

## CHAPTER II.

## THE LAWS OF CHANGES OCCASIONED BY HEAT.

*Sect. 1.—Expansion by Heat.—The Law of Dalton and Gay-Lussac for Gases.*

ALMOST all bodies expand by heat; solids, as metals, in a small degree; fluids, as water, oil, alcohol, mercury, in a greater degree. This was one of the facts first examined by those who studied the nature of heat, because this property was used for the measure of heat. In the *Philosophy of the Inductive Sciences*, Book iv., Chap. iv., I have stated that secondary qualities, such as Heat, must be measured by their effects: and in Sect. 4 of that Chapter I have given an account of the successive attempts which have been made to obtain measures of heat. I have there also spoken of the results which were obtained by comparing the rate at which the expansion of different substances went on, under the same degrees of heat; or as it was called, the different *thermometrical march* of each substance. Mercury appears to be the liquid which is most uniform in its thermometrical march; and it has been taken as the most common material of our thermometers; but the expansion of mercury is not proportional to the heat. De Luc was led, by his experiments, to conclude "that the dilatations of mercury follow an accelerated march for equal augmentations of heat." Dalton conjectured that water and mercury both expand as the square of the *real temperature* from the point of greatest contraction: the real temperature being measured so as to lead to such a result. But none of the rules thus laid down for the expansion of solids and fluids appear to have led, as yet, to any certain general laws.

With regard to gases, thermotical inquirers have been more successful. Gases expand by heat; and their expansion is governed by a law which applies alike to all degrees of heat, and to all gaseous fluids. The law is this: that *for equal increments of temperature they expand by the same fraction of their own bulk*; which fraction is *three-eighths*