

and no evidence of assimilation is present. The blocks may have been torn from the floor of the sill and risen to their present position. Such a phenomenon has been described by Campbell and Stenhouse.<sup>1</sup> Here a block of sandstone has been disrupted from the floor of a sill of teschenite and risen to the top of the sill and left trailers in its path. Thus underhand, as well as overhead, stopping is possible in a tabular intrusive body.

Bailey,<sup>2</sup> in his paper on the "Eruptive and Sedimentary Rocks of Pigeon Point, Minnesota," emphasizes assimilation in the following words:—

"More direct evidence of the action of the gabbro on the quartzite is found in the inclusion of the latter in the former. It will be remembered that the alteration of the fragments in the gabbro is in general similar to that of quartzitic fragments in the red rock. In the latter in certain cases the quartz fragments are surrounded by a rim of red material, which, under the microscope, presents all the appearances of the red rock, except in the presence of green flecks of chlorite. Quartzitic fragments in the gabbro are bordered by a rim exactly like the material in the red rock. At a point on the southern shore, in the eastern portion of the peninsula about  $\frac{1}{4}$  mile from the end of the point the rock cementing quartzite and slate fragments is similar to one of the rocks intermediate between the gabbro and the red rock, and whose formation is supposed to be due to the interfusion of these rocks. The origin of the cementing material of this breccia may be the direct solution of fragments in the gabbro. One of the fragments embedded in the intermediate rock is a large rhombohedral block of pink quartzite about 7 feet long and 4 feet wide. Surrounding this, between it and the including rock, is a bright border 2½ or 3 inches wide. The red feldspathic material has a granophyric structure in which fan-like groups of feldspar and quartz extend perpendicularly from the bounding planes of the inclusion. Since the rim is probably the result of the fusion of portions of the quartzite by the surrounding rock, and its structure and composition are identical with those of the red rock, it may fairly be concluded, in the absence of any evidence to the contrary that the red rock itself has been produced by the fusion of the quartzites by the gabbro—that it is a product of the action of the gabbro upon the slates and quartzites, melting the latter and thus producing a magma from which the red rock solidified."

In Bailey's concluding chapter on the origin of the red rock, he states that no positive determination can be made whether the gabbro is the cause of the red rock or the red rock is an original eruptive. Another solution to this problem might be given. If the intrusion is in the form of a sill, it may have been intruded as a magma of intermediate composition which later differentiated into gabbro and red rock. As the red rock contained most of the mineralizers, contact metamorphism would be greater in connexion with this phase than with the other and some assimilation of the enclosing quartzites would take place. This view is supported by the occurrence of heavy contact metamorphism only where the red rock has collected

<sup>1</sup>Campbell and Stenhouse, *Trans. of Edin. Geol. Soc.*, vol. 9, 1908, p. 121.

<sup>2</sup>Bailey, W. S., *U. S. G. S., Bull.* 109, 1893.