3. *Stutzer's Method, Modified by Wilson.*—

No.	Grams aluminum phosphate.	Per cent. digestible albuminoids.
1	0.64	82.56
2	3.20	81.32

4. *Niebling's Method.*—

No.	Grams aluminum phosphate.	Per cent. digestible albuminoids.
1	0.64	86.35
2	3.20	82.18

These results differ materially from those obtained by the other methods of digestion.

5. *Niebling's Method, Modified.*—

No.	Grams aluminum phosphate.	Per cent. digestible albuminoids.
1	0.64	86.46
2	3.20	81.74

These results agree fairly closely with those obtained by method 4, but are materially lower than those obtained by methods 2 and 3.

From these results it appears that the influence of aluminum hydroxide on the digestibility of bread is about the same as that of an equivalent amount of alum, when present in about the quantity which is usually found as a result of the use of alum baking powder which contains no phosphate.

The action of aluminum phosphate is quite different, however, for notwithstanding the supposed insolubility of this compound, ten to twelve per cent. of the albuminoids which are digestible in the presence of alum or aluminum hydroxide appear to be insoluble in the presence of an equivalent amount of the phosphate.

[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE U. S. DEPARTMENT OF AGRICULTURE, SENT BY H. W. WILEY.—No. 9.]

SOME CHARACTERISTICS OF CALIFORNIA WINES.

BY W. H. KRUG.

AMONG the exhibits of American products at the World's Columbian Exposition, at Chicago, in the year 1893, one of the most interesting and varied was that of the California wine producers at the California State Building. The wines shown there, represented all the important districts in the state and the various types grown. At the suggestion of Dr. H. W. Wiley, Chief Chemist of the U. S. Department of Agriculture, the California viticultural commission sent a set of these wines to the laboratory of the department, where they were analyzed under my supervision. All important varieties were represented and the analyses were made as complete as possible. The wines were classified as follows:

DRY WHITE WINES—	36 of the Rhenish type.
	38 of the Sauterne type.
	6 of the white Burgundy type.
	7 miscellaneous.
DRY RED WINES—	37 of the Claret type.
	22 of the Medoc type.
	20 of the Burgundy type.
SWEET OR FORTIFIED WINES—	6 of the Sherry type.
	13 of the Port type.
	9 miscellaneous.
	—In toto, 194.

GENERAL REMARKS.

California wine producers grow European types almost exclusively, and it will be seen from the table of analyses that they aim to follow these types in their description as closely as possible. This is carried even to the extent of adopting the various styles of bottles used in the European trade.

A few of the white wines were considerably deeper in color than the European wines of the same type. By far the greater number, however, were perfectly clear and brilliant, showing that great care had been exercised in maturing and preparing for bottling. This was especially true of the red wines. The following determinations were made:

Specific gravity, alcohol by weight, alcohol by volume, extract, total acidity as tartaric acid, polarization of 26.048 grams in a 200 mm. tube, polarization of the wine in a 220 mm. tube, Wild polariscope, reducing sugar as dextrose, glycerol, tannin and coloring matter, albuminoids, ash, sulphuric acid in ash, potassium sulphate in 100 cc. of wine stated in grams, chlorine in ash, sodium chloride in 100 cc. of wine stated in grams, insoluble residue in ash, sulphurous acid and salicylic acid.

In the sweet wines, the polarization was determined after inversion and after fermentation, the result being stated both in terms of 26.048 grams and of the original sample. The work on the color intensity, and the presence of foreign coloring matters, has been delayed unavoidably and will not be ready in time for incorporation in this paper. It is intended to make this branch of the investigation especially complete.

METHODS OF ANALYSIS.

Specific Gravity.—The specific gravity was taken on an analytical balance by means of a Westphal bob whose displacement had been previously determined.

Alcohol.—One hundred cc. of the wine were placed in a flask with fifty cc. of water and a little precipitated calcium carbonate, the flask attached to an upright condenser and the contents of the flask subjected to distillation. To prevent the volatilization of the alcohol, the condenser tube should be made to extend almost to the bottom of the receiver. A 100 cc. flask was used for a receiver, and when 100 cc. of the distillate had passed over, the operation was interrupted and the flask removed, shaken, and the specific gravity of the distillate determined in the same manner as given under specific gravity. The percentage of alcohol by volume was determined from the specific gravity by table II, on page 213, in Bulletin 38, Division of Chemistry, U. S. Department of Agriculture, and the percentage of alcohol by weight was determined by multiplying the percentage of alcohol by volume, by the specific gravity of absolute alcohol and dividing that product by the specific gravity of the wine.

Extract.—The direct method was used. In the case of dry wines, fifty cc. were weighed and evaporated on the water-bath to a sirupy consistence in a platinum dish about eighty-five mm. in diameter. The residue was dried two and one-half hours in a drying oven at 100°. Of the sweet wines only ten cc. were weighed and diluted with distilled water before being evaporated.

Total Acidity (expressed as tartaric acid).—Ten cc. of the wine were carefully measured into a beaker, diluted with distilled water, and a few drops of neutral litmus solution added. Decinormal sodium hydroxide solution was used in the titration, and the neutral point was determined by placing a drop of the liquid on delicate litmus paper. This was found to work equally well on white and red wines. A standard solution of calcium hydroxide has been recommended for red wines, the end reaction being the appearance of a flocculent precipitate. I found it much more difficult, however, to observe this than to note the neutral point with sensitive litmus paper. Before this point is reached the natural coloring matter of the wine will change, indicating the approach of neutrality so that the operator can work without difficulty to within a tenth of a cubic centimeter.

Glycerol.—A. In dry wines. One hundred cc. of wine were evaporated down to about ten cc. on the water-bath with about five grams of fine sand. Milk of lime was then added until the reaction was strongly alkaline, and the evaporation carried almost to dryness. The residue was gently heated on the water-bath with about fifty cc. of ninety-six per cent. alcohol, and mixed with a glass pestle until a homogeneous paste was obtained. It was allowed to settle and the supernatant liquid filtered through a folded filter. The residue was repeatedly extracted in this manner until about 150 cc. of filtrate were obtained. To this a few pieces of glass or sand were added to prevent bumping, and the alcohol carefully distilled off over a small flame until about fifteen cc. remained. The evaporation was then continued on the steam-bath until the residue became sirupy. After cooling, it was dissolved in ten cc. of absolute alcohol and fifteen cc. anhydrous ether added, the flask well-stoppered and shaken. When the precipitate had collected on the sides of the flask, the clear liquid was decanted into a tared glass-stoppered weighing bottle capable of holding about fifty cc., the precipitate washed once or twice with a few cc. of a mixture of two parts of alcohol and three of ether, the washing being transferred to the weighing bottle. The ether-alcohol removed on the water-bath, the residue dried one hour in a water-oven and weighed. When the precipitate, caused by the addition of the ether, remains flocculent, it is separated by filtering through a small filter, which is then washed repeatedly with a few cc. of the ether-alcohol mixture.

B. In sweet wines. One hundred cc. of the wine are evaporated to a thick sirup on the water-bath with about ten grams of sand. The residue is repeatedly extracted with absolute alcohol until from 100 to 150 cc. have been used (the amount being varied with the amount of sugar present). The extracts are united in a large flask and one and one-half parts ether added for every part of alcohol used. The flask is stoppered and allowed to stand until the liquid is clear. Almost all the sugar is present in the sirupy precipitate while the glycerol remains in solution. The clear liquid is decanted into a flask, the residue washed repeatedly with small quantities of the ether-alcohol mixture and the united liquids distilled. The evaporation is completed on the water-bath, the residue washed into a porcelain dish by means of a little water, and treated as in A.

Polarization.—The wines were all polarized in a Schmidt and Haensch instrument with a 200 mm. tube. In the case of the dry wines, fifty cc. were evaporated sufficiently to permit the addition of three cc. of lead subacetate solution and three cc. of a saturated sodium carbonate solution to the white, and respectively six cc. of each solution to the red wines. The precipitate was filtered off and the filtrate polarized. In the case of the sweet wines twenty-five cc. were taken and made up to fifty cc.

The sweet wines were both inverted and fermented. For inversion twenty-five cc. were placed in a fifty to fifty-five cc. flask, two and one-half cc. strong hydrochloric acid added. The flask was heated in a water-bath to 68° C., consuming about ten minutes in heating. It was removed, cooled quickly to room temperature, filtered, and polarized. For fermentation, fifty cc. were placed in a wide-mouthed flask, a quarter of a cake of Fleischmann's compressed yeast and a sufficient amount of a potassium fluorid solution added, so that ten mgms. of this salt were present. The flask was allowed to stand four days at room temperature when it was found that fermentation was complete. The liquid was then washed into a 100 cc. flask, four cc. of lead subacetate solution, two cc. of mercuric nitrate solution (U. S. Department of Agriculture, Division of Chemistry, Bulletin 38, p. 198), and a varying amount of thick alumina cream added. It was then made up to 100 cc. with water, filtered, and polarized. The mercuric nitrate solution was added to destroy any bacteria which might impair the transparency of the filtrate when the latter, by any chance, stood for a length of time before being polarized.

If, after inversion, the wine polarizes more strongly to the left, unfermented cane sugar is present.

If, after fermentation, it polarizes to the right, the unfermentable constituents of commercial glucose are probably present.

Reducing Sugar.—This was determined by Allihn's gravimetric method and was calculated as dextrose.

Reagents.—1. 34.639 grams of crystalline copper sulphate dissolved in water and diluted to 500 cc.

2. One hundred and seventy-five grams of Rochelle salt.

One hundred and twenty-five grams of potassium hydroxide.

Dissolved in water and diluted to 500 cc.

In white wines. Fifty cc. were neutralized with sodium carbonate, the alcohol removed by heating on the steam-bath, made up to the original volume with water and filtered through a dry filter. When necessary, this solution was diluted with water to bring the reducing sugar down to one per cent. or less.

Thirty cc. of the copper solution, thirty cc. of the seignette solution, and sixty cc. of water, were placed in a beaker and heated to boiling. Twenty-five cc. of the sugar solution were then added and the whole boiled two minutes. The cuprous oxide was immediately filtered off and washed with hot water. It was then dissolved in dilute nitric acid, reduced to copper by the usual electrolytic method and weighed in that form.

The red wines were decolorized by filtering through bone-black, the first portion being rejected and the second portion treated precisely as the white wines.

Tannin and Coloring Matter.—The Löwenthal method was used.

Reagents.—Permanganate of potash solution: 1.333 grams of crystallized potassium permanganate in a liter of water.

Indigo solution: Six grams of sodium indigo sulphate and fifty cc. concentrated sulphuric acid per liter of water.

Decinormal oxalic acid solution.

Washed bone-black suspended in water so as to make a thin paste.

A. One hundred cc. of wine were dealcoholized by boiling and the lost weight restored with water. Ten cc. of the dealcoholized wine are transferred to a large porcelain casserole, twenty cc. of the indigo solution and about 750 cc. of distilled water added, and the titration carried out with the permanganate solution, adding a cubic centimeter at a time until the liquid becomes green, when it is added drop by drop until the color turns to golden-yellow. Result A.

B. Ten cc. of the dealcoholized wine are diluted with water, a few cc. of the bone-black added, the liquid well stirred with a glass rod and allowed to stand some time. The bone-black is then filtered off and washed repeatedly with water. The filtrate is diluted to about 750 cc. and titrated as in A after adding the indigo solution. Result B.

Result A—Result B=cubic centimeters required by the tannin and coloring matter. This is stated in terms of oxalic acid.

Ash.—The residue from the extract determinations was carefully incinerated and weighed. In the sweet wines, the ash was determined by charring the extract and exhausting with hot water. The insoluble residue, consisting mostly of carbon, was collected on a filter, washed, dried, and burnt separately, the residue from the water extract was added to this and the whole heated to low redness until white.

Albuminoids.—The Kjeldahl method was used, the wine being previously evaporated to dryness in the digestion flasks. The amount used varied with the wines, it being necessary to use as little as ten cc. of some of the sweet wines on account of the tendency to foam when digested with sulphuric acid.

Sulphuric Acid and Chlorine in the Ash.—The ash was digested with hot water and a few drops of nitric acid and filtered into a fifty cc. flask. The residue was washed with hot water until the flask was full to the mark. It was cooled, made up and the sulphuric acid estimated in an aliquot portion in the usual manner. In another portion the chlorine was determined volumetrically with $\frac{N}{200}$ silver nitrate solution. They were respectively converted to grams potassium sulphate and sodium chloride in 100 cc. of wine.

Insoluble residue in Ash.—The filter and residue were ignited in a weighed platinum crucible and weighed.

Sulphurous Acid.—In the determination of sulphurous acid 100 cc. of the wine were diluted in a distilling flask with fifty cc. of water, acidulated with five cc. of dilute sulphuric acid (H_2SO_4 one part, H_2O, three parts). The distillation was carried on in an atmosphere of carbon dioxide and the distillate received in a flask containing a measured quantity of decinormal iodine solution. The condenser tube should extend well below the surface of the iodine solution and in case a current of carbon dioxide be passed through the apparatus, the receiving flask should be closed with a mercury valve or attached to a U tube containing a portion of the iodine solution. In the progress of the work it was found more convenient to expel the atmosphere by the addition of a small quantity of sodium carbonate and in this case the guard-tube was found to be unnecessary. After about 100 cc. have distilled over, the excess of iodine is determined with decinormal sodium thiosulphate solution.

Salicylic Acid.—The following method was worked out by Mr. W. D. Bigelow who had charge of this branch of the investigation.

Seventy-five cc. of the wine are placed in a separatory funnel, acidified with five cc. of dilute sulphuric acid (H_2SO_4 one part, H_2O three parts) and extracted with a mixture of eight parts of sulphuric ether and one part of petroleum ether. The ether is washed once with water and then thoroughly shaken with about twenty-five cc. of water and six to eight drops of a five-tenths per cent. solution of ferric chloride. The aqueous layer contains most of the coloring matter in combination with the iron and is discarded. The ether is then washed with water, transferred to a porcelain dish, evaporated to dryness and the residue heated to the full temperature of the steam-bath for a few minutes. When the dish has become cool from four to five cc. of water are added, the insoluble matter filtered off after a few minutes and the filtrates tested for salicylic acid by the addition of three to four drops of a five-tenths per cent. solution of ferric chloride. By this method an excellent clarification may be obtained with white wines and with most red wines. Sometimes, however, with the latter, a second extraction is necessary

General Remarks Concerning the Methods of Judgment.

There being no law in this country which governs and regulates the chemical composition of wines it was deemed advisable to apply some foreign standard. It is true that our wines grown under different climatic and soil conditions cannot be judged with absolute fairness by a standard based on the composition of European natural wines. Such application can only be of value as a means of comparison and was applied only in such sense.

The standards used were those adopted in the German Empire. On account of the lengthiness of the report made by the Royal Commission empowered to frame the regulations, I will only mention the more salient points relating to the constituents of wine. They are as follows:

Wines which have been prepared solely from pure grape juice contain only rarely less than one and one-half grams extract per 100 cc. If, therefore, a wine is found to contain less it must be rejected unless it can be proved that other wines of the same type and year exhibit the same peculiarity.

After deduction of the "fixed acid" the extract-rest in natural wines equals at least one and one-tenth grams per 100 cc., after deduction of the total acid at least one gram.

A wine in which the ash equals more than ten per cent. of the extract, should contain a correspondingly larger amount of extract than is usually assumed to be a minimum. In natural wines the ash and extract are very often found to be in the proportion of one to ten. A considerable variation from this ratio, however, does not justify the assumption that the wine is adulterated.

In accordance with experience the free tartaric acid does not amount to more than one-sixth of the "fixed acids."

The ratio between glycerol and alcohol can vary in natural wines from 7:100 to 14:100. Wines having a different ratio have had either alcohol or glycerol added to them.

As during the various manipulations which the wine undergoes, small amounts of alcohol (not more than one per cent. volume) may get into the wine, this must be considered in judging wines. The above limits and ratios are not always applicable to sweet wines.

For the individual inorganic constituents no reliable limits can be given. The supposition that better wines always contain more phosphoric acid is without foundation.

Wines containing less than 0.14 gram ash per 100 cc. must be rejected unless it is shown that other natural wines of the same type and year show the same peculiarity.

Wines containing more than 0.05 gram NaCl in 100 cc. must be rejected.

Wines containing more than 0.092 gram of SO_3 per 100 cc. (corresponding to two grams of K_2SO_4 per liter) must be designated as having been treated with gypsum, *i. e.*, plastered.

Various circumstances or influences can make a wine ropy, dark, brown, turbid, or bitter, or can change its color, taste, and odor. The coloring matter of red wines may thus be precipitated. None of the above phenomena justify the assumption that the wine is not genuine.

A second fermentation in a wine does not absolutely indicate the addition of sugar or sweet substances. Very often the original fermentation is hindered, or a sweet wine may have been added to the original completely fermented wine.

In only a few samples were deposits noticeable, most of the wines, both white and red, presenting a fine appearance and showing that they were well-matured before being bottled. Deposits were much more prevalent among the white than among the red wines. In the analytical tables, the wines are classified by types, and this classification is followed in the discussion as far as practicable.

To facilitate discussion of the results the most important points were arranged as follows:

1. Are substances present which are not characteristic of pure natural wines and deleterious to health?

2. Is the quantitative composition of the wines such as is shown by European natural wines?

3. In what manner have the manipulations varied from those used in the preparation of pure natural wines?

First.—Are substances present which are not characteristic of pure natural wines and deleterious to health?

Such substances may be unfermented cane sugar, the unfermentable constituents of glucose, potassium sulphate, sodium chloride, sulphurous acid, and other preservatives. Some interesting data were obtained in this connection.

Among the twenty-eight sweet wines there was only one, Port, No. 12,814, that gave a zero polarization after fermentation. In every other instance, as will be seen from the tables, there was a dextro rotation showing possibly that commercial glucose had been used for purposes of fortification. It is well-known, however, that this substance is not used in California, and, therefore, this dextro rotation is not positive proof of the use of glucose. All but five gave an increased left-handed reading after inversion, indicating the presence of non-inverted sucrose. Although there can be no objection to the presence of sucrose or invert sugar, it has not been determined as yet whether the unfermentable constituents of glucose, the most important of which is amylin, exert any specific physiological action on the human body, and as long as this is the case any decision on their injuriousness must be withheld.

To produce sweet wines it is absolutely necessary to add some saccharine substance to obtain the desired strength in alcohol and requisite sweetness. It would be much more rational, however, for the producer to use cane sugar, which can be procured pure so easily, especially as it has hitherto been impossible to obtain pure dextrose at a price which would render its use profitable.

There were found only three wines which exceeded the German limit for potassium sulphate; namely, Gutedel, No. 12,678, with 2.321 grams per liter, Zinfandel, No. 12,713, with 2.392 grams per liter, and Burgundy, No. 12,714, with 2.315 grams per liter, the latter two being from the same winery. Plastering is therefore not used very much to excess by California wine producers. Plastering is the commercial term applied to the treatment of the grapes with burnt gypsum. All Spanish, Italian, and Greek wines are extensively plastered. In Greece, a layer of grapes is placed in a low cistern and well-covered with gypsum, which is followed with another layer of grapes in turn covered as before, this being continued until the cistern is full. After from twelve to twenty-four hours the grapes are mashed by treading and the must filled in casks. The use of gypsum secures a quicker ripening and better color. The chemical changes taking place are, in brief, as follows:

The potassium bitartrate and calcium sulphate react forming calcium tartrate and potassium acid sulphate, of which the former, on account of its insolubility, separates almost entirely during fermentation. This insolubility is also the cause of the rapid clearing of the wine after fermentation. The improved color of a wine thus treated is stated by Kayser to be due to the presence of free phosphoric acid. Plastering has become very popular in France, as it enables the producers to supply a cheap red wine by avoiding the expense attached to a long period of ripening. Plastered wine contains the same amount of potash as the must, while in a natural wine the precipitation of potassium bitartrate decreases the potash more or less. Pure must contains rarely as much as two-tenths gram of SO_3 per liter, while in plastered wines this is greatly exceeded, often amounting to eight-tenths to two grams per liter. Plastered wines always show a higher ash than natural wines. Thus a wine of from eight to ten volume per cent. alcohol and 2.2–2.3 grams extract per 100 cc., which normally contains 0.2–0.25 gram of ash per 100 cc. will, after plastering, contain 0.28–0.35 gram. A plastered wine made from pure must will always contain at least one-tenth gram of potash per 100 cc., and usually considerably more.

From a physiological standpoint the only objection to plastered wines is the presence of potassium sulphate. Although it is evident that the consumption of a large quantity of such wines would be necessary to produce a physiological action on a normal individual, it must likewise be considered that much smaller quantities may be harmful to invalids and children. When we keep the fact in mind that the southern sweet wines are the ones preferred for medicinal use, and at the same time the ones most extensively plastered, we can appreciate the force of these remarks. None of the California sweet wines analyzed exceeded the limit, two grams per liter, although one, Port, No. 12,710, approached it with 1.861 grams per liter.

All the dry white and the sweet wines, with the exception of the Ports and Sherries, were examined quantitatively for sulphurous acid and only twelve were found that contained none. In every other case the amount present exceeded the limit placed by the German law. Even when we adopt the limit suggested by the Association of Bavarian Representatives of Applied Chemistry; namely, 0.01 gram per liter, we find that all the wines analyzed that were found to contain sulphurous acid exceed this by far. They are sulphured excessively. Sulphuring is, without doubt, one of the most important adjuncts to the manufacture of wine.

The use of sulphurous acid is very old. Arnolf de Villanova mentions it in his work on wine manufacture printed in 1830 and von Holburg in 1587 recommended the use of sulphur to fumigate the casks and directed to burn three sticks and then close the cask so as to retain the fumes. He found that this insured good and perfect wines that did not deteriorate on standing. In a book published in Nuremberg in 1708 entitled "Der Kuriose Kellermeister," the amount of sulphur required for a 600 liter cask is given as seventeen grams. In a book published in 1775 under the title "Treatise on the Improvement of Wine and the Prevention of Injurious Practices in Wine Making." This statement is made on page 75: "Fumigation is necessary and important, first to preserve the wines and cask and second to improve the wine."

Only twice have attempts been made to replace sulphur. Once when the use of alcohol was suggested and again when it was believed that an ideal preservative had been found in synthetic salicylic acid. Neither realized the expectations of its promoters and sulphuring to-day still holds the same position that it has for centuries. Sulphuring is used to fumigate the casks, to prevent oxidation in the wines, and to prevent diseases peculiar to the wines.

Technically the use of sulphur is, without doubt, wrong. Wine ages by a slow process of oxidation which is absolutely interrupted as long as any sulphurous acid is present. As a preservative, sulphurous acid in the amount used is not an unqualified success as is shown by the necessity of repeating sulphuring when a wine stands for some time before being consumed. Nessler found that from thirteen to eighty-one mgms.

per liter were required to prevent the browning and turbidity of red wines. Moritz found that the growth of mycoderma vini was not indefinitely hindered until 0.05 per cent. sulphurous acid was present. All these figures far exceed the limits of the European laws.

From a physiological standpoint the presence of sulphurous acid is objectionable not so much on account of any possible immediate action but more through the cumulative effect on the digestive tract. Such effects will rapidly become general throughout the whole nervous system. In connection with this the experiments of Braun and Bematzik are of interest. They are the only ones made on man and showed that doses of eighty mgms. upwards caused serious irritation of the alimentary canal. Husemann and Bischoff recorded several cases where the consumption of freshly sulphured wine caused physiological disturbances and severe headache in persons otherwise accustomed to wine.

A further objection is the formation of bisulphates and even of free sulphuric acid in frequently sulphured wine. These also have a physiological action which cannot well be overlooked.

Eighty-seven wines were examined for sulphurous acid. Thirty-three of those contained more than eighty mgms. sulphurous acid per liter. Of these twenty-nine contained over 100 mgms., nine of 200 mgms., and two over 300 mgms.

All wines were examined for salicylic acid and only four were found to contain this preservative; namely, Sauterne No. 12,631, heavy reaction; Claret No. 12,633, very heavy; Port No. 12,627, distinct; and Port No. 12,710, heavy. It is hardly necessary to explain the objections against this preservative and it is a pleasure to find it so little used by wine producers in California. Nos. 12,627, 12,631, and 12,633 are wines from the same firm.

Second.—Is the quantitative composition of the wines such as is shown by natural wines?

All the wines analyzed show when compared with European wines one striking difference, their much lower glycerol-alcohol ratio. According to the German law this should not be lower than seven nor higher than fourteen, sweet wines to be excepted. A glance at the analyses will show that in California wines it rarely rises to eight or above and that the average is from five to six. Baumert in his work on seven California wines also found this to be the case and makes the assertion that it is due to a slight alcoholizing of the wines. In our work we have, however, found it to be a general characteristic and it hardly seems possible that wine producers should practice this mode of fortification so universally. I am rather inclined to believe that the proper solution of the problem will be found in a careful study of the processes of fermentation as they take place in the California wines. It is probable that the fermentation takes place too rapidly to permit of the formation of a proper quantity of glycerol.

A comparison between the composition of California wines and European wines of the same type is difficult as the propriety of applying the same form of judgment to two kinds of wine grown under different conditions of soil and climate is doubtful. Still it may be of interest to call attention to the points wherein they differ.

For purposes of comparison the analyses given in König, Chemie der menschlichen Nahrungs-und Genussmittel were used.

Wines of the Rhenish Type.—The California Riesling is distinguished according to these analyses by a higher alcohol and lower extract content, and a somewhat lower acidity. The percentage of glycerol present is in most cases much lower. The California Riesling varies from 8.45–11.67 per cent. alcohol by weight, 1.66–2.61 per cent. extract, 0.478–0.658 per cent. total acid as tartaric acid, and 0.501–0.932 per cent. glycerol, while German Riesling varies from 5.90–10.15 per cent. alcohol by weight, 1.7–3.21 per cent. extract, 0.395–1.250 per cent. total acid as tartaric acid, and 0.49–1.34 per cent. glycerol.

California Gutedel, on the other hand, is higher both in alcohol and extract, while the acidity is somewhat lower. It varies from 9.67–11.16 per cent. alcohol by weight, 1.67–2.34 per cent. extract, and 0.467–0.662 per cent. total acidity. German Gutedel shows from 7.12–8.23 per cent. alcohol by weight, 1.67–2.01 per cent. extract and 0.241–0.830 total acidity. The California wine shows in accordance with its higher percentage of extract a higher ash than the German wine.

No analyses of German Hock could be found, so it is impossible to draw comparisons on this wine, though its close agreement with the two wines just discussed makes it highly probable that it will exhibit the same characteristics. In general, these wines are all somewhat stronger in alcohol and higher in extract than the German wines of the same type.

Wines of the Sauterne Type.—A comparison of the minima and maxima and means of American Sauterne with those of French Sauterne show that although the average California Sauterne shows a higher alcohol content, wines are found on the French market that exceed the highest found in our work. California Sauterne shows a lower extract and acidity, while the percentage of glycerol is far below that found in French wines. The following figures will exhibit this. California Sauterne: Alcohol by weight, 8.43–12.18 per cent., extract, 1.7–4.03 per cent., acidity, 0.422–0.641 per cent., and glycerol, 0.178–0.850 per cent. French Sauterne: Alcohol by weight. 9.05–12.49 per cent., extract, 2.47–3.54 per cent., acidity, 0.54–0.75 per cent., and glycerol, 0.866-1.03 per cent.

The same general characteristics are true of the other miscellaneous California white wines analyzed. On the whole, all these wines exhibit a higher alcohol, somewhat lower extract and acidity, and a much lower percentage of glycerol.

Wines of the Claret Type.—The various California representatives of the Claret type, the most important of which is the Zinfandel, all show a higher percentage of alcohol, extract and total acid, and a lower glycerol content than the French Clarets. California Zinfandel shows the following minima and maxima: Alcohol by weight, 9.15–10.5 per cent., extract, 2.28–3.37 per cent., total acidity, 0.635–0.871 per cent.; glycerol, 0.446–0.634 per cent. California Claret gives the following figures: Alcohol by weight, 9.16–11.23 per cent.; extract, 2.36–3.34 per cent., total acidity, 0.601–0.783 per cent., and glycerol, 0.484–0.620 per cent. French Clarets vary within the following limits: Alcohol by weight, 7.45–9.32 per cent., extract, 2.0–3.0 per cent., total acidity, 0.47–0.78 per cent., and glycerol, 0.55–0.99 per cent. In accordance with the higher extract a higher ash was found in California Clarets; *viz.*, 0.235–0.342 per cent., French Clarets giving 0.19–0.31 per cent.

Wines of the Medoc Type.—These wines are represented in California by the Cabernet, Malbec and Medoc. Only the last could be compared with French wines, no analyses of wines of the first two subtypes being found. Here it was again found that the California wines were characterized by a higher percentage in alcohol, extract and acidity, while the glycerol was much lower than in the French Medocs.

The following minima and maxima were obtained. California Medocs: Alcohol by weight, 11.75–12.4 per cent., extract, 2.33–2.92 per cent., acidity, 0.614–0.824 per cent., and glycerol, 0.371–0.556 per cent. French Medocs: Alcohol by weight, 9.50–10.70 per cent., extract, 1.96–2.60 per cent., total acidity, 0.380–0.680 per cent., and glycerol, 0.640–1.04 per cent. Corresponding to the higher extract a higher ash was found in the domestic wines; *viz.*, 0.304–0.386 per cent. French Medocs showing from 0.21–0.297 per cent.

Wines of the Burgundy Type.—Only one analysis of a Burgundy wine was in König. A comparison with this showed the California Burgundies to contain a higher percentage of alcohol, extract, acidity, and ash than French Burgundy, while the glycerol is lower. The following minima, maxima, and means were obtained:

CALIFORNIA BURGUNDY.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by volume	10.97	15.48	12.57
Extract	2.20	3.48	2.79
Acidity	0.594	0.783	0.674
Ash	0.190	0.362	0.283
Glycerol	0.464	0.640	0.551

CALIFORNIA MATARO.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by volume	9.58	13.40	12.38
Extract	2.24	3.39	2.79
Acidity	0.601	0.837	0.673
Ash	0.203	0.322	0.278
Glycerol	0.544	0.583	0.553

French Burgundy: Alcohol by volume, 11.23 per cent., extract, 2.63 per cent., acidity, 0.390 per cent., ash, 0.210 per cent., and glycerol, 0.680 per cent.

A general comparison of all California dry wines shows, therefore, that they are characterized by a high percentage of alcohol and low percentage of glycerol. In the white wines, the extract, acidity and ash are generally lower than in foreign wines while in the red wines these constituents are higher.

SWEET WINES.

Wines of the Sherry Type.—California Sherries on the whole are lower in alcohol than Spanish Sherries. They are higher in extract, which is due to the presence of unfermented grape sugar. The total acidity is higher while the ash and glycerol are lower. Following are the minima and maxima: California Sherry: Alcohol by weight, 14.38-17.57 per cent., extract, 3.33-9.38 per cent., acidity, 0.378-0.797 per cent., reducing sugar, 1.20-6.17 per cent., ash, 0.211-0.420 per cent., and glycerol, 0.325-0.722 per cent. Spanish Sherries: Alcohol by weight, 16.01-19.88 per cent., extract, 2.69-5.40 per cent., acidity, 0.250-0.640 per cent., reducing sugar, 0.52-3.77 per cent., ash, 0.200-0.660 per cent., glycerol, 0.220-0.910 per cent.

Wines of the Port Type.—These wines exhibit in general the same characteristics in comparison with Portuguese Ports as the Sherries; namely, a slightly lower percentage of alcohol, and a higher extract and acidity. The glycerol is in these wines slightly higher. The high extract is due to the presence of unfermented grape sugar. The following data were obtained: California Ports: Alcohol by weight, 11.97-17.40 per cent., extract, 8.52-16.51 per cent., acidity, 0.412-0.674 per cent., reducing sugar, 5.16-13.00 per cent., and glycerol, 0.161-0.688 per cent. Portuguese Ports: Alcohol by weight, 15.71-17.87 per cent., extract, 6.69-9.90 per cent., acidity, 0.290-0.470 per cent., reducing sugar, 4.42-8.12 per cent., and glycerol, 0.230-0.710 per cent.

COMPARISON OF CALIFORNIA MUSCATEL WITH OTHER WINES OF THAT NAME.

California Muscatel approaches the Syrian Muscatels in its alcohol content. No strict comparisons can be drawn between it and Sicilian Muscatels as the latter vary within too wide limits. It is stronger in alcohol and has in general a lower extract than the Greek Muscatels, due no doubt to the fact that a large quantity of concentrated must is added to the finished wine in Greece so as to obtain a very sweet product. The glycerol content is higher and the ash and total acidity lower than in foreign Muscatels.

The following minima and maxima will show the differences existing:

CALIFORNIA MUSCATEL.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by weight	10.45	15.50	13.63
Extract	17.01	18.62	17.55
Acidity	0.317	0.405	0.369
Reducing sugar	43.18	16.30	14.66
Glycerol	0.866	1.014	0.941
Ash	0.148	0.192	0.113

SYRIAN MUSCATELS.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by weight	10.67	15.26	13.63
Extract	4.22	18.86	9.76
Acidity	0.430	0.830	0.646
Reducing sugar	0.25	4.50	3.13
Glycerol	0.320	2.00	0.857
Ash	0.210	0.960	0.495

GREEK MUSCATELS.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by weight	9.44	11.62	10.57
Extract	13.32	24.13	15.27
Acidity	0.410	0.751	0.566
Reducing sugar	13.50	18.86	15.01
Glycerol	0.564	0.950	0.718
Ash	0.290	0.388	0.321

SICILIAN MUSCATELS.

	Minimum. Per cent.	Maximum. Per cent.	Mean. Per cent.
Alcohol by volume	6.00	24.66	15.34
Extract	3.56	38.18	20.08
Acidity	0.270	1.140	0.630
Reducing sugar	12.50	29.01	17.16
Glycerol	....	....	....
Ash	0.170	0.860	0.410

Five other samples of sweet wines were analyzed; namely, three Angelicas, one Tokay, and one Catawba. Of these, the Tokay is the most interesting as it differs in every respect from the Hungarian Tokays. The percentages of alcohol and glycerol present are much higher; the extract, reducing sugar, acidity, and ash, lower. It is a more completely fermented wine.

Third.—In what manner have the manipulations differed from those employed to produce a pure natural wine?

With the exception of the extensive use of sulphur very little can be said against the dry wines. They are almost all well fermented and matured grape juice. All the white wines but twelve have been excessively sulphured, three exceeded the limit for potassium sulphate, and four contained salicylic acid.

Two wines of the Sauterne type, Nos. 12,653 and 12,775, were excluded from the averages as evidently not representative wines, No. 12,653 gave 6.69 per cent. extract, and 3.52 per cent. reducing sugar, while No. 12,775 gave 5.48 per cent. extract. The glycerol was respectively 0.432 and 0.456 per cent. They were evidently incompletely fermented wines.

No. 12,792, a dry white wine, proved an interesting sample. It furnished the following figures: Alcohol by weight, 9.53 per cent., extract, 1.1 per cent., glycerol, 0.321 per cent., ash, 0.191 per cent., ash extract ratio, 17.36 per cent., extract-rest, 0.56 per cent. There is no doubt in my mind that this is merely an artistic mixture that never saw a vineyard but had its birth in the cellar of some wine mixer.

Another sample, No. 12,684, a miscellaneous red wine, gave only 0.105 per cent. total acid. The manufacturer here, no doubt, has used chaptalization to reduce the acidity and succeeded beyond his expectation.

Cane sugar is undoubtedly used by many to sweeten their wines, as is shown by the increased laevo rotation after inversion.

On the whole, it is evident that the California dry wines are fully equal to the European wines, and the red wines are in every respect superior to the young French Clarets. The sweet wines are to be unconditionally preferred to the European southern wines containing the same amount of alcohol and extract, and not being plastered. Their superiority is already being appreciated in Europe, and it is only a question of time when an extensive foreign market will be open to this, one of our most promising home products.

The Influence of Commercial Glucose on the Polarization After Fermentation.

To determine this point, a number of fermentations were made with mixtures of solutions of sucrose and glucose of varying strength, the same method being used as was employed in the analytical work. The results were not as uniform as desirable, probably on account of unequal rate of fermentation. They showed, however, that the amount of sucrose which is apt to be present in a wine is completely fermented in two days, so that any dextro rotation observed after that time must be due to the presence of glucose or its non-fermentable constituents.

Table of Results of Experiments Made to Determine the Effect Commercial Glucose has on the Polarization after Fermentation.

Original polarization of sucrose.	Original polarization of glucose.	Polarization after two days.	Polarization after four days.
+37 80	......	0	0
+18.90	......	0	0
+ 9.45	......	0	0
....	+16.33	+4.5	+5.0
....	+16.33	+4.8	+3.8
....	+ 9.80	+2.0	+1.8
....	+ 9.80	+2.5	+1.8
....	+ 3.27	+0.4	0
....	+ 3.27	+1.0	0
+19.23	+16.33	+4.6	+2.8
+19.23	+16.33	+3.5	+3.3
+11.54	+16.33	+3.5	+2.3
+11.54	+16.33	+3.0	+2.3
+ 3.85	+16.33	+3.7	+2.4
+ 3.85	+16.33	+3.6	+3.9
+19.23	+ 9.80	+2.0	+1.7
+19.23	+ 9.80	+2.8	+2.1
+19.23	+ 3.27	+0.7	+0.9
+19.23	+ 3.27	+0.7	+0.5
+11.54	+ 9.80	+2.4	+1.0
+11.54	+ 9.80	+2.3	+1.0
+ 3.85	+ 9.80	+0.9	+0.3
+ 3.85	+ 9.80	+0.8	+0.3