hundred feet in thickness, which are interstratified in the Laurentian gneissic series of North America, and have been traced in continuous lines of outcrop for hundreds of miles, have resulted from such an entire transformation of corresponding portions of the granitic, gneissic and pyroxenic rocks of the series. * These very ingenious writers further imagine that serpentine also, to which they assign, in accordance with the received views of this school, an origin by metasomatosis (or, as they call it, methylosis), from dolerite, melaphyre, diorite, euphotide, and other supposed plutonic rocks—is itself subject to a similar change into limestone. The existence of ophicalcites, the presence of masses of serpentine, and of such serpentinic structures as *Eozoon Canadense*, in limestone, are but so many evidences to them of a still uncompleted conversion of serpentine into limestone.

§ 110. Opposed to this view of the genesis of serpentines and limestones by change of substance, from plutonic rocks, is that which may be described as a general metasomatic theory adapted to neptunism, and which, recognizing the aqueous and sedimentary origin of limestone, would derive from it, by alteration, not only serpentine, but the various other silicated rocks mentioned above. Illustrations of this are seen in the supposed conversion of limestone into dolomite, and of this last into serpentine, both of which views have found many advocates. The probable change of limestone into granite and into gneiss, was suggested by Bischof, and Pumpelly subsequently, in 1873, proposed to explain the genesis of the bedded petrosilex-porphyries or halleflintas of Missouri by the transmutation of a stratified limestone, of which portions are found interlaminated with the petrosilex. † He, at the same time, suggested a similar origin for the hematitic iron-ore which accompanies these porphyries.

§ 111. With this second hypothesis of the origin of serpentines may be mentioned another, not, however, involving metasomatosis, which has sometimes been discussed, and which was suggested by the present writer in 1857, from the results of certain experiments on the artificial formation of silicates of lime and magnesia by the reaction between carbonates of these bases and free silica in presence of heated solutions of alkaline carbonates. Such a reaction is not without its significance, and, as I have elsewhere shown, has doubtless played a part in the local development of protoxyd-silicates in sediments in the vicinity of igneous rocks, and of thermal alkaline waters; but as an explanation of the genesis of great masses of comparatively pure silicates, such as olivine, serpentine and steatite, it is obviously inadequate, and was abandoned by the writer in 1860 for the view maintained below. ‡ Even if we could suppose the presence of sedimentary beds containing the requisite elements in proper proportions, it can be shown that the reactions required for the production of silicates were inoperative in the very regions where serpentine and steatite are found, since side by side with beds of these are to be met with in the Huronian series, in many places, beds of dolomite and of magnesite intimately mixed with quartz, sufficient in amount, if combined, to convert the accompanying carbonates into corresponding silicates.

§ 112. There remain then to explain the origin of serpentine, besides the three hypo-

* See for a discussion of the views of this school the author's Chem. and Geol. Essays, pp. 324-325; also, An Old Chapter of the Geological Record, by King and Rowney, 1881, chapters vii. and xii.

† Geological Survey of Missouri, Iron ores, etc., pp. 25-27; also the author on Azoic Rocks, pp. 194.

‡ Chemical and Geological Essays, pp. 25, 297, 300.