

change within the crust of the earth, whereby their original character has been so modified as to be sometimes quite indeterminable. Another geological arrangement is based upon the general structure of the rocks, and consists of two divisions: 1st, *Stratified*, embracing all the aqueous and sedimentary, with part of the less altered metamorphic rocks; 2d, *Unstratified*, nearly conterminous with the term igneous, since it includes all the eruptive rocks. Further subdivisions of this series have been proposed according to differences of structure or texture, as *porphyritic*, *granitic*, etc. These geological subdivisions, however, ignore the chemical and mineralogical characters of the rocks, and are based on deductions which may not always be sound. Thus, rocks may be included in the igneous series which further research may show not to be of igneous origin; others may be classed as metamorphic, regarding the true origin of which there may be considerable uncertainty.

A further system of classification, based upon relative age, has been applied to the arrangement of the eruptive rocks, those masses which were erupted prior to Secondary time being classed as "older," and those of Tertiary and later date as "younger." This system has been elaborated in great detail by Michel-Lévy, who maintains that the same types have been reproduced nearly in the same order in the two series, though basic rocks, often with vitreous characters, rather predominate in the later.<sup>107</sup> It must, indeed, be

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<sup>107</sup> See on this subject, J. D. Dana, Amer. J. Sci. xvi. 1878, p. 336. Michel-Lévy, Bull. Soc. Géol. France, 3d ser. iii. (1874), p. 199; vi. p. 173. Ann. des Mines, viii. (1875) "Roches Eruptives," 1889. Fouqué and Michel-Lévy, "Mineralogie Microgr." p. 150. Rosenbusch, "Mik. Physiog." ii. Reyer, "Physik der Eruptionen," 1877, part iii. opposes the adoption of relative age as a basis of classification. On the classification of compound silicated rocks, see Vogel-sang, Z. Deutsch. Geol. Ges. xxiv. p. 507; and for an incisive criticism of a too merely mineralogical classification, Lossen, op. cit. xxiv. p. 782. Consult also O. Lang, "Ueber die Individualität der Gesteine" in Tschermak's Min. Mittheil. vol. xi. part 6 (1890), p. 467.