containing the same weight of oxygen be compared, it will be seen that the latter contains twice as much mercury as the former.

	Red Oxide	Black Oxide	
Oxygen	7.41	3.85	7.41
Mercury	92.59	96.15	185.18
	100.00	100.00	192.59

The composition of the black oxide can therefore be expressed by the tickets used on page 21 to represent that of the red oxide

mercury	mercury	oxygen
92.59	92.59	7.41

using two mercury tickets instead of one.

These multiple proportions are met with not only when the substances combining are elements, but also when they are chemical compounds—indeed if it were otherwise we should have an infallible means of recognizing the elements as such, which is far from being the case—for example :—

	Washing Soda	Baking Soda	
Sodium oxide	21.69	36.94	21.69
Carbon dioxide	15.37	52.35	30 74
Water	62.94	10.71	6.29
	100.00	100.00	58.72

By "simple ratio" Dalton understood 1 : 1, 1 : 2, 1 : 3, 2 : 3; even 3 : 4 was at first hardly regarded as "simple". Later work with the compounds of carbon and hydrogen, however, has brought to light such ratios as 360 : 361, so that the law of multiple proportions in its original form is not of general applicability. It holds very well for the compounds usually dealt with in first lessons on Chemistry.

4. *Law of combination of gases by volume.*

> There is a simple relation between the volumes[1] of the gases which disappear or are formed in any reaction involving only chemical compounds and elements.—
>
> Gay-Lussac, 1809.

For instance, two volumes of steam are formed by the combination of two volumes of hydrogen and one of oxygen; two volumes of carbon monoxide combine with one of oxygen to give two of carbon dioxide; one volume of steam on reacting with hot iron, gives an oxide of iron and one volume of hydrogen.

Later experiments have shewn that the ratios cannot be represented exactly by small numbers, and that they depend on the temper-

[1] As the volume of a gas depends on its temperature and pressure, all comparisons must be made under the same conditions.