elusion that many of the great limonite deposits of the region are underlain by considerable pyrite, which, however, may be and probably is as a rule too greatly disseminated to be of any economic importance.

Part of the precipitation took place in open fissures in the limestones, but much of it was in the nature of replacement of the rocks that constitute the walls of the fissures. This feature was plainly shown in the Friedensville zinc mines, where the limestones were extensively replaced by pyrite.

The brown iron ores are invariably associated with a large amount of clay representing the residuum of shaly strata interbedded with the limestones and sandstones. These impervious shaly beds undoubtedly, to a large degree, furnished favorable conditions for the primary segregation of the pyrite through assisting the concentrated flow of the mineralized underground waters, and the places where the shaly strata were present were therefore most suitable for the deposition of the minerals that were carried in solution.

The presence of pyrite in the lower workings in considerable quantities seems to indicate that the ores cannot have been formed entirely by descending waters that have brought the iron in solution to these places, as is generally supposed. The abundance of pyrite invalidates the explanation of other writers who believed that the ores were deposited in the Cambro-Ordovician sea as limonites or that they represent the oxidation in place of iron carbonate ores that were deposited as marine precipitates. There are, likewise, valid objections to the explanation proposed by Chance,* who believed that the ores are gossan deposits that were formed by the oxidation of pyrite which was "a mechanically transported sediment, derived from the erosion of older eruptives." On account of the instability of pyrite it could hardly be liberated from igneous rocks through the decomposition of some of the constituent minerals without itself being oxidized, and the situation of most if not all the ore bodies in regions where the rocks have been greatly shattered might also be used as an argument against this view.

Whether the carbonate ores were formed during the primary mineralization cannot be definitely determined without additional information. The carbonate ores are found in the lower levels of both the valley-ore and the mountain-ore mines in association with the limonite, but data are lacking as to their association with the underlying pyrite. Where the ascending iron-bearing solutions came into contact with limestones or encountered carbonate waters from the limestones, it would be natural to expect the formation of siderite, and in all probability part of the iron in the primary segregation was precipitated as siderite and either replaced the rocks or filled fissures just as the pyrite did. In the Wharton mine, southeast of Hellertown, Northampton County, the carbonate ore was less abundant in the lowest workings than it was a short distance above them, which might mean that it did not extend into the region of unaltered primary mineral deposition and thus points to its secondary character. At present it is well to consider the carbonate ores as in part primary and in part