

been cleaved or sheared, the mica ranges itself along the planes of cleavage or shearing. The Cambrian tufts of South Wales, of which the bedding still remains quite distinct, present interesting examples of the development of a mica along the laminæ of deposit.<sup>59</sup> The Dingle beds of Cork and Kerry, on the other hand, have been subjected to cleavage, and the mica appears along the cleavage planes, which have a lustrous surface. The Torridonian and Cambrian sandstones, quartzites and shales of northwest Scotland show a development of mica along the surfaces of the shearing-planes.

**Ardennes.**—As far back as 1848, Dumont published a description of the Belgian Ardennes, in which he showed that a zone of his "terrains ardennais et rhénan," had undergone a remarkable metamorphism. Sandstones, in approaching this zone, were transformed, he said, into quartzites, and by degrees passed into rocks characterized by the presence of garnet, hornblende, and other minerals; the slates (phylades) graduated into dark rocks, in which magnetite, titanite, and ottrelite had been developed. Yet the fossiliferous character of the strata thus metamorphosed had not been destroyed. In specimens showing a gradation from a grit to a compact garnetiferous and hornblendic quartzite, Prof. Sandberger, to whom they were submitted, recognized the presence of the two Devonian shells, *Spirifer macropterus* and *Chonetes sarcinulatus*. "The garnets and the fossils are associated in the same specimen," he wrote, adding, "who, after this, can hesitate to admit that the crystalline schists and quartzites of the Hundsrück and Taunus are likewise metamorphosed Taunusian rocks?"<sup>60</sup>

In 1882 M. Renard, fortified with the resources of modern petrography, renewed the examination of Dumont's metamorphic area of the Ardennes, and conclusively established the accuracy of all the main facts noticed by the earlier observer. Not only do the geological structure of this region, and the occurrence of recognizable fossils, show that the rocks, now transformed into more or less crystalline masses, were originally parts of the ordinary series of Devonian sandstones, graywackes and shales, but the microscope comes in to confirm this conclusion. The original clastic grains of quartz and the diffused carbonaceous material of the unaltered strata can still be recognized in their metamorphosed equivalents. But there have been devel-

<sup>59</sup> Q. J. Geol. Soc. xxxix. 1883, p. 310.

<sup>60</sup> Neues Jahrb. 1861, p. 677.