

are thrown into sharp folds, and even inverted, the direction of plication being generally N.N.E. and S.S.W. This disturbance has been accompanied by a marked crystallization. The limestones have become marbles, the sandy beds quartzites, and the other strata have assumed the character of slate, mica-schist, chlorite-schist, and gneiss, among which hornblendic, augitic, hypersthenic, and chrysolitic zones occur. The geological horizon of these rocks is shown by the discovery in them at various localities of fossils belonging to the Trenton and Hudson River subdivisions of the Lower Silurian system of eastern North America. The rocks have been ridged up and altered along a belt of country lying to the east of the Hudson and extending north into Canada.⁸⁶

Menominee and Marquette regions of Michigan.—One of the most luminous essays yet published on the megascopic and microscopic proofs of dynamic metamorphism is that by G. H. Williams to which reference has already been made.⁸⁷ The author proves that a series of pre-Cambrian rocks of eruptive origin (greenstones, tuffs, agglomerates, etc.) have been converted into perfect schists. The various stages of alteration are minutely detailed, and careful drawings are given of the microscopic structures. The deductions arrived at by the author have far more than a mere local significance; they lay an accurate basis for the study of similar "greenstone-schists" in other regions, and show how the original eruptive character of such altered rocks is to be recognized.

It may be useful to group the foregoing and a few other examples of regional metamorphism in stratigraphical order, that the student may see over how wide a range of the geological formations such transformation has taken place.

Tertiary.—Northern and Central Italy.—Nummulitic limestone rendered saccharoid, and strata (including Miocene) generally more indurated in proportion to the extent to which they have been folded and disturbed. These changes, which indicate an incipient

⁸⁶ See Dana, Amer. Journ. Sci. iv. v. vi. xiii. xiv. xvii. xviii. xix. xx.; Q. J. Geol. Soc. 1882, p. 397. The identification of the so-called Taconic schists of New England with altered Lower Silurian rocks has been called in question by Sterry Hunt, but the stratigraphical evidence collected by A. Wing, Dana and others, and the testimony of the fossils collected by Dana, Dwight, etc., have sustained it. In the Punjab a series of gneisses and schists overlies infra-Triassic rocks. Wynne, Geol. Mag. 1880, p. 314.

⁸⁷ Bull. U. S. Geol. Survey, No. 62, 1890.