

seen to be composed of quartz grains, chloritoid, an asbestos-like substance, and a mica, with abundant "clay-slate microlites," and diffused carbonaceous matter. It resembles the mica-chloritoid-schists of the Taunus. Some of the chloritoid-schists or quartz-phyllites associated with this plant-bearing band are also graphitic. Petrographical investigation thus concurs with the stratigraphical evidence to prove that a tract of the crystalline schists of the north-eastern Alps consists of metamorphosed Carboniferous rocks.

The Silurian rocks, which in the eastern Alps are gray-wacke and slate, become more and more crystalline as they are followed westward. The Liassic shales become mica-sized toward the central mountains, the fossils by degrees disappear, and the limestones, assuming a jointed aspect, finally pass into a completely crystalline condition. In the Vaud Alps, the belemnites of the middle Oxfordian shales gradually disappear in proportion as the rock becomes more schistose, till at the Diablerets it is an almost crystalline sericitic schist.<sup>78</sup> The Eocene strata, also, under intense compression, have assumed the character of slates, which are worked for economic purposes.<sup>79</sup>

So far, therefore, from being entirely a pre-Cambrian series, the crystalline schists of the Alps can be demonstrated to include metamorphosed Palæozoic and Secondary rocks along their outer border. How far toward the central mass of the mountains they are of Palæozoic age has yet to be determined. As the rocks become more and more crystalline in that direction it may not always be possible to define the base of the altered Palæozoic rocks. That there is a nucleus of ancient or "Archæan" gneisses is not disputed; but its limits must be proved by stratigraphical evidence.<sup>80</sup>

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<sup>78</sup> Renevier, Bull. Soc. Geol. France (3), ix. p. 650; xvii. 1889, p. 884.

<sup>79</sup> Lory, Bull. Soc. Geol. France, ix. 1881, p. 651.

<sup>80</sup> M. Vacek has shown an unconformability between the older central schists and the Silurian gneiss, diorite schist, mica-schist and chloritoid-schist. Jahrb. Geol. Reichsanst. xxxiv. 1884, p. 620. The Palæozoic and Secondary age of part of the schists of the Alps is enforced by Heim, "Mechanismus der Gebirgsbildung," 1878; Comptes Rend. Congrès Geol. International London, 1888, p. 16; Nature, xxxviii. 1888, p. 524; Quart. Journ. Geol. Soc. xlvii. 1890, p. 236. Grubenmann, Mittheil. Thurganischen Naturf. Gesellsch. Heft viii. 1888. Baltzer, "Beiträge zur Geol. Karte der Schweiz," No. 24, 1888. The volumes of these "Beiträge" contain ample details regarding the geological structure of the Alps. P. Termier, Comptes Rend. Acad. France, cxii. 1891, p. 900. Prof. Bonney holds that the crystalline schists of the Alps are older than the Palæozoic rocks. See, for example, his Address to the Geol. Soc. (Q. J. Geol. Soc. vol. xlii 1886, p. 66), and the same Journal for 1889, p. 67; 1890, p. 187; 1892, p. 390.