

oped in them abundant new minerals—garnet (1 to 2 mm.), hornblende, mica, titanite, apatite, bastonite, ottrelite.⁶¹

Dumont appears to have believed that the metamorphism which he had traced so well in the Ardennes was to be attributed to the influence of underlying masses of eruptive rocks, though he frankly admitted that the metamorphism is less marked where eruptive veins have made their appearance than where they have not.⁶² M. Renard, however, points out that eruptive rocks are really absent, and that the association of minerals proves that the metamorphosed rocks could not have been softened by a high temperature, as supposed by Dumont, otherwise the simultaneous presence of graphite and silicates, with protoxide iron bases, such as mica, hornblende, etc., would certainly have given rise at least to a partial production of metallic iron. He connects the metamorphism with the mechanical movements which the rocks have undergone along the altered zone.⁶³ The metamorphism of this region has since been described by Prof. Gosselet, who also regards it as due to dynamical causes.⁶⁴

T a u n u s.—A similar example of regional metamorphism extends into the tracts of the Taunus and Hundsrück. In 1867 K. A. Lossen published an elaborate memoir on the structure of the Taunus, which is now of classic interest in the history of opinion regarding metamorphism.⁶⁵ He showed that below the middle Devonian limestone, the usual lower Devonian slates, graywackes and quartzites rise to the surface, but that these, traced southward, pass gradually into various crystalline schists. Among these schists, he distinguished sericite-gneiss, mica-schist, phyllite, knotted schist,

⁶¹ Renard (Bull. Mus. Roy. Belgique, i. 1882, p. 14) estimates the components of one of these altered rocks to be—

Graphite.....	4.80
Apatite.....	1.51
Titanite.....	1.02
Garnet.	4.14
Mica.....	20.85
Hornblende.....	37.62
Quartz.....	30.62
Water.....	1.32
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	101.88

⁶² Renard, op. cit. p. 34.

⁶³ Op. cit. p. 37.

⁶⁴ See his great Monograph on the Ardennes, Mem. Carte Geol. France, 1888, chap. xxv.

⁶⁵ "Geognostische Beschreibung der linksrheinischen Fortsetzung des Taunus," etc., Z. Deutsch. Geol. Ges. xix. 1867, p. 509, 1885, p. 29.