shales and porphyry he will find the under surfaces of the latter, where it has been exposed by the undermining of the shales, striated by this movement. Again the gold veins which cross the stratification of these same shales near Breckenridge, Colo., have been faulted by a movement subsequent to the formation of the veins along the stratification planes of the shales. But thrust planes do not necessarily follow stratification lines, even where their divergence of angle is so slight as to be hardly perceptible to the eye, as may be observed in Smuggler Hill, at Aspen, Colo., where a fault of this nature along the steeply upturned beds has changed the relations of the silurian and carboniferous strata so as to make their apparent thickness vary very greatly in comparatively short distances. The coherence of rock masses is not necessarily very much less along bedding planes (which are merely indications of changes in the conditions of sedimentation) than along any other plane, unless they mark such very decided and abrupt changes in character of material that the pressure resulting from a great weight of sediments accumulated above would be likely to produce such a molecular deformation along them as is indicated by slaty cleavage.

Faults of great displacement or the great structural faults have been, as far as my experience teaches, but rarely the loci of mineral deposits. It is the faults of minor displacement, and more especially those forming zones or systems of fracture (what Daubree calls *cassures conjuguees*) that have more generally become mineral veins. But these differ from the former in degree rather than in kind. They present the same or similar phenomena as evidences of movement and pressure, but on a smaller scale. In picturing to one's self the working of the causes which have produced these phenomena, however, it is necessary to bear in mind that pressure is as important, if not a more important function than movement. It is the neglect of the importance of this function that would seem to have been the cause of many of the misconceptions of earlier writers on vein phenomena, especially that which led them to consider that the vein matter was the filling of a considerable open fissure into which fragments might fall freely from the walls as they might be dropped down a well, and with two distinct and well defined walls beyond which in either direction no vein matter would naturally be looked for.

A fissure continuously open for any considerable distance is inconceivable under the conditions of pressure which must have prevailed at the great depths at which most veins have been formed.

A fault fissure is rather to be regarded as a zone of crushed material along a fracture plane, produced by movement and pressure combined, whose width may vary, from the mere knife edge of small fissures of imperceptible displacement, to the 50 or 100 ft. of crushed material often found along the faults of great displacement. The original fractures, which determine the direction and location of these zones, were probably suddenly produced by some violent force in the nature of an earthquake shock or a volcanic explosion. But such fractures would not necessarily result in a visible fissure without a subsequent compressive strain which would produce a differential movement along the broken parts. They would at first be merely latent or potential cracks along which, although the cohesion of the original rock mass had been broken, some movement, however slight, was necessary for the production of an actual fissure; as we can conceive a mass of brittle material like glass, firmly inclosed by strong bands, to be struck a blow of sufficient violence to shatter it, if free, and yet to show few if any visible cracks until, after the removal of the bands, a differential movement had been produced among the parts.

(To be continued.)