Vineyard and fermentation practices affecting wine

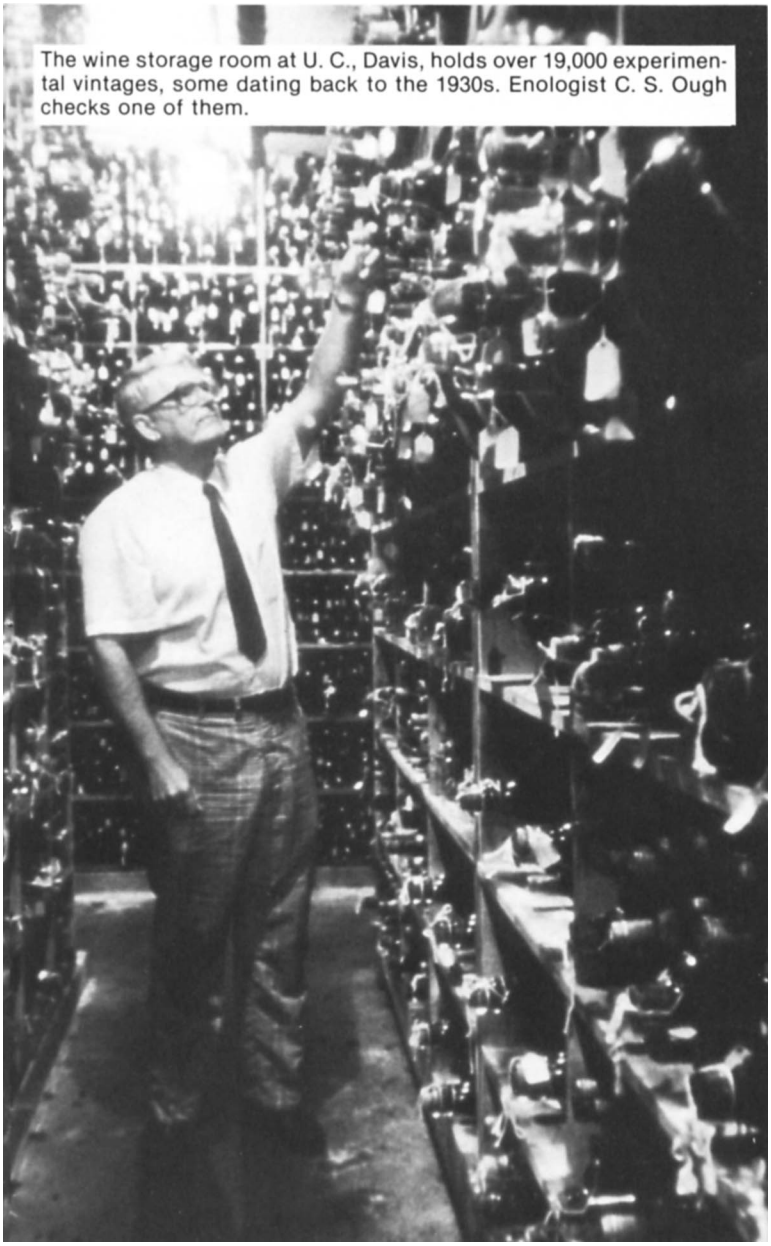
Cornelius S. Ough

It is seldom that some measurable wine quality attribute cannot be correlated with a chemical composition change. Sometimes, chemists' analytical tools are not precise enough to detect the chemical changes. Some vineyard treatments and practices that cause noticeable variations in wine are grape variety, climate, crop level, maturity, rootstock, irrigation, chemical vineyard sprays and dusts, harvesting techniques, and transport to the winery. Other indirect treatments may also alter the chemical makeup of the fruit and possibly cause quality changes.

Winery practices affecting quality include fermentation temperature, pressure fermentations, clarification of juice, treatments to produce flor sherry and botrytised wines, skin contact time, skin-juice management, and pure yeast starters.

Variety-regional evaluation

The great numbers of varieties planted randomly over the state 100 years ago caused much confusion as to which should be planted where. Professor E. W. Hilgard started the evaluation process in 1880, initially by grouping grapes into areas of origin (Italian, Bordeaux, and the like). In 1907, F. T. Bioletti suggested dividing the state into five climatic regions.



The wine storage room at U. C., Davis, holds over 19,000 experimental vintages, some dating back to the 1930s. Enologist C. S. Ough checks one of them.

In 1934 the Agricultural Experiment Station at Davis began further systematic variety evaluations. With improved facilities and techniques developed by M. A. Amerine and A. J. Winkler, large numbers of varieties were investigated for production, wines were made at Davis, and chemical and sensory evaluations were conducted. The varieties used for wine were sorted out, and a rational approach to variety evaluation began. Researchers pointed out the strong effect of climate on chemical composition and quality of the wines, and expanded the idea of climatic regional designation by the use of heat summations.

In 1963, after additional evaluations, the number of recommended grape varieties for wine use was decreased to less than 50 and then further reduced 10 years later.

Climatic variations in California are remarkable. Heat summations indicate that some areas approach the climate of northern Europe; others are similar to the deserts of North Africa. Amerine and Winkler in 1944 summed up the changes in chemical composition attributable to climate. The heat summation-regional designation is simply a method to separate the state into grape regions of some similarity and to structure the separation based on total heat summation. It does not account for microclimate variations and does not mean a great deal in predicting physiological response of the vines. It does correlate with distinct compositional changes in the fruit used for wine and quality differences in the wines.

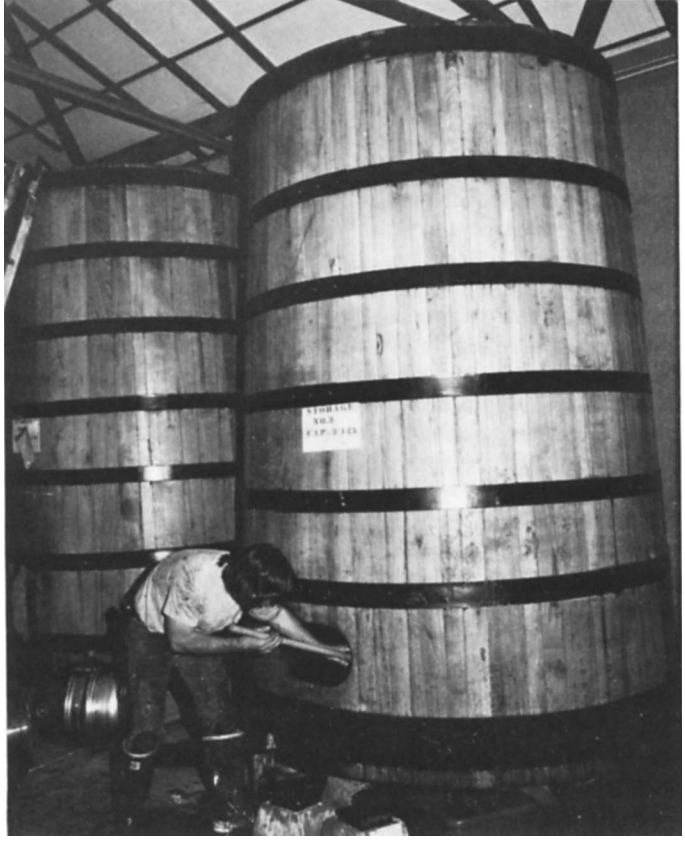
Crop level

Crop level studies are related both to the vine's ability to produce the largest crop possible and still survive and to the quality of the wine produced. In the 1950s U.C. researchers proposed relating the crop level of wine grapes to their Brix/acid ratio and, later, relating leaf area to grape quality. Crop level was related also to chemical composition and wine headspace volatiles. Further work established correlations between crop level and chemical components and certain wine quality components. Researchers have found that a "normal" crop may vary over a significant range with little change in overall wine quality.

Grape maturity

Grape maturity can be a critical factor in determining wine quality. The °Brix alone is not enough to go on in estimating maturity. Professor H. W. Berg's grade classification by total soluble solids and total acidity in 1953 (revised by the Wine Institute in 1960) is used as a basis for grading grapes as to quality. In studies on the relation of maturity to grape and wine composition and to wine quality in a cooler coastal area and a hot interior valley, we noted differences in the effects of maturity in the different climatic regions. Rate of change in certain components was greater in the warm regions when compared with the cooler regions.

U.C. researchers showed that wine grape berries could be separated in various stages of maturity by gradient separation. Demonstration of the importance of picking the fruit at the



Preparing a redwood storage tank for a new vintage in the Napa Valley. Many wineries are converting to stainless steel.

Opposite page: Drip irrigation of grapes in Napa Valley.

Far right: Harry Brenner, in charge of winemaking at U. C., Davis, takes a sample of must—the juice and grape skins—for analysis before fermentation.

Inset: The amount of time grape skins remain in contact with the juice affects the color, flavor, and style of the wine.

optimum maturity has led to rational vineyard sampling and improved harvesting of wine grapes.

It has always been recognized that wine quality is related to the quality of the fruit. All works stress the picking of mold-free or insect-free grapes for wine. Our controlled experiments have shown that most molds, beyond a small percentage of fruit infection, could cause off-tastes and aromas. Mold sampling techniques have been worked out for visual detection of moldy and rotten juice. The industry has asked the University to seek other ways to detect mold in grapes. Acetic acid provides one means, by indicating the activity of yeast and bacteria on the broken grapes. Other methods are being studied.

Juice clarification

Work by some U.C. researchers has suggested that the solids were detrimental to wine quality in white wine fermentations. Others have shown that the amount of solids, although changing the style of wines, was not necessarily detrimental. The presence of free sulfur in the grapes is a major cause of off-odor from hydrogen sulfide, and in this case the removal of solids, including the sulfur, is mandatory.

Another consideration is the effect of the solids on the yeast during fermentation. Musts relatively low in nutrients that grow a poorer crop of yeast will not finish properly, because the yeast settles out. A certain level of solids, whether grape solids or some other inert particulate matter, is essential to keep the yeast circulating and juice fermenting. Wines that do not finish fermenting properly tend to oxidize, lose fruitiness, and, in general, deteriorate in quality.

One important factor in increasing wine quality has been the understanding and use of temperature control during fermentation. Early U.C. research showed the necessity of cooling fermenting musts primarily to prevent temperatures from reaching levels that would cause the fermentation to become "stuck" (killing the yeast and allowing undesirable bacteria to grow). Recent U.C. studies on effects of fermentation temperature indicate that the concentration of maximum volatile esters depends on the ester and the fermentation temperature as well as on other factors.

The major conclusions of all these experiments were that white wines fermented at lower temperatures (10° to 15° C) and red wines fermented with skin contact at higher temperatures (25° to 32° C) were superior.

Use of pressure

Work in Germany suggested using CO_2 pressure to control fermentation rates, and this was partially accepted in Europe as superior to temperature control. U.C. data have since shown, however, that the German process could not be applied to California musts and conditions without problems, including difficulty in slowing fermentation (pressures in excess of 100 psig were required), difficulty in preventing malo-lactic bacteria growth during fermentation, and production of lower quality wines, compared with those made under temperature control.

Studies on the effect of CO_2 pressures on yeast growth, in suspension of growth at 30 psi of CO_2 in champagne in continuous sparkling wine production, explained the lack of successful verification of the Russian process.

In the late 1950s and early 1960s we elucidated the process of making flor sherry by submerging the yeast rather than by the normal method of film growth. Most of the flor sherry in the United States and much of it elsewhere now is made by this process or a variation of it.

A procedure was devised at Davis for artifically inoculating grapes with spores of *Botrytis cinerea*, controlling humidity and temperature to ensure rapid growth of the mold, and then rapidly dehydrating the grapes. It is an expensive process but is being used commercially to produce wines of exceptionally high quality.

Skin-contact time

The amount of skin-juice contact is a controllable variable that the winemaker can use in determining wine style.

The amount of skin contact can determine how long a red wine will be aged and the amount of color and flavor that will be extracted from the skins. The amounts extracted are related to the fermentation temperature, the amount of alcohol at time of press, and the color and flavor available in the grape.

For white wine, the length of desirable skin-juice contact is much shorter than for red wines; again style of wine is the determining factor. In our studies, varying the juice-skin contact caused significant changes in wine composition, with mainly increases in pH and total phenols among the variables measured. Differences in quality or "style" were also significant.

We found significant compositional and quality differences in wines made from grapes grown on two different stocks, St. George and 99R, in the Oakville area. The difference in stock vigor seems to cause the differences.

Cornelius S. Ough is Professor of Enology, Department of Viticulture and Enology, University of California, Davis.