may even have been here and there enough for the actual fusion of the rocks by the crushing of which it was produced.

Rise of temperature by intrusion of erupted rock.—The great heat of lava, even when it has flowed out over the surface of the earth, has been already referred to, and some examples have been given of its effects (pp. 385, 393). Where it does not reach the surface, but is injected into subterranean rents and passages, it must effect considerable changes upon the rocks with which it comes in contact. That such intruded igneous rocks have sometimes melted down portions of the crust in their passage can hardly be doubted. But probably still more extensive changes may take place from the exceedingly slow rate of cooling of erupted masses, and the consequently vast period during which their heat is being conveyed through the adjacent rocks. Allusion will be made in later pages to the observed amount of such "contact-metamorphism" (p. 990 *et seq.*).

Expansion.—Rocks are dilated by heat. The extent to which this takes place has been measured with some precision for various kinds of rock, as shown in the subjoined table:

Rock	Linear expansion for every 1° Fahr.	Authority
Black marble, Galway, Ireland	·00000247 = $\frac{1}{404858}$	Adie, Trans. Roy. Soc. Edin. xiii. p. 366
Gray granite, Aberdeen	·00000438 = $\frac{1}{228310}$	Ibid.
Slate, Penrhyn, Wales	·00000576 = $\frac{1}{173611}$	Ibid.
White marble, Sicily	·00000613 = $\frac{1}{163182}$	Ibid.
Red sandstone, Portland, Connecticut	·00000953 = $\frac{1}{104909}$	Totten, Amer. Journ. Sci. xxii. (1832), 136.[5]

According to these data, the expansion of ordinary rocks ranges from about 2·47 to 9·63 millionths for 1° Fahr. Even

[5] For additional results, see Mellard Reade's "Origin of Mountain Ranges" (1886), p. 109.