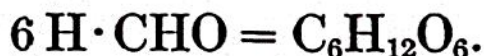


hydrogen in one molecule, and so that, further, the relative proportions of the three elements may become what they are in the simple carbohydrates, $C : H : O = 1 : 2 : 1$.

(2) Somehow individual carbon atoms must be joined together until there are six in each molecule, where formerly there was but one.

Theoretically, it might be possible by reduction to form from carbon dioxide and water without union of carbon atoms the following substances: carbon monoxide, CO ; formic acid, $H \cdot COOH$; formaldehyde, $H \cdot CHO$; methyl alcohol, CH_3OH ; and methane, CH_4 . Of such reductions the formation of formic acid, formaldehyde, and carbon monoxide has been directly realized by laboratory experiment.¹

The most familiar theory of the formation of carbohydrates in the leaf is that of von Baeyer, which assumes a polymerization of one of the above substances, formaldehyde, leading directly to the formation of sugar, according to the reaction



This process also has been carried out experimentally. Indeed, as a result of the investigations of Butlerow, O. Loew, and

¹See Meyer u. Jacobson's "Lehrbuch der Organischen Chemie," Leipzig, 1907, p. 688, 693-696.