

However important it is to fully know the nature and chemical substances of wine and the law of fermentation, we must restrict ourselves to the absolutely necessary; it may also suffice, for most practical purposes, to know that the juice of the grape contains, chemically speaking,—

- (1.) *Sugar*, which afterwards, by fermentation, is transformed into alcohol. Most of the cellular substances in the unripe grape have transformed themselves, during the process of ripening, into sugar; the residue of these are thrown out during fermentation, and sink to the bottom. The less ripe the grapes, the more of these substances and the less sugar will be contained in the must.
- (2.) *Acids*.—Tartaric, tannic, and other acids, more or less, according to the degree of ripeness and the character of the grapes.
- (3.) *Albumen*.—A nitrogenous substance, plainly visible in the scum of the must; also some resinous substances, gum, affecting the body and taste of the wine; colouring matter adhering to the skin, giving the colour especially to red wines, and so called extractive matter. All these substances, and many more, which have been chemically analysed, are combined and dissolved in about three to four times their quantity of water in the juice of the grape.

As long as this juice is enclosed in the skin, which protects it from contact with the oxygen of atmospheric air, so long no fermentation can take place. As soon as the grapes are mashed, the influence of the air begins to act thereon. Spores of ferment are contained everywhere in our atmosphere, and develop themselves under certain conditions. They grow and augment in the must (as can be seen by the aid of a microscope), decomposing the sugar, setting the fluid in motion, and forming alcohol; at the same time the other substances combine, transform, and form new substances. Thus, however clear the unfermented juice may be, it becomes turbid by fermentation. The albumen commences to oxidize; the alcohol, while forming, separates the colouring matter from the skin; carbonic-acid gas is formed in the mass, pushing up the firm parts and forming a dense cover over the liquid; the gas is developed in increasing quantities and escapes with a bubbling noise, and the heat of the fermenting mass is augmented. Gradually all these phenomena disappear, fermentation becomes less stormy, and the undissolved substances and new-formed matter fall to the bottom. The new wine is formed; by degrees it becomes almost clear, but fermentation still continues slowly—almost imperceptibly; there are still substances of the must, finely distributed, floating in the young wine, and these substances, under an increased temperature, create anew a stronger fermentive motion, until the wine is clear and fully developed.

The more sugar grapes contain the more alcohol will be developed in the wine under proper fermentation, and the more durable will it be, from the fact that the floating yeast more effectually settles. The durability of a wine depends largely on the quantity of the remaining undissolved substances in the same; it is therefore necessary to free it from those substances as soon as possible. The more regular, uninterrupted, and complete the first fermentation, the more of the dregs or lees will have settled and the better the wine will become; particles of the sugar, however, remain floating undecomposed until after the second fermentation, usually during the time of the next blooming of the vines. Some of the acids, tannin, and albumen are also generally precipitated, and settle only during the second summer; and not till then can most wines be considered completely developed. Even after that period there is a further change perceptible in most wines. They become milder, and not only their taste but also their effects change. Old wines are considered less intoxicating and more beneficial; but there is a limit to this improvement by age, and very old wines become rougher and less palatable, unless younger wine is added from time to time.

It is self-evident that the qualities of wine depend on the combination and proportion of the above-mentioned substances in the must, and their proper development during fermentation. From analysis of the best wines we find that a good wine should contain from 10 to 12 per cent. of alcohol, from 1 to 3 per cent. extractive substances, and $\frac{1}{2}$ per cent. (5 to 6 per mille) acids, bouquet, and aroma in proper proportions (which cannot be expressed or measured by any scale).

The alcoholic strength of wines cannot be measured by any of the so-called wine scales; these show the specific gravity, but never the alcoholic strength. A small distilling apparatus, *alambic Salleron*, would be required for this purpose. (Instructions for its use accompany this instrument.) The wine-maker may, however, know in advance, from the sugar percentage of his must, how many per cent. of alcohol his wine will have after complete fermentation, calculating 1 per cent. of alcohol for every 2 per cent. of sugar, measured by Oechsle's well-known must scale. For a correct examination of the must, it should be clear (filtered), not yet fermenting, and its temperature about 65° F. (14° R. or 17° C.). Tables showing the percentage of sugar for the various degrees of Oechsle's scale may be obtained with the instrument. To determine the acidity of wines, as well as of must, we have now in Twichell's acidometer a safe and practical instrument.

Wines are generally classified, according to their saccharine substances, as follows:—

- (1.) Dry wines, in which all the grape sugar has been absorbed or transmuted by fermentation.
- (2.) Sweet wines, which still contain a considerable quantity of sugar.

The former might be called the wines of the North, the latter the wines of the South. The northern wines contain more acidity, and are consequently of a richer perfume; bouquet; the southern wines lack acidity; the spirituous element, sweetness, is predominating. They generally have no bouquet, and even the strong muscadine flavour of some southern grapes disappears in a few years.

With regard to colour, wines are classified as white and red wines, though there are many shades between the two extremes, from the pale greenish-yellow of the Kelly Island Catawba to the deep dark-red of our Norton's Virginia. The intermediate shades are generally not as well liked. Sometimes wines are also classified as still and sparkling wines—a merely artificial classification, as the sparkling is simply the result of a peculiar mode of manipulation (by fermentation in closed