The first step in the formation of the ore was the segregation of the iron that was disseminated through the gneisses, sandstones, limestones, and shales of the region in the form of pyrite and siderite. Meteoric waters that passed downward through the strata dissolved the pyrite and siderite. When these solutions reached the shattered areas in the limestones or the zones of porous jasperoid rock that rested on gneisses the water in many places ascended, just as now the deep-seated waters of the region rise to the surface along fault or fracture zones. Even in the areas where only limestones are present, flowing wells have been obtained at depths of 750 feet, which shows the tendency of the deeper waters of the region to rise under artesian pressure when a passageway is provided.

In the Cambrian sandstones the ascending solutions precipitated pyrite in part as a filling of previous existing cavities and in part as a metasomatic replacement of the jasperoid rock or the shales that were interbedded with the quartzite, especially in the upper part of the formation. So few mines have been worked to the depth where the pyrite ore still persists that little evidence of the manner of deposition of the pyrite is available. Some specimens obtained from one of the mines about halfway between Emmaus and Mountainville indicate an almost complete replacement of the quartzite, but it is doubtful whether these are typical. Instead, it is probable that the substitution of the pyrite for the jasper and shales was irregular and variable. One of the chief supports of the view that ascending waters have caused the segregation of the pyrite is furnished by the depth to which the pyrite extends. It is now found at the greatest depths explored, far below ground-water level. The level of ground water has fallen as the valleys have been deepened by erosion, and therefore it is probable that part of the pyrite was formed at much greater depths than would be possible if it were segregated by descending waters. Besides, in the almost complete absence of any organic matter in the Cambrian quartzite it is difficult to see how the precipitation of the pyrite could have been accomplished by descending waters rich in oxygen, in which the temperature and pressure would have continually been on the increase. Decrease of temperature and relief of pressure were probably the dominant factors in the precipitation of the pyrite from the ascending solutions.

In regard to the valley ores, the primary segregation of pyrite by artesian waters as the first stage in the formation of the present ore bodies is less definitely known. The massive pyrite found in the lower levels of the Friedensville zine mines and the increase of pyrite with depth in many of the limonite valley-ore mines indicate the presence of pyrite beneath the brown ores in certain places, although the data are too meager to warrant the conclusion that a zone of pyrite is everywhere present. In a brown iron ore mine near Breinigsville enough pyrite was obtained in the lower levels to be profitably marketed. In most places, however, the mines were not worked deep enough to determine whether pyrite commonly underlies the limonite ores or not. The increase of sulphur in the ore caused some mines to become unprofitable, but the excess of water and the slumping of the clay banks were the principal causes for other mines closing before a zone of pyrite was reached. Nevertheless, the facts at hand warrant the con-