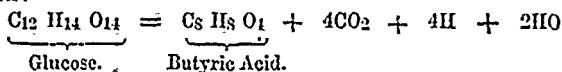


stances, only traces of carbonic acid are evolved, and the liquid becomes gradually so intensely acid, that the process of transformation is arrested unless the free acid be neutralised by some carbonate. After the lapse of some time the sugar is entirely converted into lactic acid, and hence the name of "lactic fermentation" which is given to this process. No mannite, and only traces of gum-like substances, are generated during the reaction. If the transformation of sugar be effected by *casine* at the temperature of the viscous fermentation (i.e., between 30° and 40° C.—86° and 104° F.) instead of at the temperature of the alcoholic fermentation, another change sets in, which gives rise to perfectly different products. Between these temperatures the process becomes very tumultuous, abundance of gas is given off, which is no longer pure carbonic acid, but contains a large proportion of hydrogen. If the liquid remaining after all action has ceased, be examined, it is found to contain an acid differing in every respect from lactic acid. The acid thus produced is volatile; it has the composition and all the properties of one of the acid constituents of ordinary cow's milk-butter, in fact, it is butyric acid. The transformation of sugar into butyric acid is represented by the following equation:—



But this butyric fermentation is but a further stage of lactic fermentation, preceded, as the formation of butyric acid invariably is, by the formation of lactic acid. But lactic acid, you recollect, differs from glucose simply by containing 2 equivalents of water less. So that, the conversions require no further explanation.

The transformation of sugar into butyric acid was discovered about ten years ago by Messrs. Pelouse and Gelis. It is a process of particular interest, inasmuch as it furnished the first direct proof of the controvertibility of sugar into fats,—a change which at that period was contested by physiologists.

From the statement which I have brought under your notice, you perceive that sugar must be looked upon as a sort of magazine of carbon, hydrogen, and oxygen, from which, by the action of fermentation, a very considerable number of different substances may be compounded. It is probable, not to say certain, that this number is by no means completed with alcohol, mannite, gum, lactic, and butyric acids, but that a further examination of this process, especially that of fermentations accomplished at certain different temperatures, and induced by a variety of ferments, will enable chemists to produce a vast series of bodies from sugar, which are at present obtained from perfectly different sources.