Part 1—History

Introduction
What is wine?
Galileo: "Wine is a combination of moisture and light."
Robert Louis Stevenson: "Wine is bottled poetry"

The Legal Definition
• The product of the normal fermentation of sound ripe grapes without additions or deletions, except as may occur in the usual cellar treatment.
• The grapes used are vitus vinifera
• Varieties: cabernet sauvignon, chardonnay, etc.

What’s in wine?
Major Components
• Water 85%
• Alcohol 12%
• Everything else 3%

The Everything Else
• Glycerol
• Acids
• About 1000 more compounds* *The things that give wine its complexity

Some of the 1000 chemical compounds that are present in wine

Fermentation
• Wine is produced by the action of yeast on sugar.
• Sugar is converted into alcohol and carbon dioxide
• \( \text{C}_6\text{H}_{12}\text{O}_6 \xrightarrow{\text{Yeasts}} 2\text{C}_2\text{H}_5\text{O} + 2\text{CO}_2 + \text{Heat} \)
• sugar alcohol

Outline of the History of Wine From 6000 BCE to now

The First Wine Jug(?) 6000 BCE
A Neolithic jar — possibly used for brewing wine — found at the site of Khramis-Didi-Gora in Georgia, on display at the Georgian National Museum

Georgia—the Birthplace of Wine(?)
• The Georgian wine jug is evidence
  – Wine culture has long been part of the history of Georgia
  – Elaborate toasts are part of traditional feasts
  – Evidence of its consumption during:
    • The Bronze Age, Classical Period, Greco-Roman Period and Medieval times

Ancient Georgia
Ancient Armenia

• Overlaps Ancient Georgia
• Earliest winemaking facility ever found—6100 years old
  – Fermenting vat
  – Wine press
  – Storage jars
  – Dried grapeseeds
  – Etc.

• ca. 6000 BCE
  – Archeological evidence for early wines in Caucasia and Mesopotamia

• 5400-5000 BCE
  – In Persia, evidence of wine storage jars

• Wine becomes part of Persian culture, celebrated in poetry
• Forbidden after the 7th century CE under Islam

• 4000 BCE
  – Evidence of wine production in Greece (wine residues)

• 3000 BCE
  – Egypt and Phoenicia produce wines
  – Grapes harvested by hand
  – Crushed by feet.
  – Fermentation carried out in wooden vats.
  – The wine is stored in earthenware jars

• Wine is the drink of the aristocracy
  – The masses drink beer

Wine Production in Egypt
Tomb of Nakht at Thebes, 18th Dynasty, 1539-1292 BCE

• Egyptian viticulture
  – Vines are trained and pruned
  – Grapes are harvested

• Grapes are crushed by feet
  – The workers support themselves in the slippery vat by holding onto straps
• The juice is collected and fermented in wooden vats
• And finally stored in ceramic vessels

Siphons used in the year 1450 BCE
Wine is served by a slave
Slave waits on mistress who has overindulged
Men carried home from a drinking party
• ca 1500 BCE
  — Greek viticulture is well established

• 1000-950 BCE
  — Greeks bring viticulture to Spain and Italy

ca. 1000 BCE
  — Old Testament contains 155 mentions of wine.

• 1000 BCE
  — Greeks store wine in ceramic vessels called amphorae.

Hesiod (ca. 700 BCE) used a star calendar to give advice on wine making
  • When Orion and Sirius are come into mid-heaven, and dawn sees Arcturus [i.e., in September] then cut off all the grape-clusters and bring them home. Show them to the sun ten days and ten nights; then cover them over for five, and on the sixth day draw off into vessels the gifts of joyful Dionysus.

• ca. 500 BCE to ca. 500 CE—The Roman Era
  — The Romans learn viticulture from the Greeks.
  — Adapt and improve the methods
  — Introduce viticulture to France, Spain, Germany, Eastern Europe, and (even) England

Amphora built into the floor of a Roman ruin

306-337 CE The Reign of Constantine
  • Adoption of Christianity as the official religion of the Romans
  • Wine is part of church rites, viticulture flourishes

ca. 800 CE Charlemagne
  • Charlemagne (742-814) takes an interest in wine production
    — He introduces winemaking improvements
    — Grapes crushed with a press
    — Wine stored in wooden kegs
  • His land holdings include Corton-Charlemagne

The World Famous White Wine of Corton-Charlemagne
  • As Charlemagne grew old, he developed Parkinson's disease
  • His shaking caused him to spill the Corton red wine on his beard
  • In consideration of his appearance, his wife, Desiderata, asked Corton winemakers to produce white wine
  • They did with enthusiasm.
  • Today, "Corton Charlemagne" is one of the most renowned white wines of Burgundy

Corton-Charlemagne still produces today

Viticulture in Medieval France
1100 CE
The Cistercians found Clos de Vougeot (Burgundy), which is still producing
Clos Vougeot Label

c. 1000-1300 The Moors
  • The Moors (Arabs of African origin) rule Spain
    — Halt wine production
    — It resumes after their defeat and expulsion

c. 1300-1800 The Ottoman Empire
  • Ottoman Empire (Islamic Turks) rules the Middle East and Greece
  • Tradition of Greek viticulture is lost for 500 years

15th, 16th, 17th centuries
  • Development of international wine trade
  • Improvement in glass gives better bottles
  • Standardization and classification of wines
  • Bordeaux wine (Claret) is popular in England
  • Burgundy wine less well known in England

Travelling by sea, England was remote from Burgundy but close to Bordeaux

15th cent Viticulture in France

Early 15th Century—Vineyard workers in Flancers

An illustrated prayer book  Paris, 1490

c. 1625
  • Corks are now used in place of glass stoppers
    — Wine can now be aged without spoilage
    — First mention of a corkscrew in 1681

c. 1650
  • Champagne is invented by a monk, Dom Perignon, near Epernay …
    or so the story goes

1703
  • High duty on French wines in England leads to popularity of Port (Oporto) from Portugal

1769 California
  • Father Junipero Serra plants the first grapes in California (Mission San Diego)

1781
  • The modern bottle is introduced
    — Wine ageing is now widely done

Depiction of an Italian Harvest, ca. 1810

1789—The French Revolution
The French Revolution has profound effects on the wine industry…
  • Vineyards of nobles and the Church are confiscated
• They are divided and distributed among the people
• Small holdings result, particularly in Burgundy
• Unique wine making system: "negociants"

1850—The French wine industry is at its peak
• Except:
  – Fermentation is not well understood
  – Much spoilage occurs during vinification
• Nevertheless
  – Wine is totally accepted as part of French culture
  – And is not considered "drinking alcohol"
  – As is consumption of gin

Choose wine instead of alcohol(?)

French wine exports in 1854
A menu from 1857, showing the penetration of French wines into the U.S.

1857  Louis Pasteur
• The French wine industry hires Louis Pasteur
• He investigates fermentation
• Discovers the roles of yeasts, bacteria

Pasteur performs a demonstration on the harmful effect of oxygen in air on red wine
Pasteur in his Laboratory

1866
• Pasteur publishes his results in Etudes sur le Vin.
• He explains
  – Yeasts convert sugar to alcohol
  – Bacteria lead to wine spoilage

From his book, a method for Pasteurizing wine—little used…Why not?
A fermentation tank used by Pasteur in his studies

The wine industry prospers when, in the 1850s, a disease strikes the vineyards of Europe that all but destroys wine production

The Phylloxera Infestation
• About 1860
  – Native American vines are brought to Europe as an experiment
• The result—
  – Almost the total destruction of the continental fine wine industry.
• Was the faster steamboat responsible?
The Province of Languedoc in the Rhone Valley where Phylloxera was first detected
Phylloxera Outbreak
   France  19th Century

What do diseased vines look like?

Phylloxera-damaged vines, Napa Valley
Healthy and Phylloxera-infected Vines

Phylloxera Vastatrix (destroyer)

1863—Discovery of the Root Louse
   • Because of its small size (1mm)
     – Escaped detection for years
     – After discovery, five more years until
   • Identified as a native American pest
   • And… American vines were resistant
   • But vitus vinifera (the European variety) was susceptible

Phylloxera Root Galls on Infected Vines

“Death to Phylloxera”
   A poster for an insecticide against Phylloxera, 1883

The blight spread throughout Europe and ultimately the rest of the wine-growing world
   The ultimate distribution of phylloxera

Infected vineyards are uprooted

Effect of the Infestation
   • Destroyed over 40% of the plantings
   • Most of the vineyards of France and the continent were infected
   • French wine production fell by 68%
   • Tremendous economic disruption:
     – Vineyard workers were unemployed
     – Significant migrations

Punch Comment (1890)
   "THE PHYLLLOXERA, A TRUE GOURMET, FINDS OUT THE BEST VINEYARDS AND ATTACHES ITSELF TO THE BEST WINES."

1881—The NY Times noted France is importing wine

1874--The French government offers a 300,000 franc prize for a solution

Two ideas sort of worked (sort of)
   • Flooding the vineyards drowned the insects
     – But most vineyards are planted on slopes
• Injection of carbon disulfide (CS$_2$) into the soil poisoned them
  — But expensive and dangerous (flammable, toxic)

A French vineyard is flooded in 1939 to destroy Phylloxera
Water is pumped up on a French vineyard
Typical Hillside Vineyard along the Rhone River (un-floodable)
Manufacturer and Builder, 1886, describing the use of CS$_2$

A guide for the winemaker
  How to use CS$_2$ to combat Phylloxera (Lyon, 1886)

A plow-hauled device for treating vineyards with CS$_2$

Hand-injecting CS$_2$ in the vineyards in the Champagne region

Was there a solution to the American menace?

1875—The Solution to Phylloxera
• The cause may be the cure
• By grafting, the European vines might use the resistance of the American rootstock
• The method worked
• The French vineyards could be successfully replanted

Grafting Sequence
Field Grafting
  The year-old vine is cut
  A groove for the scion is cut
  A V-graft

Nursery-grafted vines ready for replanting

Reaction to Grafting
  French wine growers split into two camps
• The 'chemists' advocated…
  — Continued use of CS$_2$ and flooding
• The “Americanists,” or “wood merchants”...
  — Proposed adopting the grafting method

Reaction to the Results
• Great resistance to the scheme from traditionalists
• Many believed that grape quality would suffer
  — Blind tastings now show comparable quality
  — Still, some say quality has never recovered
• Today the great majority of vines are planted on phylloxera-resistant rootstocks

The Reappearance of Phylloxera
• 1982—a Phylloxera variant appeared in Napa
• The blame placed on AxR1 (a UC Davis product)
• Contained some character of v.vinifera
  – This seems to have opened the door
  – Many vintners blamed UCD for keeping mum
• Over 25 years, replanting is carried out throughout Northern California

**Grapevine affected by Phylloxera in Rutherford, California, 1989.**

**A Unique Case: Phylloxera in South Australia**
• Phylloxera detected in 1880, but
• SA is still largely Phylloxera-free
• Australians believe they have
  – The oldest original non-grafted Cabernet Sauvignon vines in world

**A Phylloxera-Free Wine Region in SA**

**How do they keep it Phylloxera Free? By building a fence?**
• They enforce a quarantine by…
  – Discouraging vehicular traffic
  – Limiting access to vineyards
  – Reserving the right to inspect vehicles

**The next threat to grapes**
  With Phylloxera largely under control, it is time for the next destructive plague to enter.
  And here it is—Pierce's Disease

**Pierce's Disease—A New Threat**
• Pierce’s disease is caused by a bacterium
  – Xylella fastidiosa
  – First identified in 1892
• The leaves are "scorched"
• Vine dies in one to five years
• In 1989, a new vector was recognized
  – The glassy-winged sharpshooter (GWSS)
  – Control is carried out using…
  – Quarantines and insecticides

**Damaged grape leaves caused by GWSS borne bacteria Xylella fastidiosa**

**Glassy-winged Sharpshooter**

**Distribution of GWSS in California**
  Mendocino County
  Sonoma County
  Napa County
  So far, the fine wine producing regions of Northern California appear safe

**Attempts to control the spread of GWSS**
  Entering Napa County, June, 2008
The History of Wine in California

The Vintage in California—At Work at the Wine Presses (1878)
Paul Frenzeny (1840-1902)

Mission San Diego—Site of the first vineyard in California

1769—Father Junipero Serra (1713-1784)
• Father Serra, a Franciscan missionary
  – Arrived in California from Baja
  – He planted vineyards at Mission San Diego
  – The grape was the Mission variety
• Over the next 50 years, 21 other missions were established along the coast, many with vineyards

1824—The vineyards at Mission Sonoma were planted by Father Jose Altamira

1836—George Yount (1794-1865)
• George Yount given a land grant from the Spanish throne
• The first U.S. citizen to be so recognized
• He planted the first vines in the Napa Valley in 1838
• In 1865, Yountville was named for him

1852
• The first non-Mission grapes planted near Glen Ellen in Sonoma County
• Identity uncertain, but possibly zinfandel

1857—Count Agoston Haraszthy [ Hungarian (1812-1869)]
• He purchased land in Sonoma County
• Experimented with European varieties and published his results
• Considered the Father of the Calif Wine Industry
• Drowned in a river in Nicaragua in 1869

Title page of Haraszthy’s book on wine (1862)

The first commercial winery in Napa is established in 1861 by Charles Krug, a German immigrant

1889
• More than 140 wineries in the Napa valley
• State industry is robust

California’s wine-confidence shows (1883)
From E. H. Rixford's The Wine Press and the Cellar (San Francisco, 1883)

1892
• Phylloxera appears in Northern California with the same destructive results as in Europe
• Grafting is the solution here, as elsewhere
• Ad for Phylloxera treatment "Wheeler's carbon bisulphide"

A new threat to the wine industry appears...
1895—Prohibition becomes a political force culminating in...

1919—The 18th Amendment and the Volstead Act

- Production and sale of alcoholic beverages prohibited
- Consumption is not against the law
- Wine for sacramental purposes is allowed
- Home consumption (200 gal/family) of "non fermented fruit juices" is allowed

So... The Rules
- You can't make it
- You can't transport it
- You can't sell it
- You can buy it and you can drink it
- And, you can make 200 gallons of grape juice
- If it ferments, well who's fault is that?

Enforcing prohibition—Enforcement was often lax

- Many speakeasies satisfied the thirst of urban drinkers

Sacramental wine was available

- Did you have to prove you were Jewish?

Some objected to Prohibition

1920-1933

- Wineries may make only sacramental wine
- Vineyard production continues, providing grapes for home "grape juice" makers

1933—Repeal

- Northern California wineries are slow to recover
- California had 713 wineries before Prohibition
- It is 1986 before that many were again operating

The effect of Prohibition on alcohol consumption is debatable

1960
- Number of Napa Valley wineries at an all-time low: 25 (vs. 140 in 1889)

1960-present

- The quality of California wines increases
- Napa and Sonoma counties gain prestige

Present Time

- ~475 wineries in Napa
- ~250 wineries in Sonoma
- Statewide ~4000 (~8300 nationwide)
- California produces 90% of US wine, about 680 million gallons annually
- Fine California wines enjoy world-wide reputations

Top Five States in Number of Wineries
U.S. Wine Production by State
1982
- Phylloxera again appears in California
  - It is claimed to be a variant, Biotype B
- Knowledge gained in previous outbreaks allows avoidance of widespread disruption
- Systematic replanting on resistant rootstock is conducted as the pest spreads
- Some small wineries are absorbed because of the financial strain

California Fine Wines

Fine Wine Producing Regions in California
- All share the following characteristics
  - Warm days
  - Cool nights (near water)
  - Long season sufficient for grapes to ripen
- All lack the intense heat of the central valley
  - Where grapes tend to over-ripen and...
  - Lose character

There are four major fine wine-producing regions in California
- North Coast—Napa, Sonoma, Lake, Mendocino
- Central Coast—Santa Clara, Monterey, SLO, Santa Barbara
- Central San Joaquin—Lodi-Woodbridge
- Sierra Foothills—Amador
- And, bulk wines from Southern San Joaquin

Top 5 Grape Producing Counties in California 2015 (Value in millions of U.S.$)
Kern (1642.5), Fresno(911.8), Tulare(646.1), Napa(549.5), Sonoma(446.8)

Price of Grapes in California Wine Regions—Yield per Acre and Price per Ton

<table>
<thead>
<tr>
<th>Region</th>
<th>Yield per Acre</th>
<th>Price per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napa</td>
<td>2.8 tons/acre</td>
<td>$3400/ton</td>
</tr>
<tr>
<td>Sonoma</td>
<td>3.0 tons/acre</td>
<td>2200/ton</td>
</tr>
<tr>
<td>Central Valley (N)</td>
<td>8-12 tons/acre</td>
<td>500/ton</td>
</tr>
<tr>
<td>Central Valley (s)</td>
<td>15 tons/acre</td>
<td>380/ton</td>
</tr>
</tbody>
</table>

Notes
- As the yield per acre increases
  - The quality decreases
  - Reflected in the decreasing price
- North Coast (Napa, Sonoma)
  - Has the lowest yield and the highest prices
- South Central Valley (Fresno, Tulare, Kern)
  - Has the highest yields and the lowest prices
  - Produces 75% of California wines in jugs, boxes, etc.
  - Franzia is an example: Sunset Blush, 5 liters, $19.69

Price Per Ton by Region

Looking at just the two top fine wine producing areas…
Napa and Sonoma County Grapes  Price Per Ton, 2015

Comments
  • Highest price grapes
    – Napa Cabernet Sauvignon
  • Second highest price grapes
    – Sonoma Pinot Noir
  • In all other types, Napa grapes are higher in cost
  • Conclusion
    – You can expect to pay more for Napa wines in general

Do we care about the price of grapes?
  • Yes, because…
  • Grape cost is the single most important factor…
    – In determining bottle price
  • The finished bottle will cost
    – Roughly 1% of the price per ton
  • Example: If grapes are $2900/ton
    – The finished wine should retail for about $29.00
    – There are many exceptions, but it is a useful rule

The Beckstoffer Rule  (After Andy Beckstoffer, owner of 1000 acres of Napa vineyard land and a founding director of the Napa Valley Grape Growers Association)
  • Fair price for a bottle of wine is
    – Price of a ton of grapes times 0.01
    – If grapes are selling for $4500/ton…
    – The bottle price should (might, could) be
    – 4500 times 0.01 = $45

A Case in Point: Napa Valley Cabernet Sauvignon
  • Price for these grapes in 2016
    – Average $6943/ton
    – Thus, you can expect to pay $70 per bottle of 2016 Napa Valley Cab
  • Problem
    – This high price may have a depressing effect on sales
    – Current price on Napa Valley Cabs: $30 to 70
    – Some as high as $300

Mondavi Cabernet Sauvignon
  • Robert Mondavi
    – Carneros (the appellation)
    – Cabernet Sauvignon (the variety)
    – 2013 (the vintage)
    – 63% cabernet sauvignon
    – 37% cabernet franc
    – Alcohol 15%
Compare: Carlo Rossi Cabernet Sauvignon

- Produced in Modesto (San Joaquin Valley)
- Price of cabernet sauvignon grapes
  - $526 per ton (2014)
- Predicted bottle price $5.20
  - Actual price $23.75 for 5 liters
  - Or $3.57 per 750 ml (one bottle)

A look at the Napa Valley

Napa Valley Facts

- The most renowned wine growing region in the United States
  - Only 9% of Napa County is planted to grapes
  - Only 4% of California wine grapes come from there
- Wine producers
  - There are 700 grape growers in Napa County
  - There are 475 wineries in Napa County
  - 95% of the wineries are family owned
  - 80% of the wineries produce 10,000 cases or fewer

The Napa Valley AVAs

- The Napa Valley is an AVA—American Viticultural Area
  - An AVA is a designated wine grape-growing region in the U.S.
  - Distinguishable by its geographic features
- There are 16 nested AVAs within the Napa Valley

Napa Valley Red Wine Grape Tonnage 1990-2016

Napa Valley Price per Ton of Red Wine Grapes 1990-2016

Wine Around the World

The Major Wine Countries...

- France, Italy, Spain, the US, Argentina, Australia, Portugal, Germany, and China

Top Producers

- The four top producing countries are
  - France, Italy, Spain, and the U.S. in order of production
- France and Italy lead and often change places for first

World Wine Production, 2016
• 2016
  – Italy
  – France
  – Spain
  – U.S.
  – Australia
  – China
  – S. Africa
• 2010-2014
  – France
  – Italy
  – Spain
  – U.S.
  – Argentina
  – China
  – Australia

Wine Consumption
"I drink one glass of wine a day for my health. The rest of the bottle? Why not?"

World Wine Consumption, 2016

Consumption Change, 2000-2014
• The Romance nations are decreasing
• Russia and China show the largest increase

Per Capita Consumption—Quite a different story
The World's Largest Wine Drinkers
Annual per capita wine consumption (2015) in liters

The Vatican is the leading consumer of wine, about 98 bottles per person every year

Wine Consumption by Region (2002 to 2017)

World Wine Exports, 2016 by Volume
No surprise here, Spain, Italy, and France leading —Chile and Australia next

Vineyard Acreage

World Vineyard Acreage, 2016

Vineyard Acreage by Country 2005 and 2015 (in thousands of acres)

Wine Drinking in the U.S.
• 40% of U.S. adults drink wine
• Of those
  – 20% drink daily
  – 48% drink several times a week
  – 18% once a week
  – 14% occasionally
• The most popular varietals are
1) Chardonnay, 2) Cabernet Sauvignon, 3) Pinot Grigio, 4) Red Blends (e.g., Syrah-Grenache) 5) Pinot Noir

• But, just as in the rest of the world…
  – We consume more beer

**Our Favorite Wines in 2016**

• U.S. sales in millions
  Chardonnay, Cabernet Sauvignon, Red Blends, Pinot Grigio, Pinot Noir

**Why Do We Buy Certain Wines?** (1081 wine consumers from 50 states)

Price, brand, varietal, country, label, vintage, alcohol level, state, region, etc.

**Beer, Wine, Spirits Dollar Sales**

- Beer always leads
- Spirits $69 billion
- Wine $50 billion

**Beer remains the favorite American tipple**

**U.S. Per Capita Wine Consumption in gallons**

Consumption in gallons per person

**What age groups buy wine?**

• Baby Boomers lead
  • Gen X-ers and Millennials are buying craft beers

**What is the geographical distribution of wine drinking in the U.S.?**

**U.S. Wine Consumption, 2013**

(Liters per capita measured by sales)

**Liters of wine per capita by state**

• D.C. is the highest
  – Surprised?
• New Hampshire
  – Very high consumption
• What accounts for it?
  – Low liquor taxes in N.H encouraging out of staters to come to N.H. to shop?
  – Or is it just due to the unreasonably harsh winters?

**State Wine Excise Tax Rates** (Dollars per Gallon)

**Is there a bicoastal affinity?**

• Is high wine consumption on the coasts an example of the similarity of tastes from the east coast to the west coast?

**Compare and Contrast**

U.S. Wine Consumption U.S. Electoral Results, 2016

**Total alcohol consumption (wine, spirits, and beer)**

About 60% of U.S. Adults Drink Some Alcohol
Total Alcohol (in liters per year per capita)
• Range—1.37 (Utah) to 4.55 (New Hampshire)

State per Capita Consumption by Type

World Per Capita Alcohol Consumption (per year)
• U.S consumption is 8.67 liters/person
• World rank: 28th of 46 countries

Which are the BIG Wine Companies

The Largest Wine Companies in the World (2016)

<table>
<thead>
<tr>
<th>Wine Company</th>
<th>HQ Location</th>
<th>Case Sales (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constellation Brands</td>
<td>Victor, NY</td>
<td>95</td>
</tr>
<tr>
<td>E. &amp; J. Gallo</td>
<td>Modesto, CA</td>
<td>75</td>
</tr>
<tr>
<td>The Wine Group</td>
<td>San Francisco, CA</td>
<td>54</td>
</tr>
<tr>
<td>Treasury Wine Estates</td>
<td>Melbourne, Australia</td>
<td>47</td>
</tr>
<tr>
<td>Pernod Ricard</td>
<td>Sydney, Australia</td>
<td>40</td>
</tr>
</tbody>
</table>

Gallo Wineries—The Largest Privately Owned Wine Company in the World
• The second largest producer in the world
• Totally integrated production facility
• Grapes to bottle glass to semis and trailers
• Its winery in Modesto is over 400 acres
• It owns over 20,000 acres of vineyards
• It operates fifteen wineries
• It buys one-third of all grapes grown in Calif.
• It controls the price of Central Valley grapes

Wine Tanks, Aerial View, Gallo, Modesto

50,000 gallon tanks at Gallo winery in Modesto
This winery produces table wines

Gallo’s Fresno Winery
This winery produces dessert wines

Gallo’s Livingston Winery
This winery produces table wines

Gallo Winery, Dry creek Valley, Sonoma County
Gallo Business Practices
• Gallo cited by the TTB in 2011
  – It bribed retailers to obtain preferred display space and product placement
  – 2007 through 2009
  – At various casinos in Nevada
• It settled the complaint
  – Paid a $225,000 fine

The TTB Complaint
• The offer by Gallo to settle the complaint
• The recommendation to accept the offer

Other Violations
• Nothing very serious for a company of its size
• But, being privately owned, we do not know its income numbers

Gallo and the United Farm Workers (UFW)
• 1967 – Gallo signs a contract with the UFW
  – Farm workers' wages now above minimum wage
• 1973 – Farm workers strike for improved conditions
  – The UFW calls for a Gallo boycott
• 1994 – The UFW unionizes workers at Gallo Sonoma
• 2005 – The UFW again calls for a Gallo boycott when…
  – Negotiations for a new contract fail

The Gallo Boycott
• Suppose you disapprove of Gallo's labor policies
  – You would like to support the UFW
  – And Caesar Chavez's union
• Simple enough!
• Just avoid the following…

The 78 labels that Gallo sells its products under…

- Alamos
- Anapamu
- Apothic
- Ballatore
- Barefoot Cellars
- Bartles & Jaymes
- Bella Sera
- Black Swan
- Bridlewood
- Boone's Farm
- Carlo Rossi
- Camarena tequilas
- Carnivor
- Cask & Cream
- ChocolatRouge
- Clarendon Hills
- Columbia Winery
- Covey Run
- Dancing Bull
- Dark Horse
- DaVinci
- Delicia
- Don Miguel Gascon
- E. & J. VS Brandy
- E. & J. VSOP Brandy
- E. & J. XO Brandy
- Ecco Domani
- Edna Valley Vineyards
- Frei Brothers
- Frutézia
- Fairbanks
- Gallo Family Vineyards Estate
- Gallo Family Vineyards Single Vineyard
- Gallo Family Vineyards Sonoma
- Ghost Pines
- Indigo Hills
- J Vineyards and Winery
- La Marca
- Laguna
Las Rocas
Liberty Creek
Livingston Cellars
Louis M. Martini
MacMurray Ranch
Martín Códax
Maso Canali
Matthew Fox Vineyards
Mattie's Perch
McWilliam's
Mirassou Vineyards
New Amsterdam Gin
New Amsterdam Vodka
Night Train
Orin Swift Winery
Peter Vella
Pölka Dot
Rancho Zabaco
Red Bicyclette
Redwood Creek
Red Rock Winery
Sebeka
Shellback Rum
Talbott
Thunderbird
Tisdale Vineyards
Turning Leaf
Twin Valley
Vella Wines
Viniq
Whitehaven
William Hill Estate
Wild Vines
Winking Owl
Wycliff Sparkling

**Worthy of Special Mention...**

- Thunderbird, Night Train, and Ripple
- High alcohol (17.5 to 20%) wines of poor quality
- Intended for effect rather than taste
- “Gallo” does not appear on the label
- Neither "Night Train" nor "Thunderbird" appears on Gallo's "Portfolio" page
- Ripple is no longer produced

**Part 2—Grapes and Wine**

There are three wine types...
• Table or Still Wine
  – 8-14% alcohol, no bubbles
• Sparkling Wine
  – 8-14% alcohol, CO₂ bubbles
• Fortified Wine (e.g., Sherry or Port)
  – 17-22% alcohol, no bubbles

Anatomy of the Grape
The terms are • Stems • Skin • Pulp • Seeds

Composition of grape bunches...
• Stems 3%
• Fruit 97%

For the fruit alone...
• Pulp—light in color, juice bearing 75%
• Skins—color, flavors, tannins 20%
• Seeds—tannin 5%

The Skins...
• Form a waterproof membrane
• Contain the coloring and flavor compounds
• Contain much of the tannin which is...
  – Important for wine preservation
  – Important for some flavor characteristics

The Pulp is...
• Source of the juice or must
  – The liquid part of the wine
• Colorless to pale green
  – For both red and white grapes
  – Red wines obtain color from the skins

Tannin is important in winemaking.
• It’s distribution is...
  – Seeds are 6.4% tannins
  – Stems are 3.1% tannins
  – Stems are 1.7% tannins

In wine making...
• The seeds remain whole
  – Their tannin is not available
• The stems are removed before fermentation
• Therefore...
  – The skins are the main source of tannin

The Growth Cycle of the Grape
Dormant buds: Through the winter
Leaving: 72-75 days
Flowering: 10-20 days
Grape development: 40-45 days
Color change (Veraison): 10 days
Late stage of Veraison: 10 days
Maturation: 38-40 days

The grape growing cycle takes 170-190 days—
About six months from leaf (spring) to harvest (fall)
About four months from flowering to harvest

Change in berry size and color during ripening

Change in sugar concentration during ripening

Change in acid concentration during ripening

Changes in Anthocyanins (color containing materials) during ripening

What characterizes a ripe grape?
Two ways to look at maturity—
- Physiological maturity
  - Maximum size
  - Maximum sugar
  - Little acid

or
- Technological maturity (suitable for wine)—
  - Sugar at 20-25% (20-25 Brix)
  - Acid at 0.8%

Ripeness (Brix) at Harvest
- Traditional Brix at harvest: 22
- Grapes of 22 Brix produce wine of about 12% alcohol
- Current trend: 24, 27, to as high as 30 Brix
- Result: Highly alcoholic wines: 14%, 16% and up
- But wines of low acidity

What is responsible for this trend?
- What makes it possible to produce high alcohol wines?
  - New rootstocks produce higher sugar
  - Mild weather tolerates longer hang time (allowing acid to be converted to sugar)
  - High alcohol tolerant yeasts
- Why are these wines desirable?
  - The wines are bolder and fruitier
  - Cf. Robert Parker’s expectations
- Wine makers and critics are divided on this
Some High Alcohol Wines
Hop Kiln Zin, 16.3%
Cline Zin, 15.5%
Mondavi Fume Blanc, 15%

When to harvest—the winemakers most important decision
• Ripeness (Brix) comes first
• Other influencing factors
  – Weather: frost, rain, intense heat—all bad
  – Availability of harvesting crews
  – Hand vs machine harvest—careful vs rapid
  – Night harvest might be desirable

Raisened and moldy grapes past normal harvest time

Botrytis Mold

Trellising the Vines

Training Vines or Trellising
Trellising is done to…
• Prevent foliage from shading the fruit in order to…
• Increase exposure to direct sunlight
• Encourage full maturation of grapes in order to…
• Maximize color, flavor, and sugar
• Also, separate foliage from fruit to minimize disease, e.g., mold

Four Trellis Types
• Head Pruned or Vertical Trellis
• Cordon Trellis
• Geneva Double Curtain (GDC)
• Lyre Trellis

Head Pruning
• A traditional pattern
• Rarely used in new plantings
• Does little to expose fruit to sun

Head Pruned Vines
Head Pruned Vine with Fruit

Horizontal Cordon
• Vine trained along a horizontal wire
• Foliage is trained on a wire above
Sun exposure is greatly increased

**Horizontal Cordon-Trained Vines**
- The fruit is well exposed to sunlight

**Geneva Double Cordon (GDC) Trellis**
- Vine divided into two fruit-bearing arms
- Foliage trained above or below the fruit-bearing arms

**GDC Trellis**

**Lyre Trellis**
- Two fruit bearing arms
- Foliage trained to upper wires

**Lyre Trellised Vineyard before Planting**
**Lyre Trellis Early Growth**
**Lyre Trellis—Mature Vines**

**How does trellising affect quality?**

<table>
<thead>
<tr>
<th>Comparison of Vertical (Head) and Lyre Trellised Vines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trellis type</strong></td>
</tr>
<tr>
<td>Row spacing</td>
</tr>
<tr>
<td>Height of foliage</td>
</tr>
<tr>
<td>Yield in tons/acre</td>
</tr>
<tr>
<td>Alcohol % by vol</td>
</tr>
<tr>
<td>Anthocyanins* mg/L</td>
</tr>
<tr>
<td>Total phenols**</td>
</tr>
<tr>
<td>Tasting score</td>
</tr>
</tbody>
</table>

*Coloring
**Color and flavor

**The Role of Pruning**

**Unpruned and Pruned Vines**

**How Pruning Works**
- A characteristic of the grape vine
  - The buds for next year's grape clusters are on this year's stalks
- By selective pruning, it's possible to control
  - The number of next year's clusters
  - The position of next year's clusters

**Why limit the number of next year’s grape clusters?**
- Unrestricted growth produces…
  - A tangled mess of stems and…
  - Too many clusters
- Too many clusters tax the vine and result in…
  - Inadequate ripening
• Poor fruit quality
  • Unpruned vines may even fail to produce fruit

**Yield vs. Quality**
There is always a conflict between…

• The number of clusters to allow for proper ripening—a low number
• The number of clusters to allow for a commercially viable crop—a high number

**Yield as a Measure of Grape Quality**

• In Europe
  – Yield is set at 3-4 tons per acre (TPA)
  – By EU regulations
• In the US
  – No yield restrictions
  – Yields may go to 6 TPA
• In *fine wine* regions (Napa, Sonoma, Santa Barbara, etc.)
  – The 3-4 TPA limit is usually observed
  – Some vineyards go as low as 1-2 TPA
• The term *overcropping* refers to excessive yields and the corresponding poor quality

**Is there a clear relationship between yield and quality?**
The following table makes the relationship clear...

**Relationship of Yield to Wine Quality**

<table>
<thead>
<tr>
<th>Yield in tons/acre</th>
<th>Low(3.7)</th>
<th>Med(7.3)</th>
<th>Hi(10.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brix</td>
<td>23.2</td>
<td>22.1</td>
<td>20.8</td>
</tr>
<tr>
<td>pH</td>
<td>3.75</td>
<td>3.73</td>
<td>3.76</td>
</tr>
<tr>
<td>Total acid (g/L)</td>
<td>5.5</td>
<td>5.4</td>
<td>5.7</td>
</tr>
<tr>
<td>Sugar per berry (g)</td>
<td>35.9</td>
<td>35.6</td>
<td>32.4</td>
</tr>
<tr>
<td>Phenolics (flavor)</td>
<td>7.0</td>
<td>5.7</td>
<td>4.9</td>
</tr>
<tr>
<td>Flavonoids (color)</td>
<td>4.1</td>
<td>3.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Notice the following...**

• Sugar (Brix)
  – Higher in low yield (leads to more alcohol)
• Acid (pH and TA)
  – Largely unchanged among the three levels
• Phenolics (flavor)
  – Significantly higher in low yield
• Phenolics (color)
  – Higher in low yield

**Result...**

• We expect an overall better wine from a low crop vineyard
  – More alcohol
  – Better flavor
  – Better color
• However, the lower yield per acre
  – Results in a higher cost per ton and...
  – Will result in a more expensive wine

Example
• Duckhorn Vineyards Cabernet Sauvignon
  – Yield 3.5 T/A
  – Brix at harvest 26.1
  – Alcohol 14.5% ABV
  – Titratable acid 0.56%
  – pH 3.73
• Cost $79.99

Other Objectives in Pruning
• Removal of excess vegetative growth
  – For sun exposure
  – To direct plant growth to the grapes
• Removal of diseased stalks
• Control of foliage to facilitate harvesting

When to prune...
• To control yield
  – During dormancy (winter)
  – The bare stalks are pruned
• To reduce vegetative growth
  – During growth months (June, July, August)
  – The growing vines are trimmed
  – Referred to as “canopy management”

Pruning a Vine for Yield Control
There are two pruning styles:
• Spur pruning
• Cane pruning
  The styles work better with different varieties

Spur pruning—a short spur is left on the permanent cordon
Spur pruning—Fruit buds are retained on each spur
A spur pruned cordon

Cane pruning—a full cane is trained along the wire
Cane pruning—Fruit buds run along the length of the cane

Cane pruned vine

Pruning of Vegetative Growth or Canopy Management
• Objectives
— Removal of excess vegetative growth

- For sun exposure
- To direct plant growth to the grapes
  — Control of foliage to facilitate harvesting

Unpruned vines during growth season

Mechanized Pruner
Pruning Blades
Pruner at work...
After Pruning
Before and After

Vineyard Soils and Contours

Slopes or Flats?
- Good drainage is required
  - Grapevine roots require oxygen
  - Available from air between soil particles
  - Poorly drained soils can "drown" the vines
- In Europe...
  - Frequent summer rains
  - Vineyards are planted on slopes for drainage
- In California and Australia...
  - Summer rains are rare
  - Slopes are not required

Summer Rainfall Europe vs Napa

Soil Fertility
- Soils of low fertility are desirable
- Vineyards can be planted on
  - Gravel, sand, chalk, shale, or slate
- Why not fertile soil?
  - Fertile soils lead to excessive vegetative growth
  - Canopy management becomes difficult
- Quality of the fruit is unaffected by poor soil

A Vineyard or a Rock Pile?
Some Examples of Vineyard Soils and Contours
The Mosel River in Germany
Mosel River
Mosel Vineyards
Mosel Slate
Languedoc, Tavel, Rhone Valley
Rhone Valley
Chablis
Pomerol, Bordeaux, Haut-Brion, Bordeaux
Grignan, Provence
Chalky Soil of Champagne
Champagne Vineyard Soil (?) This poor chalky soil now sells for about $700,000 per acre
Cahors, Southwestern France
Portugal
Napa Valley Sandy Soils
Bennett Valley Sonoma County

Replanting a Vineyard

• Why replant?
  – Disease (e.g., phylloxera)
  – Old vines (~25 years) have decreased yields
  – Change of variety
(Warming has caused some growers to shift to warm tolerant varieties)
  – Change of trellising style or spacing
• It takes three to five years for new vines to produce

Growth of Newly Planted Vines

The old vines are uprooted
Cleared......and burned
The vineyard is fumigated with 1,3-dichloropropene...
  Fumigation kills undesirable microorganisms and bugs
Laid out...
Nursery-grafted vines are planted
One year’s growth
Three year’s growth
Young vines in production

Final Step—Identify and Protect Your Vineyard

A Visitor—Enophile?

Napa Valley Enophiles?
  South Africa, actually—baboons stealing grapes

Save Time, Buy a Producing Vineyard

• Rather than plant, just buy a vineyard in production
• Sonoma County vineyard prices, 2016
  – Low end per acre, $70,000
  – High end per acre, $150,000
  – Average per acre, $110,000
• Production is about 200 cases per acre
• A small winery (1000 cases) requires 5 acres or an investment of about $550,000
• Napa Valley—about double the prices of Sonoma or more
• Champagne region you, will recall, was $700,000 per acre

The right climate for viticulture—Where do grapes grow?

Grapes grow in the temperate zones* (between 30° and 50° latitude, north and south)
Why not warmer, cooler?
- Warmer climates are bad because...
  -- Need cool winter to force dormancy and complete the annual cycle
  -- Tropical climates encourage mold or other diseases
- Cooler climates are bad because...
  -- Need warm summer to ripen grapes

*Within the temperate zones, there are differences in temperature...*
- Bordeaux is warmer than Burgundy
- The Champagne region is the coolest wine region in France
- Germany is the coolest wine region in Europe
  -- In some years, the grapes do not ripen
- Napa Valley (inland) is warmer than southern Sonoma County (coast)
- And many other examples

Grape varieties respond differently to heat/cool
- Warm climate grapes
  -- Cabernet sauvignon
  -- Merlot
  -- Zinfandel
  -- Syrah
- Cool climate grapes
  -- Pinot noir
  -- Chardonnay
  -- Riesling
    -- Sauvignon blanc

Dual Climate Grapes
- Cabernet sauvignon
- Chardonnay
- Dual climate grapes show very different characteristics in each zone

Consider Chardonnay...
- In cool climates
  -- It is crisp and fresh
  -- Perfect for sparkling wines
- In warm climates
  -- It is richer and fruitier
  -- Takes oak well to give a balanced wine

What happens to grapes planted in an unsuitable climate?

Consider Pinot Noir...
(The name comes from the French word for pine reflecting the pine cone shape of the grape clusters)
- Early plantings of Pinot Noir in California
Napa results were poor
– Weather too warm for Pinot Noir
– The grapes over-ripen and all acidity is lost
– The result is flat wines with little character

• Recent plantings of Pinot Noir
  – Santa Barbara, Russian River, Anderson Valley
  – These cooler areas have given good results

Preferred Climates for Red Grapes
Season
  Northern Hemisphere Apr-Oct
  Southern Hemisphere Oct-Apr

Climate Change
• Climate change is now happening
  – Wine grapes are being affected
  – Cooler climate varieties may need to be moved
  – More heat tolerant Spanish and Italian varieties may come to dominate California vineyards
  – Drought and water usage will continue to be a problem
• Pinot noir
  – This variety may end up on the Northern California coast
• Experiments are underway

Global Warming
• Temperature rise over the last 50 years vary from region to region
  – Champagne region—about +0.75 °C (1.35°F)
  – Bordeaux region—about +1.6°C (2.9°F)
  – Northern California—about +1.25°C (2.25°F)
  – Hunter Valley (Australia)—about +0.5°C (.9°F)
• Global average temperature rise
  – About 0.8°C (1.5°F)

Global Warming and Some Wine Regions

Grape Varieties
• These are the names we use to recognize wine types
  – Chardonnay, Cabernet Sauvignon and so on
• There are over 1000 varieties of Vitis Vinifera
• The TTB recognizes ~370 for U.S. labels
  – Many are unfamiliar
  – Clinton, Van Buren, Watergate (really!)

Grape Names
• Here are 330 of the 370 government approved grape names for American wine labels
• You can get a legible copy of the list at the TTB (Trade and Tax Bureau) website

Some popular white varieties
  Chardonnay, Sauvignon Blanc, Viognier, Chenin Blanc, Pinot Grigio, Semillon, Gewurztraminer, Riesling, Sylvaner

Some popular red varieties
Some Popular Varieties (in rough order of popularity)

- **Reds**
  - Cabernet Sauvignon
  - Pinot Noir
  - Syrah
  - Zinfandel
  - Merlot
  - Cabernet Franc
  - Sangiovese
  - Gamay
  - Malbec
  - Grenache

- **Whites**
  - Chardonnay
  - Sauvignon Blanc
  - Chenin Blanc
  - Pinot Grigio (Gris)
  - Semillon
  - Gewurztraminer
  - Riesling
  - Viognier
  - Sylvaner
  - Algote

A glance at each of the varieties with a comment on their origin and use...

(in alphabetical order.)

**Red Varieties**

- Cabernet Franc (Bordeaux)
  - Component of Bordeaux blends
  - Early maturing

- Cabernet Sauvignon (Bordeaux)
  - The principle grape of Bordeaux reds
  - Napa wines are full-bodied

- Gamay (Beaujolais, France)
  - Makes grapey wines such as Beaujolais

- Grenache (Spain)
  - Used in Rhone Valley blends
  - California wines are weak

- Malbec (France)
  - Used in Bordeaux blends
  - Very successful in Argentina and Chile

- Merlot (Bordeaux)
  - Component of Bordeaux blends
  - On its own, very soft wines

- Pinot Noir (Burgundy)
  - The great grape of Burgundy
  - Very sensitive and climate dependent

- Sangiovese (Tuscany)
  - The main grape of Chianti
  - Does well in California

- Syrah, Shiraz (Rhone Valley)
  - The grape of the northern Rhone Valley
  - In Australia, very bold wines

- Zinfandel (Italy)
  - Called Primitivo in Italy
  - California's contribution to the world's wines
White Varieties

• Aligoté (Burgundy)
  – The 2nd white wine of Burgundy
  – Pleasant

• Chardonnay (France)
  – The great white grape of Burgundy
  – California wines very good

• Chenin Blanc (Loire Valley)
  – The grape of Vouvray, Anjou, Muscadet, etc. (wonderful wines)
  – Weak in California

• Gewürztraminer (Alsace and Germany)
  – pink grapes
  – Highly fragrant and spicy wines
  – California and Oregon products good

• Pinot Grigio or Pinot Gris (Italy, France)
  – pink to red grapes
  – A light variety from NE Italy and Alsace

White Varieties (cont.)

• Riesling (Germany and Alsace)
  – Rich and fruity wines in Europe

• Sauvignon Blanc (Bordeaux)
  – The main white grape in Bordeaux
  – "Grassy" in California
  – Excellent in New Zealand

• Semillon (Bordeaux)
  – Used in Sauternes and Graves
  – Blended with Chardonnay in Australia

• Sylvaner (Austria and Germany)
  – Widely grown in Central Europe
  – Used in blending

• Viognier (Rhone Valley)
  – Fruity wines
  – Successful in California
  – New World wines pleasant

How do these wines compare
How wines are named.

New World vs Old World

New World—Named after grape variety
Example: Cabernet Sauvignon

Old World—Named after region
Example: Bordeaux

New World Examples...
• California Merlot
• Chilean Malbec
• Australian Shiraz
• Oregon Pinot Noir
• New Zealand Sauvignon Blanc

Old World Examples
• French Red Bordeaux
  No wine type is mentioned
• French White Burgundy
  White Table Wine
• Italian Chianti
  Red Wine
• Grape varieties are not specified
• Grape content dictated by law or custom

The Grapes of Old World Wines

<table>
<thead>
<tr>
<th>Wine</th>
<th>Customary or Legal Grapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaujolais</td>
<td>Gamay</td>
</tr>
<tr>
<td>Bordeaux (red)</td>
<td>Cab. Sauvignon, Merlot</td>
</tr>
<tr>
<td></td>
<td>Cab. Franc, Petit Verdot, Malbec</td>
</tr>
<tr>
<td>Bordeaux (white)</td>
<td>Sauvignon Blanc, Semillon</td>
</tr>
</tbody>
</table>
Burgundy (red)  Pinot Noir  
Burgundy (white)  Chardonnay  
Chablis  Chardonnay  
Champagne  Chardonnay, Pinot Noir, Petit Meunier  
Chianti  Sangiovese  
Rioja (Spain)  Tempranillo, Grenache

Red Bordeaux, the most complicated—
Two examples follow...

**Chateau Petrus—Red Bordeaux Wine**
- **Grape Plantings**
  - 95% Merlot
  - 5% Cabernet Franc

**Chateau Lafite Rothschild—Red Bordeaux Wine**
- **Grape Plantings**
  - 70% Cabernet Sauvignon
  - 20% Merlot
  - 5% Cabernet Franc
  - 5% Petit Verdot

Two wines with the same designation and completely different grape compositions.
The label tells you nothing!
How do you know what’s going on?
You learn by reading, asking, web-crawling, and tasting!

Terroir
What is Terroir?  A French wine word derived from terre, Fr. earth
- To its defenders — some winemakers of the U.S. and Europe
  - It refers to the combination of soil, light, topography and microclimate...
  - Giving a wine its unique “soul”
- To its detractors — professors of enology at American universities and some wine critics
  - It is a marketing slogan dressed up as a poetic reverie
  - In other words— meaningless

(See Mark Matthews, *Terroir and Other Myths of Winegrowing*, University of California Press, 2016)

Part 3—How Wine is Made
- **White**
  - Crush, stem, SO₂
  - Press
  - Adjust vintage
– Ferment
– Settle
– Rack
– Age
– Fine, stabilize
– Bottle
– Bottle age
– Serve

• Red
  – Crush, stem, \( SO_2 \)
  – Adjust vintage
  – Ferment
  – Press
  – Settle
  – Rack
  – Age
  – Fine, stabilize
  – Bottle
  – Bottle age
  – Serve

The major difference in red and white wine vinification...

• White wines
  – Pressed before fermentation
  – Thus, not in contact with the skins during fermentation

• Red wines
  – Fermented before pressing
  – Thus, reds are in contact with skins during fermentation

The steps of modern winemaking...

  We begin by checking the ripeness of the grapes... Are they ready for harvest?

A hand-held refractometer is used in the field

  A refractometer measures the index of refraction of a liquid, a property which varies as the concentration of sugar changes.
    A single grape is plucked...
    A drop of grape juice is squeezed onto the prism surface
    Aim the prism at a light source and view the scale
    This is the view through the eyepiece
      A reading of 23 Brix
    These grapes are ready for harvesting

The Ideal Harvest Factors

• Ripeness—20-26 Brix
  – "Brix" is simply percent sugar by weight
  – 23 Brix is 23% sugar by weight

• Hand-picked clusters are best
• Whole berries preferred
• Why whole berries?
  – Less chance of mold formation
  – Less chance of wild yeast F’n

**Hand Harvesting the Bunches**

**Machine Harvesting**
  The harvester’s blades whip the vine back and forth. Clusters and berries fall, are caught by the belt, and carried to the hopper.
  The hopper is emptied into a gondola

**Machine Harvesting—the Issues**
  • The whipping action is hard on the fruit and
    – More likely to give broken berries which are...
      • Subject to spoilage and…
      • Likely to ferment prematurely
  • So, why use it?
    – It is faster
    – It is cheaper
    – It is more reliable (than harvesting crews)
    – It can be done easily at night when it is cooler
  • Note: It is not yet used for premium wines

**The grapes are transported to the winery...**
"Caution Danger Road Slippery With Grape Juice"
Oops!

**Tipping the grapes into the crusher...**

**Crushing and Stemming**
Stems being collected for removal

**Crusher**
**Crushing in Biblical Times**
**Crushing in Roman times** 2nd century CE
**Crushing in Ancient Israel**
**Crushing in Medieval Times**
**Crushing in Burgundy (1988)**
**Crushing in Contemporary Portugal**

**The Must**
  • The must is the result of crushing the berries
    – A mixture of juice, skins, seeds, and bits of stem
    – Can be adjusted to compensate for any deficiencies
    – Sulfites are added to the must to stabilize it
    – Finally, yeasts are added to initiate fermentation
  • The term "must" comes from the Latin
    – *Vinum mustum* or "young wine"
Addition of Sulfites

• Sulfite (or SO$_2$) is added to the must

• Function of SO$_2$
  – Inactivates undesirable micro-organisms (wild yeasts, bacteria, molds)
  – Acts as an anti-oxidant
  – Inhibits browning in white wines

• A stable wine is difficult to achieve without addition of SO$_2$

Note: SO$_2$ has a sharp penetrating odor. It is non-toxic but can be irritating.

A Sulfur Candle

• In earlier times, a sulfur candle was burnt to produce SO$_2$
  \[ S + O_2 \rightarrow SO_2 \]

• Now, liquid or gaseous SO$_2$ is added from a cylinder

Sulfites, Sulfur, and Sulfides

• A second form of sulfite
  – Potassium metabisulfite, K$_2$S$_2$O$_5$(KMS)
  – Used in small scale (or home) winemaking
  – Campden tablets are premeasured KMS
  – One tablet for one gallon of must
  – Sometimes incorrectly referred to as "sulfur"

• Avoids having to handle gas cylinders

Note: Hydrogen sulfide, H$_2$S, is not used in winemaking

Sulfur and Hydrogen Sulfide

• Sulfur is sometimes applied to the vines to suppress powdery mildew
  – Avoided near harvest time

• Some yeasts convert sulfur to hydrogen sulfide, H$_2$S
  – The H$_2$S odor (rotten egg) in wine is a fault

• Hydrogen sulfide should not be confused with Sulfites
  – Used in wine preservation

Composition of the Must

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>70-75%</td>
</tr>
<tr>
<td>Sugar</td>
<td>20-26%</td>
</tr>
<tr>
<td>Acids</td>
<td>0.5-1.5%</td>
</tr>
<tr>
<td>Minerals</td>
<td>0.2-0.3%</td>
</tr>
<tr>
<td>Nitrogenous</td>
<td>trace to 0.1%</td>
</tr>
</tbody>
</table>

The Sugars in the Must

• Sugars are glucose and fructose approximately 50-50

• Both ferment to give alcohol and CO$_2$

• Total concentration: 20-26 Brix

• The final alcohol can be estimated
  – It is 0.55 x Brix
  – So, for a Brix of 23, we can expect a final alcohol of 23 x 0.55 = 12.65

The Acids in the Must
• Tartaric acid
• Malic acid
• (Citric acid, trace)
• Overall Acidity
  – pH 3-4 (between lemon juice and tomato juice)
  – TA (total acidity) = 0.6-0.8%.

The Importance of Acidity in Wine
• A proper level of acidity…
  – Gives wine balance, freshness
  – Inhibits spoilage organisms
• Insufficient acidity gives a wine…
  – That is flat and dull
  – And is susceptible to spoilage
• Excessive acidity gives a wine…
  – That is tart and harsh

Adjusting the Vintage
• Sugar may be added
• Acid may be added or removed
• Tannins are rarely added
• Nitrogenous material may be necessary

Addition of Sugar: Chaptalization
• Named after Jean-Antoine Chaptal
  – A minister in Napoleon’s government
  – One of the first to advocate its use (to consume the excess “ferments”)
• The effect
  – The added sugar is fermented
  – Increases the final alcohol content
  – Does not increase sweetness
• May be necessary to have a stable wine

Chaptalization—the Controversy
• Generally allowed in cool climates
  – France, Germany, and the U.S.
• Generally prohibited in warm climates
  – Spain, Italy, Australia, and California
• Although legal in some places, it may...
  – be used to compensate for poor ripening
  – be used to compensate for overcropping
  – give unbalanced high-alcohol wines

Chaptalization in the EU
The EU and Chaptalization
• In December of 2007
  – EU ministers proposed a ban on Chapt’n (but not out of high motives)
  – Grape juice concentrate to be used instead
  – To reduce the grape surplus in the EU
• Overwhelming opposition from wine folk
• Proposal withdrawn in April, 2008

**Chaptalization in the U.S.**

**California and Chaptalization**

• California is the only state that forbids the addition of sugar to the must
• However, it is legal to add grape juice concentrate to the must
• Is there any difference?

**Chemistry of Sugar Addition**

• Sucrose (table sugar) is glucose–fructose
  – A disaccharide
• Grape enzymes convert it to glucose + fructose
  – Two monosaccharides, the normal grape sugars

\[
\text{C}_{12}\text{H}_{22}\text{O}_{11} \xrightarrow{\text{Enzymes}} \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6
\]

• Fermentation is normal
• Adding 1.5 oz/gal increases alcohol by 1%

**Adjusting Acidity**

• Normal acidity (TA) is 0.6 to 0.8%
  • If TA is low, tartaric acid may be added
  • Legal everywhere
• If TA is high, deacidification may be done
  • Potassium tartrate is added to de-acidify

**Other Adjustments to the Vintage**

• Adjusting the tannins
  – Rarely done
  – Skin contact accomplishes this
• Adjusting nitrogenous materials
  – Essential for yeast growth
  – A pinch of fertilizer is added if needed
    • Typical is diammonium phosphate (DAP), (NH₄)₂HPO₄

**Now…Fermentation (F’n)**

• Poorly understood before 1850
  – Much spoilage of wine
  – And stuck fermentations
• Pasteur explained..
  – The necessary role of yeasts
  – The destructive role of bacteria and oxygen

Pasteur in his laboratory ca. 1857

Pasteur's demonstration of the harmful effect of oxygen on red wine

Where does the yeast come from?
• Grapes naturally harbor yeasts—"wild yeasts" (genus saccharomyces)
  – Exist on the skins in a filmy coating
  – No doubt responsible for the first wines
  – But unpredictable
• Modern winemakers use cultivated yeasts
  – Cultivated yeasts reliably carry fermentation to dryness
  – They do not introduce off flavors

Some cultivated yeasts
• All are varieties of Saccharomyces cerevisiae, the main fermentation yeast
• Each packet will ferment one to six gallons of must

Which yeast should you use?
• Following is one producer's recommendations for various grapes and wines
• As you will see, different yeast strains can be chosen to produce quite different products and types of fermentations

Red Star Yeast Strain Selection Chart
• Recommendations for various properties, alcohol tolerance, rate of fermentation, etc
  For Example, Pasteur Red

<table>
<thead>
<tr>
<th>Species</th>
<th>Saccharomyces Cerevisiae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommend for</td>
<td>Full-bodied reds</td>
</tr>
<tr>
<td>Type of wine</td>
<td>Tannic red, light young red</td>
</tr>
<tr>
<td>Varietals</td>
<td>Cab. Sauv., Cab. Franc., Merlot, Zin</td>
</tr>
<tr>
<td>Fermentation temp</td>
<td>64-86°F</td>
</tr>
<tr>
<td>Alcohol Tolerance</td>
<td>16%</td>
</tr>
<tr>
<td>Rate of fermentation</td>
<td>Fast</td>
</tr>
</tbody>
</table>

Larger Scale Operations
This 500g (1.1 lb) package is suitable for 500 gal
• Red Star Côte Des Blanc
  – A strain of Saccharomyces Cerevisiae
• Recommended Use
  – Aromatic whites and Chardonnays
  – Light young reds
  – Sparkling wines
• Properties
  – Alcohol Tolerance: 13%
– Fermentation Speed: Slow
– Temperature Range: 64-86 °F

Yet, the old ways persist…

• In France, some traditionalists still use wild yeasts
• But the tradition is dying out because of
  – The unreliability of the results
  – The off-flavors that often result

The Fermentation Vessel

• The best F’n vessel is the one easiest to clean
  – Stainless steel
  – Cement
  – Glass or plastic (small scale)
  – Oak (hard to clean)
• Fill it about ¾ full to allow for frothing

Adding the Yeast to the Must

• The dry yeast is revived with water
• This moist yeast is added to a small amount of must
• After the initial F’n becomes vigorous, the sample is added to the bulk of the must
• After 12-24 hours, F’n becomes very active

Active Large Scale Fermentation

Active Small-scale Fermentations (about one gallon)

The Chemistry of Fermentation

\[
glucose \text{ or fructose} \xrightarrow{\text{enzymes in yeast}} 2 \text{ ethanol} + 2 \text{ CO}_2 + 56\text{kcal} \\
C_6H_{12}O_6 \xrightarrow{\text{enzymes in yeast}} 2C_2H_6O + 2 \text{ CO}_2 + 56\text{kcal}
\]

Points to note…

• Large volumes of CO₂ are produced
  – CO₂ is not toxic
  – But it may cause asphyxia*
• Considerable heat is evolved
  – It may be necessary to cool the ferment
• A pound of grapes gives
  – About a half pound of alcohol and…
  – About a half pound of CO₂

What about the heat?

• Excess heat will cause…
  – The must to Pasteurize itself
• Deactivating the yeasts
  – The result is a “stuck” fermentation
• The proper temp. range: 55° min to 95° max
• Cooling may be required

*CO₂ is more dense than air and tends to settle to the bottom of fermentation vessels. Entering a large fermentation vessel should only be done with suitable breathing equipment.
• Note: White wine F'n is always cool
  – This preserves the fruitiness of the wine
  – Thus, refrigerated vessels are used

**Effect of Temperature on Fermentation**

• **Lower temps** are associated with
  – Greater fruitiness
  – Higher alcohol
  – Longer F'n times

• **Higher temps** are associated with
  – Loss of fruitiness
  – Deeper color
  – More tannin
  – Shorter F'n times

**The Role of Temperature in Red Wine Fermentation**

• Red wines are usually styled to have
  – More color
  – More tannin
  – More complexity but less fruitiness

• Thus, red wines are fermented at a relatively high temperature (no cooling)

• And, because rate of F’n follows temp…
  – Red wine F’n takes 5 to 14 days

**A red wine fermentation (open vessel)**

**The Role of Temperature in White Wine Fermentation**

• White wines are usually styled to have
  – High fruitiness
  – Little tannin
  – Minimal color

• Thus white wines are fermented at low temperatures (cooling)

• And, because rate of F’n follows temp…
  – White wine F’n takes 4 to 6 weeks

**A white wine fermentation—closed vessel with refrigeration**

**“Stuck” Fermentation**

• Term is applied to a F'n that has stalled
  – Usually due to excess heat or…
  – A lack of oxygen

• A dangerous situation because…
  – Spoilage reactions will set in

• The F’n must be restarted by
  – Cooling the ferment
  – Adding some actively fermenting must
Optimal vs Stuck Fermentation

Following a Fermentation
- Using this chart…
  - You can follow your F’n
- After 13 days
  - If no change in Brix
  - You have a "stuck" fermentation
- Now you would take action
  - Cool the ferment
  - Add actively fermenting must
  - Add additional yeast

Fermentation—an “Anaerobic” Reaction
- Most “respiratory” reactions require O$_2$
  \[
  \text{Glucose} + O_2 \rightarrow \text{CO}_2 + H_2O + \text{energy}
  \]
- But F’n requires no oxygen
  \[
  \text{Glucose} \xrightarrow{\text{yeast enzyme}} \text{ethanol} + \text{CO}_2 + \text{energy}
  \]
- Termed an “anaerobic” reaction
  (In practice, some oxygen is needed to allow yeast growth)

“Cap” Formation

During red wine fermentation…
- The rising CO$_2$ bubbles carry seed and skins to the top of the ferment
- A “Cap” forms
- Maintaining juice-skin contact is necessary
  - For extraction of color and tannin
- Two methods are commonly employed
  - the cap is “punched down” or…
  - the must is “pumped over” the cap

Pumpover vs. Punchdown
- Pumpover
  - Said to give a more intense wine
- Punchdown
  - Less so
- Both procedures are done three times a day
  - Punchdown is usually done by hand
  - Pumpover done by mechanism

Punching down the cap

At this French winery in the Lot Valley, they use a combination of methods

Next Step: Pressing the Wine

Pressing White Wines and Red Wines
- Recall:
  - White wines are pressed before F’n
  
  \[
  \text{crush} \quad \text{press} \quad \text{ferment}
  \]
- Red wines are pressed after F'n

- The equipment for both is the same
- Typical yields:
  - Whites 160 gal/ton
  - Reds 175 gal/ton

**Common Press Types**
- Basket press used in all kinds of winery operations
- First developed in the Middle Ages

**Stainless Basket Press**
- More easily cleaned
- Reds and whites can be alternated

**Pressing the Wine**

**The "Americain" Press**
Patented in 1874 by Felix Marmonier of Lyon

Large basket press currently in use in Bordeaux

**Filling a Basket Press**

**Free Run draining from a basket press**

**Operating the Ratchet**

**Basket Press at Use in a Winery (Motorized Version)**

**Second Press Type: A Bladder Press Used in Larger Winery Operations**

**Loading a Bladder Press**

**Bladder Press in Operation**

**Pressed Wine**

**How a Bladder Press Works**

<table>
<thead>
<tr>
<th>Load</th>
<th>Position</th>
<th>Press</th>
<th>Evacuate</th>
<th>Unload</th>
</tr>
</thead>
</table>

- The press applies compressed air to one side of a bladder to squeeze juice out of grapes
- Vacuum is then used to pull the bladder back to its fully retracted position
- The "pomace" can then be removed

**Industry Preferences**
• What type of press do you use?
  – Basket press 27%
  – Bladder press (door loaded) 53%
  – Bladder press (axial feed) 20%
  – Continuous feed 0%

*Wine Business Monthly*, 2009

• “Some winemakers prefer a basket press for their premium wines.…
  – They feel the wines have less solids and extract less of the bitter, rougher phenolics.
  – This leads to fewer steps for clarification, preserving positive aroma profiles and a finer and softer tannin profile due to less phenolic extraction” (Anita Oberholster)

**Pressing Red Wine**

• The F’n mixture is poured into the press
• The liquid that drains out is the “free run”
• The liquid pressed out is the “press run”
• The free run and press run differ
  – The press run is harsher
  – More tannic

**Free Run vs. Press Run**

<table>
<thead>
<tr>
<th></th>
<th>Free Run</th>
<th>Press Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>12%</td>
<td>11.6%</td>
</tr>
<tr>
<td>Sugar</td>
<td>1.9%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Acid</td>
<td>0.49%</td>
<td>0.55%</td>
</tr>
<tr>
<td>Anthocyanins (color)</td>
<td>330 mg/L</td>
<td>400 mg/L</td>
</tr>
<tr>
<td>Tannin</td>
<td>1.75 g/L</td>
<td>3.20 g/L</td>
</tr>
</tbody>
</table>

**Because the press run is harsher...**

• In some winery operations
  – It may be separated and..
    – Distilled into brandy
• Only the free run being used for wine
• Or, winemakers can exercise choices
  – And use blending to,,
  – Make a more or less tannic wine
• Or, wine may be “lightly” pressed to reduce harsh elements

**The Residue After Pressing**

**Pomace**

• A cake of skins and seeds
  – About 100 lbs/ton
• Can be used for
  – Cattle feed
  – Vineyard fertilizer

Pomace accumulating at a winery
Another Use for Pomace...

Pomace Sugar Water → Ferment → Alcoholic Brew → Distil → Marc or Grappa

Marc and Grappa
• In France, Marc is a cheap vineyard drink
  – For vineyard workers when...
  – Wine would be too costly
• In Italy, Grappa is a fancy export
  – A product of little distinction, but...
  – A triumph of marketing

Back to the Winemaking Sequence
• After fermentation and pressing
  – The winemaker’s goal is a clear stable wine
• The next steps are Clarification steps

Preliminary Clarification
• After pressing, the wine is cloudy due to...
  – Traces of pulp and skin
  – Dead yeast cells
  – Colloidal particles
  – Proteins
• Settling brings these materials to the bottom
  – A sediment forms

Settling
• The sediment—called the "Lees"
  – Dead yeast cells
  – Bits of skin and stems
  – Proteins
  – Other solid matter

Wine After Settling
• The lees are clearly visible
  – Leaving the wine "sur lees", on the lees, imparts certain flavors
  – Some winemakers want this, others not
  – This effect is controlled by "racking" the wine

Racking the Wine
• “Racking” means transferring the wine...
− Away from the sediment
− To a clean vessel
− Without disturbing the sediment
• Method: siphoning, decanting, or pumping

Small Scale Racking by Siphon
Small Scale Racking by Pump
Some winemakers consider pumping too hard on the wine

Large Scale Winery Racking
• A tube is attached and the wine flows to a new barrel
• The wine flows via a *splashing plate*
  − Which collects and aerates the wine
  − Aiding in the aging process

Racking using *compressed air*

Further Settling
• Vessel closed with a F’n bung
  − Allows escape of CO₂
  − Prevents entry of air
• More settling
• Racked again, perhaps into oak
• Sealed with an airtight bung

Barrel Ageing
• Clarification by settling
• Barrel flavors (e.g., oak) added
• Oxidation prevented by excluding air but...
  − Small amounts of oxygen enter
  − Causing some precipitation of tannin
• Chemical reactions add complexity

Evaporation Occurs—Ullage
• The head space increases
  − Due to evaporation of alcohol and water
• Topping up required
  − To prevent overexposure to air

Topping Up
Barrel Storage

Barrel Management

Barrel Disaster
August 24, 2014 Earthquake Damage, B.R. Cohn Winery, Glen Ellen
Adding Oak Flavors

• Oak—not a natural wine flavor
• Added by aging in oak barrels
• Cost
  – $700 to $900 for French oak
  – $400 to $700 for American oak
  – Different flavors imparted
• Barrel life—three years
  – Older barrels do not add flavor
  – Discarded or sold as planters

Alternative Ways to Add Oak

• Oak chips or oak staves
  – May be added to the maturing wine
  – A less expensive way to introduce oak flavors

Aids to Clarification

• Winemaker’s goal—a clear wine
• Settling alone sometimes doesn’t work
  – Or may just take too long
• Then, aids to clarification may be used
• The two main methods are...
  – Fining
  – Filtration

Fining

• Types of fining agents...
  – Clay (bentonite)
  – Proteins (egg whites, casein, or gelatin)
  – Others, including some commercial products
• Four steps
  – Agent added to the wine
  – Mixed thoroughly
  – Allowed to settle out
  – Rack
• Hazing materials adhere to the agent

A fining agent drawing hazing materials to the bottom of the vessel

Filtration

• Cloudy wine is passed through…
  – Cellulose sheets or pads
  – Solids are retained
  – The filtrate is (usually) clear
• Settling is slow—filtration is rapid
  – So, filtration is chosen for time

Home Winemaking Filtration Kit
The Kit in Use

Winery Filtration Setup
• The wine is pumped through cellulose pads
• Haze-causing elements are trapped on the pads
• The filtrate (wine) is clear

Large-scale Membrane Filter

Cellar Rats at KJ

Should Wine be Fined/Filtered?
• Many winemakers avoid fining or filtering
• They believe that these treatments...
  – Remove flavor or aroma elements
  – May even alter wine color
  – Should be avoided if possible
• Thus, a label may boast “Unfined” or “Unfiltered”

Cold Stabilization for Tartrates
• Potassium bitartrate \( (\text{KHC}_4\text{H}_4\text{O}_6) \)
• Naturally present in must
  – Also known as cream of tartar
  – It is soluble in water and must
  – Insoluble in alcohol
• As the fermentation proceeds, alcohol concentration increases
  – The solubility of the tartrate decreases
  – It precipitates out of solution as crystals

Cold Stabilization for Tartrates
• The tartrate precipitate is not considered a fault in wine, but…
  – It is often removed
  – By cooling, crystallization, and racking

The Next Step
• You now have a clear, stable wine
• It is ready for bottling

Bottling
• Modern bottles and corks
  – Allow for long-term storage of wine
• Factors to be watched at bottling:
  – Air exposure should be kept to a minimum
Bacterial contamination must be prevented
New bottles are usually preferred for cleanliness
The bottle closure must be efficient
• A modern bottling machine does it all

Glass
• A mixture of (primarily)
  − Silica (SiO$_4$)
  − Soda (Na$_2$CO$_3$)
  − Lime (CaO)
• Melted together at 2700°F
• Modern glass is very inert
  − Wine in a bottle will last for 100 years
• 18th century glass was much less stable

Colored Bottles?
• Plain glass filters out most UV light
• But wines in colored bottles are more stable
• Traditional bottle colors
  − Red wines in green glass
  − White wines in colorless, green, brown, and blue

What Do They Cost?
• Ordinary wine bottles—$1.00

Bottle Shapes—Is there a reason?
Burgundy Bordeaux German Champagne

The Function of the Bordeaux Bottle
• As Bordeaux wines mature…
  − The tannins form a sediment
  − Which falls to the bottom of the bottle
• To prevent pouring this into the glass…
  − Older Bordeaux wines are decanted
  − Into a clean container
• The shoulder in the bottle helps hold back the sediment

The wine is slowly poured into a clean decanter.
• The bottle’s shoulders help retain the sediment.
• Thus, by tradition, all Bordeaux wines come in a bottle with shoulders
  − Even white wines, which do not form a sediment.

Are all wine bottles created equal?
• The weight of the empty bottle seems to be reflected in the cost of the wine
• Shown are three 750ml bottles
• Cost of wine: $39 $28 $3
• Wt. of empty bottle: 30.5 oz  19.5 oz  12 oz

Corks
• Made from the bark of the cork oak, *quercus suber*
• If properly maintained, trees last 100 years
• Grown primarily in the Mediterranean region
  – Half the world's cork comes from Portugal
  – 30% from Spain
  – Lesser amounts from other Mediterranean countries

Cork Oak Plantation in Portugal

Method of Manufacture
• Bark is stripped every nine years
  – Dried
  – Boiled
  – Aged
  – Sawn into strips
  – Punched
• The corks are
  – Ground
  – Polished
  – Bleached
  – Sorted for quality

Harvesting the Cork Bark

The Thickness of the Bark (1½ to 2 inches)

The Collected Bark
Stacking the Bark
Aging the Bark
Stacking on pallets for further processing

Boiling to soften and clean

Boiled planks are softer and easier to work with

Good-looking cork plank

Punching the Corks
After punching—these remains will be ground to make agglomerate cork

Corks are hand sorted for quality

Top grade corks—about $1.25 each
Corks are bleached using peroxide and formerly chlorine*

*Chlorine bleach is no longer used
—Suspicion that it contributes to cork taint

Why Use Corks?
- The structure of cork
  - A cellular structure comparable to honeycomb
  - Result: an excellent insulator
- Properties of cork
  - Low density
  - Compressibility
  - Impermeability
  - Inertness towards gases and liquids
- A corked wine bottle is a stable system
  - Lets no liquids out
  - Lets no gases in
    - Except for a small amount of oxygen
    - Desired for proper aging

How Much Oxygen Enters the Sealed Bottle
- Natural cork
  - Allows leakage of a small amount of oxygen
  - Over the first 6 to 9 months
  - Additional oxygen leakage is virtually nonexistent
  - So, properly stored wine will develop without oxidized flavors

Why Not Use Corks?
Disadvantages
- They are expensive
  - 40¢ to $1.25 per cork depending on quality
  - Prohibitive for cheap wines
- Corked wines
  - Wines that have a moldy odor described as
    - moldy cardboard
    - damp basement
    - damp burlap
  - Estimate—5% of bottles

What causes a “corked” wine?  Answer—TCA
- The smell is due to a specific chemical...
  - TCA (2,4,6-trichloroanisol)
- Origins somewhat uncertain—Some options
  - Natural cork components interact
  - Chlorine used to bleach corks
  - Natural molds in the cork bark
  - The bottom foot of the bark nearest the ground in contact with molds

Two Theories on the Origin of TCA
- Lignin in cork tree bark
- Contains phenol
- Undergoes chemical changes

• TCP is present in agrochemicals
  - Undergoes chemical change

**Solutions to the Problems—Obvious**

• Problem of Cost
  - Use cheaper closures
  - Plastic, screw-cap, cork composite

• Problem of TCA
  - Use chlorine-free corks
  - Use non-cork closures
  - Plastic or screw-cap

**Cork Substitutes**

<table>
<thead>
<tr>
<th>Closure</th>
<th>Cost($)</th>
<th>Life (yrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cork (best quality)</td>
<td>60-125</td>
<td>20+</td>
</tr>
<tr>
<td>Cork (ave. quality)</td>
<td>40-60</td>
<td>8-15</td>
</tr>
<tr>
<td>Plastic</td>
<td>15-40</td>
<td>5</td>
</tr>
<tr>
<td>Compressed cork (solid ends)</td>
<td>26</td>
<td>4</td>
</tr>
<tr>
<td>Compressed cork</td>
<td>10-15</td>
<td>2</td>
</tr>
<tr>
<td>Screw Cap</td>
<td>15-20</td>
<td>10+</td>
</tr>
</tbody>
</table>

**Cost and Durability of Closures**

**A Novel Approach**

• The convenience of the Screw Cap
• The prestige and durability of a cork
• The Screw-Cork
  - Called "Helix" by the manufacturer

**The bottle has a threaded top**

• Interacts perfectly with the threaded cork to give an air-tight seal
• Developed by Amorim (cork) and Owens-Illinois (glass)
• Adopted by 26 wineries around the world

**Bronco Wines’ “Red Truck” employs the Helix closure**

• In 2016, Bronco Wines announced…
  - “Red Truck” wine will use the Helix
• “We are proud at Bronco to be the first winery in America to deliver this incredible innovation.”
  Fred Franzia (Whoopie, Whoopie!)

**The Screw-cork in Action**

Intact Removing Unscrewing Voila!
the wrapper the cork
A Familiar Friend as Closure
• An Austrian rosé for $15 uses an old standby
  – The "crown" cap or soda pop cap
• Rarely used in the U.S.

Significance of the Closure
• The winemaker knows...
  – The time span for each closure
  – The cost of each closure
• So, his choice reflects...
  – His opinion of the quality of the wine
  – His opinion of the durability of the wine
  – His estimate of what the consumer knows
  – His estimate of what the consumer prefers
• Except, the screw cap is a different ballgame
  – And where does the screw cork fit in?
  – And the crown cap?

Plastic vs. Cork
The Case of "Two Buck Chuck"
• Fred Franzia is the owner of Bronco Wines
  – Producer of Charles Shaw Wines
• Two Buck Chuck…
  – Does not have a plastic cork, the cheapest closure
  – It has a composite cork with one solid end
• Why?
  – Franzia says a plastic cork would "cheapen customers' perception of Charles Shaw"
  – Is that possible?
• The point—Fred gets the consumers' perception of a plastic cork

"Two-buck Chuck" Was once a rhyme,
Now Two-buck Chuck Costs two-ninety-nine!

What do you think of the wine when you pull out a solid cork?
…a compressed cork?
…a plastic cork?
…a perfect 2½ inch blemish-free solid cork?
  Chateau Petrus Pomerol 2000, $4175 to $4824 at auction

2000 Chateau Petrus Pomerol (100 points)
A magical effort from Petrus, the 2000 has continued to gain weight and stature. From the bottle, it is a perfect wine, much like the 1998. The color is inky plum/purple to the rim and the nose, which starts slowly, begins to roar after several minutes, offering up scents of smoke, blackberries, cherries, licorice, and an unmistakable truffle/underbrush element. On the palate, this enormous effort is reminiscent of dry vintage port, with fabulous ripeness, a huge, unctuous texture, enormous body, and a colossal 65-second finish. I did not have the benefit of tasting it side by side with the equally perfect 1998, but it appears the 2000 is a more massive, macho/masculine wine, with more obvious tannin and structure than the seamless 1998. It is another wine to add to the legacy of the great vintages of Petrus. Anticipated maturity: 2015-2050.
A Case in Point
• A middle priced wine — $15.99
• Closed by a middle quality closure — Ground and compressed cork with solid disc ends
• OK and OK

Putting a Cork in It

Factors in Corking
• How well does the cork fit?
  – The bottle neck is 18 mm—the cork is 24 mm
  – The cork must be compressed before insertion
  – It immediately expands
• After 24 hours a tight seal is formed
• If a wine bottle is stored on its side
  – The cork will be kept moist and...
  – An airtight seal will remain indefinitely

Using the Floor corker
Bottle in place, cork inserted, cork compressed, cork plunged into bottle, a successful corking

Winery Scale Bottling and Corking
• New bottles are placed on the conveyor belt
• Inverted, washed, and flushed with CO₂
• Filled with wine
• Corked
• Covered with a capsule

Placing new bottles on the conveyor belt
Bottles are rinsed
Filling
Corking
The Capsule Goes on

Bottle Shock
• Wine is said to undergo “bottle shock”
  – Changes due to “stress” of bottling
  – Probably due to exposure to oxygen
• Characterized by flavor changes
  – Flat flavor and aroma
  – Sometimes off-putting odor
• A rest period of 3 to 6 months is typical
  – The wine regains its health
  (“Bottle Sickness” is another term for it)

Bottle Aging
• The purpose of bottle aging wine
  – Softens the tannins
• Some is thrown off as sediment
  – Allows the wine to develop complexity
  • Chemical reactions continue, forming new flavor compounds
• What else happens in aging?
  – Fruitiness is lost
  – Colors change

Color in Aging Wines
• Reds go from purple to brick to brown
• Whites go from green/straw to amber

How Long to Age Wines
• Wines are now made to be drunk younger
  – Tannins are reduced
• The Three Factors of aging
  – Tannins soften
  – Fruitiness is lost
  – Complexity develops
• Therefore...
  – Most whites do not benefit from aging (little tannin)
  – Fruity reds do not benefit from aging (Beaujolais, Zinfandel)
  – Most other reds—three to five years in the bottle (Merlot, Syrah)
  – Bold reds—seven years or more in the bottle (Cabs)

Proper Aging
• Storage Conditions
  – Cool, dark place at 55-60°
  – Bottles on their sides

Malolactic Fermentation
• Malolactic fermentation (ML)
  – Converts malic acid
    • The sharp acid of green apples
  – Into lactic acid
    • The milder acid of yogurt
    – Initiated by the ubiquitous lactic acid bacteria
  • Occurs spontaneously but can be controlled by the winemaker
    – Initiated by inoculation
    – Inhibited by treatment with SO₂
  • The result...
    – Conversion of a stronger acid to a weaker acid—less acidity
    – Production of CO₂

Effects of ML
• Reduces acidity
  – “Softens” a wine
• Therefore
  – Best for wines that are a little too tart
Avoided in wines of low acidity

• Produces by-products
  – May give a “buttery” quality
  – Due to diacetyl

• Winemakers often use ML...
  – for all or part of the batch
  – to achieve a desired bouquet

For Example
Gloria Ferrer 2010 Chard
• The winemakers description of the wine
  – 100% Chardonnay
  – 100% barrel fermented
  – 29% put through ML
  – Aged for 9 months in medium-toast French oak barrels
  – Alcohol 13.5%

Meursault
A Burgundy White
• Description of the wine
  – 100% Chardonnay
  – Fermented in oak barrels
  – Indigenous (wild) yeasts
  – Aged on the lees 11 months
  – 100% malolactic fermentation
  – Bottled after one racking

ML in the Bottle
• Rare in US wines
  – Vintners control ML carefully

• More common in European wines
  – Result is slight effervescence in the wine due to the production and capture of CO₂
  – Not unpleasant in a dry white
  – Considered a fault in a red

Red and White Wine Vinification Compared

Reds
• Harvest Criteria
  – High Brix is OK
  – High alcohol common
• Fermentation
  – Crushed, fermented (open tanks, hi temp one week), pump over, skin contact, then press
• ML
  – Ignored (spontaneous)
• Cold stabilization
  – Ignored
• Aging in oak
  – Carried out
  – 1-2 years

Whites
• Harvest Criteria
  – High acid is preferred
  – So, moderate Brix
• Fermentation
  – Crushed, pressed, fermented (closed tank, low temp w/ cooling, 4-6 weeks), no skin contact
• ML
  – Controlled
• Cold stabilization
  – Carried out
• Aging in oak
  – Optional
  – If done, 6 months typical
• Bottle aging
  – Rare

Part 4—Champagne

Statue of Dom Pérignon (1638-1715)
  at the *Maison* of Moët et Chandon in Epernay, France in the Champagne region, founded in 1743

The (supposed) discovery of Champagne
  by the Benedictine monk, Dom Pérignon near Epernay, 1668

*Le Petit Journal of June, 1914*
  celebrating the 200th anniversary of the discovery of the method of making bubbly wine by Dom Pérignon (1714)

  – A paper presented to the Royal Society in London described the Champagne production method in 1662, six years before Pérignon ever set foot in a monastery.

*Le Déjeuner d’huîtres ("Oyster Lunch")*
  • Painted in 1735 by Jean-François de Troy
  – The first depiction of Champagne in a painting
  – Shows the early acceptance of champagne at festive occasions
  • They're all looking at

The Wine Regions of France

The Wines of France

• Champagne
  .
  – Champagne
• Loire Valley
  .
  – Sauvignon Blanc
  – Chenin Blanc
  – Muscadet (Melon)
  – Cabernet Franc
  – Crémant de Loire
• Alsace
  .
  – Pinot Gris
  – Riesling
  – Gewürztraminer
• Burgundy
  .
  – Chardonnay
  – Pinot Noir
• Beauxjolais
  .
  – Gamay
• Bordeaux
  .
  – Bordeaux Blend
  – Semillon-Sauvignon Blanc
  – Sauternes
• Rhône Valley
  - Rhône Blend (GSM)
    (Grenache-Syrah-Mourvèdre)
  - Syrah
  - Marsanne-Roussane
  - Viognier
• Provence
  - Rosé
  - Crémant de Bourgogne
  - Aligoté

The Champagne Region
The Vineyards of Champagne (Restricted to the proper chalky soil)

Unplanted Acreage in Champagne
• Unplanted—because it fails to meet the strict requirements of the government on soil, climate, slope, and so on
What is “Champagne”?  
• "Champagne" refers to the region in France
  - 90 miles northeast of Paris
  - The northernmost vineyards in France
• Only wines from here may be called "Champagne"
  - Observed everywhere except in the U.S.
  - In the U.S., any bubbly can be called Champagne (if in use before 3-10-06)
• Some U.S. producers observe the restriction
  - They call their products "Sparkling Wine"

“Champagne” in Other Countries...
• In Italy—Spumante
• In Spain—Cava
• In Germany—Sekt
• In South Africa—Cap Classique
• In Portugal—Espumante

The Differences
• Between three of the European sparkling wines
  - Champagne
  - Prosecco
  - Cava

Aging Cava in Spain or Champagne in France
  The methods are the same

Crémant Wines of France
• One of the great bargains of the wine world—the Crémant sparkling wines of France
  - These sparkling wines are made exactly like Champagne
  - Using grapes from France, but not from the Champagne region
Try Trader Joe's

- Blason de Bourgogne
  - Brut Réserve——$10
  - Blanc De Noirs——$11
  - La Réserve Rosé Brut——$11

- For comparison
  - Veuve Clicquot Champagne
  - Typical price $45

"Champagne" from the U.S.

- The term "Champagne"
  - May legally be used on a U.S. produced sparkling wine
  - If in use before March 10, 2006
- Otherwise "Sparkling Wine" is correct

Climate of the Champagne Region

- The weather of Champagne is unreliable
  - Spring frosts
  - Cool summers
  - Autumn rains
- The average August high temp is 76°F
- Compared to Napa 81°F
- Compared to Calistoga 92°F

Average High Temperatures
Monthly Rainfall

Touring the Champagne Region
Champagne Vineyards
Harvest
Fall Colors in Champagne

The Chalky Soils of Champagne

- Champagne vineyards comprise about 83,000 acres owned by 13,648 individual growers
  - 30% planted in Chardonnay (white)
  - 38% planted in Pinot Noir (black)
  - 32% planted in Pinot Meunier (black)
- Good varieties for cool climates, but
  - Full ripening is rare
  - Chaptalization is the rule

The Champagne Harvest

- Because of the cool climate...
Grapes often don't ripen

- Typical harvest parameters
  - Sugar: 18-20 Brix (compared to 20-28)
  - Acid: TA of 9-13 g/L (compared to 6-8 g/L)

- That is, Champagne grapes are
  - Low in sugar
  - High in acid

- The perfect character for sparkling wine

Hand harvesting is required in Champagne

Who Makes Champagne

- Called Maisons (Houses)
  - Moët & Chandon, Veuve Clicquot, Nicolas Feuillatte (Three of the largest, ~50% of exports)
  - About 300 Houses
  - Over 4,000 small producers

- Most are near two towns, Reims and Epernay
  - The Houses get grapes from many vineyards
  - The goal: a consistent product year after year

Who Buys Champagne

- Primarily, the French
  - 51.8% is consumed domestically
  - 48.2% is exported

Top 10 Champagne Importers (Bottles and Euros)

MOËT & CHANDON—1743
CHAMPAGNE MERCIER—EPERNAY

Le Foudre Mercier

- On May 7, 1889, the Foudre Mercier made its much anticipated entrance at the Exposition Universelle in Paris

A foudre is a large barrel

- This one was drawn by a team of 24 oxen all the way from Epernay
- Its capacity was about 42,000 gallons—it was actually used for blending
- Mercier's giant Champagne barrel was seen as a worthy rival to the Eiffel Tower which was also built for the Exposition Universelle

Le Foudre on its specially built railway base for its trip from Epernay to Paris
Le Foudre Mercier on display at the Exposition Universelle, Paris

“Never Drink Water”, Laurent-Perrier, Reims

Cost of Champagne Acreage (as of 2015)

- Producing vineyard acreage
  - Average in France
    - $5700 per acre
  - Average appellation acreage (AOC)
    - $61,000 per acre
– Average Champagne acreage
  • $500,000 per acre

• And for comparison…
  – Prime acreage in Napa Valley
    • $225,000 to $350,000

California Sparkling Wine

The Scattered Sparkling Wine Regions
• Throughout Northern California
  – Both cool and warm climates
• The Four Leading Regions—all are cool
  – Anderson Valley (Mendocino County)
  – Green Valley (Sonoma County)
  – Russian River Valley (Sonoma County)
  – Carneros Region (Southern Sonoma and Napa Counties)

Anderson Valley
Green Valley
  The Smallest District (AVA) in Sonoma County

Russian River Valley
The Carneros District Borders the Northern Bay

Carneros

Carneros Vineyards

Some California Standouts
• Anderson Valley
  – Scharffenberger, Roederer Estate
• Green Valley
  – Iron Horse
• Carneros Region
  – Domaine Chandon
  – Domaine Carneros
  – Gloria Ferrer
• Russian River Valley
  – J (Jordan Wine company)

A Blended Cuvée
• Schramsberg
  – Blended from wines from
  – Napa, Mendocino, Sonoma and Marin

Compare California to Champagne
• California is warmer than Champagne
  – Result: Grapes always ripen and...
  – Ripe grapes have stronger varietal character
• Production methods are nearly identical
  – French vintners are often employed in California
  – French Companies are often owners
• Nevertheless, there are significant differences
In soil, climate, and cuvée composition (e.g., pinot meunier is not used in California)
In winemaking choices—ML fermentation, autolysis

### California Sparkling Wine vs Champagne

<table>
<thead>
<tr>
<th></th>
<th>Champagne</th>
<th>California</th>
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</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Cool</td>
<td>Warm</td>
</tr>
<tr>
<td>Soil</td>
<td>Chalky</td>
<td>Rich</td>
</tr>
<tr>
<td>ML Ferm’n</td>
<td>Always done</td>
<td>Not required</td>
</tr>
<tr>
<td>Autolysis</td>
<td>Always occurs</td>
<td>May occur</td>
</tr>
<tr>
<td>Grape Blend</td>
<td>Includes P. Meunier</td>
<td>P. Meunier not used</td>
</tr>
</tbody>
</table>

### Champagne vs California (cont)

- California Sparkling Wines are a work in progress
- Changes are being made all the time
  - To improve the product
  - To better replicate the Champagne taste

#### Domaine Chandon
Founded in 1973 by the Moët-Hennessy company— the first French-owned sparkling wine venture in the United States.

#### Roederer Estate
Jean-Claude Rouzaud, president of Champagne Louis Roederer, selected the 580-acre Anderson Valley vineyard and winery site in 1982.

#### Mumm Napa
Founded by G.H Mumm winemaker Guy Devaux in 1983

#### Domaine Carneros
Founded in 1987 by Champagne Taittinger

### The Méthode Traditionnelle
also known as the Méthode Champenoise

- All *fine* sparkling wines…
  - Are produced by this method
- Its main feature—a major cost
  - Re-fermentation *in the bottle*
  - The bubbles of CO₂ formed in this second fermentation
  - Are trapped in the bottle
- Hence, a bubbly wine

### The Méthode Traditionnelle

#### The Méthode Traditionnelle—Summary

- Early harvest
• Whole cluster pressing
• 1st Fermentation
• Blending—*assemblage*
• 2nd Fermentation
• Maturation *sur lie*
• Riddling—*remuage*
• Disgorgement—*dégorgement*
• *Dosage*
• Corking

**The Champagne Harvest**

• The grapes must be hand picked
  – It is a law
• The harvest window is one to two weeks
  – Usually in mid-October
• Up to 100,000 temporary workers are imported
  – Mostly from Eastern Europe and the Paris suburbs
  – After the harvest, they are quickly bussed out of the region

**The Champagne Harvest**

• There are 13,648 vineyard owners
  – Half of the parcels of two acres or less
• 96% of the owners sell their grapes
• If you own a champagne vineyard and…
  – Don’t abide strictly by the champagne laws
  – You can’t sell your wine with the “Champagne” label on it

**Everybody helps out at Redon Champagne**

The youngest member of the Redon family works the harvest

**Why Not Machine Harvest?**

• It’s faster and cheaper and more reliable
• But…
  – Machine harvesting causes more grape damage
  – More grape skins are broken
• For Champagne, this is critical because
  – Juice-skin contact must be kept to a minimum
  – To avoid the juice picking up the dark skin colors
• Remember: Light juice from black grapes

**The "Base" Wine**

• The grapes are
  – Chardonnay (white)
  – Pinot Noir (black)
  – Pinot Meunier (black)
• The goal—a white wine from black grapes
• What’s required?—minimum skin contact
• How done?—whole cluster pressing

Why Three Grapes?
• This is what the official Champagne site says
  – "Pinot Noir contributes aromas of red fruits and adds strength and body to the blend"
  – "Pinot Meunier, the fastest-maturing component in Champagne, contributes supple body, intense fruit and roundness"
  – "Chardonnay gives the blend finesse. As a young wine, it brings floral notes, sometimes with a mineral edge. It is the slowest to mature of the three Champagne varietals and the longest-lived."

Whole-berry Pressing
• Black grapes are not crushed
• They go directly to the press
• Rapid pressing minimizes the juice-skin contact
• Requires special hydraulically operated presses
  – Large diameter—10 feet
  – Minimal depth—2 feet

Black Grapes  White Grapes  Mixed Grapes  The Press Descends
Emergence of the light-colored juice
Light Colored Juice from Black Grapes
Large scale Champagne making operation

Hand cranked presses from 1920  E. Renaudin, Riems
Modern pneumatic wine presses now coming into use

Completing the Base Wine
• The rest of the steps are conventional
  – Addition of SO₂, fermentation, racking, clarification, fining, cold stabilization for tartrates,
• The result—a clear white wine
  – Alcohol 10-11.5% (normal 12-13.5%)
  – Acidity 7-9 g/L (normal 6.5-7.5 g/L)
  – SO₂ at 10 ppm max (normal 20-30 ppm)
• Low alcohol and low SO₂ are required to allow the second fermentation to take place

Assemblage
• Champagne is unusual among fine wines
  – It is a blend of wines
  – From different years
  – From different grapes
  – From different vineyards
• The Goal—a consistent product from year to year
• The "House" style must be dependable
  – Blending is the mechanism of this consistency
  – Carried out by the House "tasting committee
• The resulting blend is called the "cuvée"
• The process is called "assemblage"

**Blends of Some Houses**

<table>
<thead>
<tr>
<th>Moët &amp; Chandon</th>
<th>Taittinger</th>
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</thead>
<tbody>
<tr>
<td>45% Pinot Noir</td>
<td>30% Pinot Noir</td>
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<tr>
<td>40% Pinot Meunier</td>
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<tr>
<td>20% Chardonnay</td>
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<table>
<thead>
<tr>
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<th>Lanson</th>
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<tr>
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<td>50% Pinot Noir</td>
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<tr>
<td>20% Pinot Meunier</td>
<td>15% Pinot Meunier</td>
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<tr>
<td>30% Chardonnay</td>
<td>35% Chardonnay</td>
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<table>
<thead>
<tr>
<th>Nicolas Feuillatte</th>
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<tr>
<td>40% Pinot Noir</td>
<td>33% Pinot Noir</td>
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<tr>
<td>35% Pinot Meunier</td>
<td>33% Pinot Meunier</td>
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<tr>
<td>25% Chardonnay</td>
<td>33% Chardonnay</td>
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<table>
<thead>
<tr>
<th>G.H. Mumm</th>
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<tr>
<td>45% Pinot Noir</td>
<td>55% Pinot Noir</td>
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<tr>
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<td>13% Chardonnay</td>
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<thead>
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<th>Carard-Duchêne</th>
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<tr>
<td>35% Pinot Noir</td>
<td>45% Pinot Noir</td>
</tr>
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<td>50% Chardonnay</td>
<td>20% Chardonnay</td>
</tr>
</tbody>
</table>

**The Blends Vary**

• Pinot Noir, for example, has the following percentages in the various wines
  – 30, 33, 35, 40, 45, 45, 50, 50, 55
• Obviously, the “perfect” blend is a matter of taste.

**Re-Fermentation**

• To the cuvee are added…
  – sugar, yeast, yeast nutrient
• Mixed and crown capped
  – This bottle will be the final Champagne bottle
• The bottles are stored a few weeks at 60º
  – The second fermentation now occurs
  – This time, the CO₂ formed is trapped in the bottle—the final fizz

Although not routinely done, it is possible to follow the formation of CO₂ in the second fermentation by means of a pressure gauge

**En Tirage (Storage)**

• The bottles are then stored at 50º for 1 to 4 years!
• Now, the Champagne bouquet evolves
  – Yeast cells undergo self-destruction (autolysis)
  – Yeast flavors blend with normal aging flavors
• Result: the distinctive Champagne bouquet
  – nutty, yeasty, peachy and sweet, floral, metallic, toasty and waxy
En Tirage

The Developing Champagne Aroma Components
A few of the over 600 flavor compounds that give Champagne its complex bouquet

The next step in the Méthode Traditionnelle…Clarification

Clarification
- The fermentation sediment (dead yeast cells) must be removed to achieve a clear wine
- Gravity is used to move the sediment to the neck
- The bottles are stored neck down in a rack
- The sediment migrates toward the neck, with the proper help—riddling

Riddling or Remuage to Move the Sediment to the Neck
- Once a day for a month
- The bottle is lifted
- Rotated quickly to the right and left
- Replaced with a jolt
- The sediment migrates down the neck

The progress of the sediment over 21 days

Riddling 1920
The Invention of Riddling
- Prior to riddling
  - Wine was clarified by pouring from bottle to bottle
  - Time-consuming and wasteful
- The Widow Clicquot devised the method of inverting the bottles in 1818
- In 1864, the pupitre (Fr., desk), the riddling rack, was patented
- In 1889, the rotation of the bottles was added
  - Riddling became a skilled occupation
  - A skilled riddler (remueur) can turn 80,000 bottles a day (about 150 per minute)
  (Using both hands, that comes to 1¼ seconds per riddle)

Remuage at Veuve Clicquot
Checking the Sediment
Automated Riddling Racks

Automated Riddling Rack at Chandon, Napa Valley

Dead yeast cell sediment in the bottle neck

Removal of the Sediment… Disgorgement
- The bottles are cooled to 45º to reduce pressure
- Inverted
- And the neck is immersed in a freezing bath at 5º F
- The wine containing the sediment freezes forming a one-inch plug in about two minutes
- The bottle is removed from the bath
- The cap removed
• The plug shoots out from CO₂ pressure
• The result is a clear wine

Automatic Disgorging Machine

The Date of Disgorgement

• "The date of disgorgement is very important, because a bottle will taste very different six months after disgorgement than it will two years after,"
  – Champagne grower Didier Gimonnet, of Pierre Gimonnet & Fils.
• Most non-vintage Champagnes do not display this date
  – The house style dominates the tastes
  – Taste is not expected to improve over time

Dosage

• The lost wine is replaced by adding the "dosage"
  – In addition to wine, it may include sugar and brandy
  – To adjust sweetness and bring the alcohol level to 12% to 13%, the legal limit
• The levels of sweetness are:
  – Brut 0 to 1.5% sugar
  – Extra Dry 1.2 to 2.0
  – Sec 1.7 to 3.5
  – Demi-Sec 3.3 to 5.0
  – Doux above 5

Dosage Machine

The final step in the Méthode Traditionnelle…Corking

The Champagne Cork

• Unique design
• Larger diameter (30.5 mm) compared to wine (24mm)
• Made of two parts
  – Two solid discs (4.5mm) at the bottom
  – Glued to a granulated cork body
• Overall length 48 mm (1.88 inches)
  – Compared to a wine cork (38mm)

Sequence

• The cork is inserted halfway into the neck
• Secured with a wire basket (a muselet) invented in 1844 to keep the corks from flying off the bottles
• Covered with the foil wrapper

Putting on the Foil By Hand

New and Used Corks

Unused Cork After Use The Andre Special (Immutable)

The Champagne Bottle

• It is unique among wine bottles
  – Thicker glass (31.5 oz vs 18.5 oz)
  – Sloping shoulders (for proper riddling)
Top rim to seat a crown cap
Bottom indentation (punt)

These features ensure that the bottle is
- Protected against the high CO\textsubscript{2} pressure
- It may reach 90 psi or more

**2017 Update**
- The Champagne industry is adopting a new lighter bottle—appearance unchanged
  - New weight 29.2 oz (lighter by 2.3 oz)
  - It will reduce carbon emissions and transportation costs
- It will be employed in the April 2018 bottling

**The Finished Product**

**Summary of the Finishing Steps**
Freezing the necks, Dégorgement, Dosage, Corking

**Degorgement and Corking**

**Vintage and non-Vintage Champagne**
- In exceptional weather years
  - Grapes ripen perfectly
  - Yield is ample
- French makers may make a **vintage** Champagne
  - Consisting of at least 80% grapes from that year
- These Champagnes are considered to be the best
  - Reflected in their higher cost
- Most champagne is, however, non-Vintage (NV)
  - Blended from several years’ wines

**Comparing Some Vintage and NV Champagnes**

**Should You Age Champagne?**
- For NV Champagnes
  - Already aged 1 to 4 years
  - Little improvement with further aging
  - Belief: Freshness is lost over time
- For vintage champagnes
  - Complexity and subtlety can be enhanced by aging for up to 20 years

**The Bubbles**

There are about a million bubbles in the average glass of Champagne

**About the Bubbles**
- Bubbles in Champagne and in soft drinks
  - Are both CO\textsubscript{2}
- In carbonated drinks, the CO\textsubscript{2} is simply dissolved
  - And present in the form of carbonic acid, H\textsubscript{2}CO\textsubscript{3}
  - Which quickly releases CO\textsubscript{2} bubbles
  \[
  \text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}
  \]
• The bubbles in Champagne are different
  – They are smaller (.4 to 4 mm)
  – And they last longer

• Why?
  – The CO₂ molecules in Champagne are "bound"
  – That is, they are attached to other molecules
  – And thus, released more slowly

• It is while aging sur lie that the bound form of CO₂ is formed

Scientists have found that bubbles about 1.7 mm in size may give the best sparkling wine taste

Serving Champagne
• It is the bubbles that make Champagne unique among wines. Therefore, serving techniques should preserve the bubbles.
• To preserve the bubbles...
  – At what temperature should it be poured
  – How should you pour it
  – What kind of glass should you use

Champagne Glasses
• The Coupe
  – Supposedly modeled after the breast of Marie Antoinette
  – It was in fact designed in England a century earlier

• The Flute
  – Traditionally considered the preferred shape for sparkling wines
  – The flute retains the effervescence better than the coupe

Champagne Glasses continued
• The Tulip
  – The tulip is considered by some to be the best of all choices
  – Its tall shape preserves the bubbles well
  – Its slightly wider opening allows the Champagne aromas to reach the nose more easily

The best temperature for serving Champagne
From the Comité Champagne
• The official website of the Champagne region
  – Representing the "Coteaux, Maisons, & Caves de Champagne"
  – Or the "Hillsides, Houses, and Cellars of Champagne"
• This committee has recommendations regarding the correct way to serve Champagne

From the "Comité"
• The ideal temperature is 8-10 °C (47-50°F).
• Below that temperature
  – The wine is too cold
  – Making aromas harder to detect
• Above 10°C (50°F)
  – The wines appear "heavier and less bright"
Getting to the "Ideal" Temperature (again from the "Comité")

- The two preferred methods are
  - Place the bottle in an ice bucket for half an hour, or
  - Store the bottle on its side in the bottom of your refrigerator for four hours

Other Choices?
Some background information

- The relationship between temperature and CO₂ solubility in water
  - The less soluble, the more bubbles
- Secondly, the relationship between the applied pressure and CO₂ solubility in water

First, solubility of Champagne bubbles (CO₂) in water at different temperatures

- As the temperature rises, the solubility of CO₂ decreases
- As the solubility decreases, bubbles form and rise to the surface and escape

Temperatures your Champagne bottle is likely to encounter

- Ice bucket—Freezing 0° C (32° F)
- Refrigerator—Typical 4° C (30° F)
- Room temp—Typical 22° C (71° F)

What does it all mean?

- If the bottle is at freezing (0° C, 32° F)
  - Opening it will produce the least amount of fizz in the flute
  - Drinking it will give little fizz in your mouth at first, then more as the liquid warms up
- If the bottle is at 4° C (30° F)
  - Opening it will produce more fizz in the flute as the CO₂ escapes
  - Drinking it will give somewhat more fizz in your mouth
- If the bottle is at room temperature (22° C, 71° F)
  - Opening it will produce lots of fizz in the glass as the CO₂ escapes
  - Drinking it will give a lot of fizz in your mouth

Physics Part II

- Henry's Law
  - The higher the pressure, the more that gas will dissolve in a liquid
  - Conversely, as the pressure decreases, the gas will undissolve (?,) form bubbles, and escape
- Proof:
  - If you take the cap off a Coke bottle (allowing the pressure on the liquid to decrease),
    the Coke will go flat
  - If you remove the Champagne cork, the Champagne will eventually go flat

Uncap the Coke
The pressure is released
CO₂ escapes
The Coke goes flat

Caution

- If you take the wire basket off the cork…
  - Do not let the bottle stand unwatched
  - Pressure (9 atm or 126 psi) will dislodge the cork
  - It will shoot out with potentially dangerous consequences
  - If you must leave it, put a towel over it
• Death by Champagne cork (?)
  – Several people are injured by flying Champagne corks each year
  – No deaths have been verified

The Flying Champagne Cork
• Longest recorded flight of a Champagne cork is 177 feet

The Cork is Launched

Three Aspects of Serving Champagne
• The shape of the glass
  – Flute versus wine glass
• The orientation of the glass
  – The flute is tilted versus a vertical flute
• The condition of the glass
  – Dried with a towel versus air dried

Observations from the Experiments
• First Experiment—flute or wine glass
  – The bubbles last longer in the flute than in the wine glass
• Second Experiment—vertical or wall pour
  – The foam falls more rapidly when the pour is vertical
  – The bubbles are more numerous and last better when the pour is along the wall
• Third Experiment—cloth or air dried
  – There are more bubbles in the flute dried with a cloth

A second set of experiments shows the flow of CO\(_2\) when the Champagne is poured
• In the following slides, the concentration of CO\(_2\) is visualized by the intensity of the color
• Blue-green-yellow-orange shows the presence of CO\(_2\)

Flute or Coupe
• After the pour, there is more CO\(_2\) above the flute than above the coupe

Tilt of the Flute
• More of the CO\(_2\) is lost when the flute is oriented vertically than when it is tilted
• The French don't like the tilted pour because it reminds them of pouring beer

So, how to pour Champagne (summary)
• Temperature
  – Cool the Champagne to
    • 32° F (ice bucket)
    • 39° F (refrigerator) or
    • 50° F (½ hour in fridge)
  – Depending upon the amount of bubbling you want in your mouth
• Glassware
  – The flute is preferred over the coupe
  – The tulip may be the best balance between aroma and bubble preservation
• The Pour
  – Pour along the side of a tilted flute to preserve CO\(_2\)
Pour vertically in the center to release more bubbles

Champagne “goes right to your head”

- Research

<table>
<thead>
<tr>
<th></th>
<th>Blood Alcohol (%)</th>
<th>Blood Alcohol (%)</th>
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<tbody>
<tr>
<td></td>
<td>After 5 min</td>
<td>After 40 min</td>
</tr>
<tr>
<td>2 Glasses Champagne</td>
<td>0.054</td>
<td>0.070</td>
</tr>
<tr>
<td>2 Glasses degassed Champagne</td>
<td>0.039</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Legally intoxicated in California, 0.080%

Effect of Champagne

- Theory
  - The pressure of the CO₂ gas in the stomach causes the pyloric valve (or pyloric sphincter) to open prematurely
  - The alcohol enters the small intestine
  - Alcohol is absorbed faster in the small intestine than it is in the stomach
  - Blood alcohol rises faster
- The fact is true, the theory is questionable

Shouldn't gin and tonic show the same effect?

- It should and it does
- Any alcoholic drink will show this more rapid absorption of alcohol in the presence of a bubbly mixer
- Hence, Scotch and soda, gin and tonic, Jack and Coke, whiskey and ginger ale, Seven and Seven, and so on

And the Champion Get-you-drunk Tipple, the Boilermaker

- Or, a shot and a beer
- Or, a beer and a bump
- Instructions:
  - Drink the shot in one gulp
  - Chase it slowly with the beer
  
(Do not stand up suddenly!)

Champagne display at Paul Marcus Wines

All that glitters…

- Charles de Marques
  - Brut Champagne
  - Product of France
  - $19.99
- Looks pretty good, huh?
- It's awful
Part 5—Laws Governing Wine and Alcohol

The Source of Our Alcohol Laws

- US alcohol laws—complex and contradictory
- Outgrowth of our mixed tradition: Alcohol is...
  - Forbidden (LDS and some Protestant religions)
  - Required for religious ceremonies (Judaism, Catholicism)
  - Socially desirable (Scotch-Irish, German, Italian)
- Result: Hodge-podge of laws varying from
  - Local or county prohibition to...
  - State stores to...
  - Specific hours of sale to...
  - No controls except age* (Nevada only)

*As of July 1988, all states must enact a minimum purchase age of 21 as required by the National Minimum Drinking Age Act of 1984
“He who does not love wine, wife, and song will be a fool his lifelong”
—an expression of German-American cultural values, 1873

"The Drunkard's Progress" 1846
expresses the beliefs of the Temperance movement in the United States.

Making Alcohol in the New World
Grapes to wine
Grain to beer
Distilled Spirits

Wine from Native Grapes
• Several varieties are native
  – All have shortcomings
  – e.g., insufficient sugar, or…
  – "Musky" or "foxy" flavor
• Colonials attempted to make wines with native grapes
  – All attempts gave unacceptable results
  – Sour or strange tasting
• How about importing grape seedlings from Europe?

European Grapes
• All the great wines of the world…
  – Come from one species
  – Vitis vinifera
• Vines and cuttings
  – were imported to North America
• Who by?
  – The Pilgrims in Massachusetts (1620)
  – The Dutch in New York (1640)
  – The Swedes in Delaware
  – The Germans in Pennsylvania
  – As well as others in Georgia, Virginia, and New Jersey

But the Imported Grapes Failed
• What happened?
  – Imported grapes were attacked by Phylloxera
  – The minute root aphid
• Native grapevines had adapted to Phylloxera
  – But European vines withered and died
• So, one possible avenue of alcohol production was closed
• The solution to Phylloxera infestation was only found two hundred years later, in the 1870's

Beer and Cider
• Early colonial beer was made from corn
  – Just acceptable
• Plentiful apple crops
  – Gave apple juice, thence cider
• Fermented peach juice
  – Produced an acceptable product
• In any case, the demand for alcohol was not being met
The Answer—Distilled Spirits

- Rum was imported
  - In large quantities
  - From the West Indies
- Better yet, import molasses
  - The starting material for rum
- A large scale domestic rum industry resulted
  - The first distillery was on Staten Island (1667)
  - Then Boston
  - Thence to New York, Pennsylvania, and Carolinas

Ubiquitous Rum

- Rum changed colonial drinking habits
  - Rum became embedded in the social life of Americans
- One observer noted
  - Rum seemed to be ubiquitous
  - Found in the finest tavern and the vilest road-house
  - People of fortune kept a stock in their homes
  - Servants and laborers regarded it as indispensable
  - Parents gave it to children for their ills

Demon Rum

- The widespread use of rum at all social levels
  - Led to frequent abuse
  - Hence, "Demon Rum"
- But all that was about to change
  - With the arrival of the Scotch-Irish

The first potato is grown in North America

The Scotch-Irish

- The colonists pushed west including the Scotch-Irish
  - Who settled in western Pennsylvania, and throughout the Appalachians
- They brought with them their whiskey-making skills
  - Using grain as the base
- Rye and bourbon
  - Gradually replaced rum
  - As America's favorite spirits

Early Whiskey distillation

Laws Governing Alcohol

- Drunkenness was viewed by all religions as undesirable
  - So, laws to control alcohol consumption were inevitable
The Laws

• The 1630 Law
  – Specified prices for meals
  – Price for beer
  – Number of nights guests could stay at an inn
• Maximum time spent drinking in a tavern
  – "Ye space of halfe an houre"
• A fine of 2 shillings and 6 pence to be levied…
  – "for sitting idle & continuing drinking above halfe an houre"

The 1680 Law of Massachusetts

• Limited the number of drinking places per town
  – Boston (pop 4,500)
    • Ten inns
    • Six wine taverns
  – Other towns
    • Permitted from 2 to 6 places
  – Smaller communities
    • One each

Other Laws

• Forbidden in drinking establishments—
  – Gambling
  – Dancing
  – Playing games (?)
• The Result
  – A complex set of regulations
  – Designed to prevent excessive drinking
  – Which is harmful to religion, morals, and the social order

Alcohol Consumption in Early America

• By 1810
  – Distillers numbered over 2000
  – They produced over two million gallons
• In 1820, whiskey cost 25¢ a gallon
  – Cheaper than beer, wine, coffee, tea, or milk
• Annual alcohol consumption:
  – Reached 7 gallons per person
  – Three times the current rate, 2.3 gal/person

Among his many pursuits, George Washington established a distillery, now restored, at Mount Vernon,
The restored distillery at Mount Vernon

• The McCormick Reaper (1831)
Brought on the expansion of grain agriculture
Excess grain was now common

Problem
• Excess grain
  – Bulky, Expensive to ship east

"Liquid Assets"
• Why not convert the excess grain into whiskey
  – And ship the higher value product east
  – A bushel of grain weighs about 56 lbs.
  – It yields 5 to 5.3 gallons of 50% alcohol
• Now there was a new enterprise in the west
  – Supplying spirits to the East
  – Further challenging the supremacy of rum
• These "liquid assets" were sometimes even used as currency in the west

Family Operation
• In Western Pennsylvania
  – Each family distilled its own spirits
  – Whiskey drinking was pervasive in rural villages
  – Any work required the stimulus of spirits
• Special occasions…
  – Haymaking, corn-husking, or barn raising
  – Time to drink

The Whiskey Rebellion (1791-1794)
• To settle the revolutionary war debt
  – A tax on distilled spirits
  – Proposed by Alexander Hamilton
  – Adopted by Congress
• In 1789, imported spirits taxed
• In 1791, domestic spirits taxed
  – Large producers: 6¢ a gallon
  – Small producers: 9¢ a gallon

Objections
• The tax was viewed as unfair
  – Proposed by Easterners
  – For the benefit of Easterners
• Objections came from the Scotch-Irish of Western Pennsylvania
  – It discriminated against small distillers
  – Most of whom were in Western Pennsylvania
• By the summer of 1794…
  – Tensions were high along the western frontier

Opposition to the Tax
In 1794, an armed rebellion broke out in Western Pennsylvania
Tarring and Feathering

President Washington Declared it a Rebellion, August 7, 1794
(Seen as a test of the power of the new Federal Government)

Washington Takes Action, September 19, 1794
Washington became the only sitting U.S. President to personally lead troops in the field when he led the militia on a nearly month-long march west over the Allegheny Mountains to the town of Bedford.

Washington in Pennsylvania
The President reviews the troops at Carlisle, Pennsylvania in September, 1794

Monument in Carlisle, Pennsylvania

Consequences of the Supression
• The power of the new government was demonstrated
• But, many small whiskey producers relocated...
  – To the west which was...
  – Outside of Federal control
• Thus was established the tradition of defying "revenoors"
• The whiskey tax was repealed in 1803
• It had been largely unenforced

Wine in Revolutionary America
• The beverages of choice...
  – Whiskey and rum
• Wine
  – Little known
  – Little made
  – Rarely appreciated.
• Contrast this with France at this time
  – Wine production high in quality
  – French wine was greatly valued in Britain

Enter Thomas Jefferson
Jefferson’s Interest in Wine
• Jefferson farmed in Virginia
  – Attempted cultivating European grape vines
  – But, the European grapes failed to thrive
  – Of course, he did not know about Phylloxera (1 mm in size)
• While Ambassador to France (1780s)
  – Visited the wine centers of France and the neighboring countries
  – Soon became known for his taste in wines
• His example led many Americans to try wine

Jefferson's Wine Tour through France, 1787
"I am just setting out on a journey of three months to the South of France." – Thomas Jefferson to Elizabeth Trist, a friend, February 23, 1787

The Hôtel de Langeac
Residence of Thomas Jefferson in Paris, 1785 to 1789, Demolished in 1842

Building where the Hôtel de Langeac once stood on the Avenue Des Champs-Elysees

A page from Jefferson's wine diary recording his purchases

Jefferson on France
– "Every man has two countries: his own and France."

Jefferson on Wine
– "No nation is drunken where wine is cheap: and none sober, where the dearness of wine substitutes ardent spirits as the common beverage."

"By making this wine vine known to the public, I have rendered my country as great a service as if I had enabled it to pay back the national debt."

Alcohol Taxes (cont)
• Social goals have often influenced tax policy
• Example: In the early 1800’s Pennsylvania...
  – Enacted an excise tax on liquor partly...
  – “To restrain persons in low circumstances from an immoderate use thereof.”
• A hint of the temperance movement to come

Creation of the IRS
• No attempts to tax spirits again until the Civil War
  – Funds were needed to prosecute the war
  – Taxes on alcohol and tobacco were the targets
• In 1862, Congress created the IRS to...
  – Administer the Income Tax and...
  – Levy taxes on spirits and tobacco
• By 1868, the income tax was repealed and...
  – Tobacco and alcohol taxes were then the main source of US revenue

The Lead-Up to Prohibition
Alcohol Abuse
• Alcohol abuse was common in mid-1800s
• Excess drunkenness...
  – Became a public outrage and..
  – Provoked the temperance movement
  – Which contained a strong religious element

NO WONDER THE WIVES OF THESE MEN HAVE JOINED THE PRAYING BAND

The ladies of Logan sing hymns in front of a barroom, 1874
Pleading with a Saloon Keeper, 1874

“Roughnecks Hanging Out in a Bar” while the ladies pray for their souls

Success of the Temperance Movement

- By the 1840s, many towns and counties had gone "dry"
- Maine banned manufacture and sale in 1851
- By 1855, thirteen states had "Maine" laws
- Annual per capita consumption of alcohol dropped
  - From 10 gallons in 1830
  - To 2.1 gallons by 1850

Pause...for War

- When the Civil War came, the movement became largely inactive
  - The nation's thoughts were elsewhere
- After the war, the prohibition movement was revived
  - Led by the formerly quiescent female population

Poster and a Song

Dedicated to the growing temperance movement

A spoof of the same sentiment

"If a body meet a body
Comin' through the rye."

Anti-Alcohol Organizations

- Political entities were important
  - Prohibition Party, 1869
  - Woman's Christian Temperance Union, 1874
  - Anti-Saloon League, 1893

Many Took the WCTU Pledge

Temperance Parade
  Chicago, 1908

Picketing for Prohibition, Madison, Wisconsin, 1917

Prohibitionist Carrie Nation, ca. 1905

Carrie Nation, Fighter for Temperance

- Kansas banned alcohol in 1881
  - By constitutional amendment
  - But...largely ignored
- Carrie established a WCTU Chapter in Medicine Lodge, Kansas (1899)
  - She campaigned for enforcement of Kansas’s ban
- Received a heavenly vision (1900)
– “Destroy saloons”
– “Use weapons”

Carrie Nation (cont)

• Arrested over 30 times for...
  – Using a hatchet to destroy saloons
  – Paid her fines out of her lecture fees
  – And sales of miniature hatchets
• Banned from Kansas City by a judge (1901)
• Continued her campaign in US and Europe
• Died in 1911, honored by the WTCU

Memorial to Carry Nation

Temperance Supporter, San Francisco

What About Wine at this Time?

American Wines Before Prohibition

• In 1900, America had a prosperous wine business
• US brands appeared on many restaurant wine lists
• California wines were widely exported

Typical Early California Labels

Made everywhere in the state
  Italian Family Winery
  Downtown, Los Angeles, ca 1910

Bullard Winery, Anaheim 1885

The Picchetti Winery, Cupertino Founded in 1897

Wine Press, Picchetti Winery

Italian Swiss Colony delivery truck, 1915
California Wine Association was formed on August 10, 1894
  This company's goal was to establish a monopoly in California wines. Prohibition ended their efforts

Products of the California Wine Association

Burgundy "Type"

• By adding the word "type" to familiar names
  – Such as Burgundy
  – or Chablis, etc.
• California winemakers..
hoped to avoid the assertion
that they were misleading consumers
as to the wine's origin

First Headquarters of the California Wine association in San Francisco
Destroyed in the Fire of April, 1906

American Wines at the Paris Universal Exposition, 1900

View of the Wine Display, Paris Universal Exposition, 1900

The Story of the American Wines at the Paris Exposition, 1900

• 59 American winemakers submitted wines
  – Among them, some still familiar names
    • Ben Lomond Wine Co
    • Beringer Bros
    • Gundlach-Bundschu
    • Italian-Swiss Colony
    • Paul Masson
    • Jacob Schram
  • But, some of the wines were objected to!

What was the problem with the American wines?

• French members of the judging committee
  – Objected to American wines that had misleading labels
  – For example, G. Piuma showed a Burgundy made in Los Angeles
  – But Burgundy is a wine region in France
  – "American" Burgundy is misleading, said the French

A Second Example

• Again, an American wine is labeled with a French place name
• The Americans withdrew their entire entry pending a resolution
  – Noting, similar wine were judged at the 1889 Exposition without objection
  – After 3 weeks, the American wines were accepted for judging

The Judging Results

• American wines won
  – Six Gold Medals
  – 13 Silver Medals (including Italian Swiss)
  – 17 Bronze Medals (including Beringer and Gundlach Bundschu)
  – Four Honorable Mention (including Paul Masson)
• Subsequently, American winemakers have largely abandoned French place names
  – They use grape varietal or generic names
Except, of course, Gallo and another Gallo product

American wines won 36 medals at the Paris Exposition of 1900

Great Western, a gold medal winner, does a little bragging
   Note: Great Western did not use the word "Champagne" on its label

California Wines on a Menu (1877)

But at a Fancy Restaurant in New York, 1861
   Only European wines

At another upscale restaurant in 1860, American wines poorly represented

At a San Francisco Restaurant, 1862
   Sonoma Cal  Champagne  2.50
   Sonoma Cal  Sauternes  1.00
   Sonoma Cal  Hock      1.50
   Sonoma Cal  Claret    1.00

Effect of the Temperance Movement on Wine Production
   • In the dry states the winemaking situation was dire
   • Wine could be made for out-of-state sales
   • But few wineries could succeed without local sales.
   • Most closed their doors, abandoned their vineyards

Abandoned Vineyard

Abandoned Winery

The March toward Prohibition

Dry States, 1855

Dry States, 1905

Dry States, 1919

Dry States, 1920

The Enactment of Prohibition
   • December, 1917
     – The 18th Amendment was adopted by Congress
   • January 16, 1919
     – Ratified by 36 of the 48 states
     – Eventually 46 ratified (Rhode Island and Conn. against)
   • January 19, 1919
     – Ratification certified by the Secretary of State
   • October 28, 1919
     – The Volstead Act (clarifying legislation) is adopted
January 19, 1920
National Prohibition goes into effect

The Geauga (Ohio) Republican, January 29, 1919
Map showing the first 36 states (in white) to ratify prohibition

Amendment XVIII

- Section 1. After one year from the ratification of this article the manufacture, sale, or transportation of intoxicating liquors within, the importation thereof into, or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes is hereby prohibited.

- Section 2. The Congress and the several states shall have concurrent power to enforce this article by appropriate legislation.

- Section 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of the several states, as provided in the Constitution, within seven years from the date of the submission hereof to the states by the Congress.

Provisions

- From 1920 on, prohibited in the US were
  - Manufacture
  - Sale
  - Transport of alcohol

- Not prohibited were private possession and consumption of alcohol
  - (If you could find it, you could drink it)

The Volstead Act

- This was the detailed (20 pages) legislation
  - Passed October 28, 1919
  - It defined "intoxicating liquor" as any beverage containing more than 0.5% alcohol

- President Wilson vetoed the bill
  - As too extreme

- Congress easily overrode him

- Gone were any hopes that...
  - Light wines or beers might be permitted
  - A disappointment to many less-than-enthusiastic supporters of prohibition

Acceptable

- Near Beer
  - Brewed as normal beer
  - Alcohol removed
  - By heating, or vacuum

- Result
  - Beer with <0.5%
The Volstead Act (cont.)

• Provisions of the Act
  – "No person shall manufacture, sell, barter, transport, import, export, deliver, or furnish any intoxicating liquor except as authorized by this act."
  – Wine for sacramental purposes and alcohol for medicinal purposes were allowed
• The Act superseded all existing state and local prohibition laws

"Non-intoxicating Cider and Fruit Juice"—A Specific Provision in the Law

• A household was allowed to make
  – 200 gallons of non-intoxicating cider or fruit juice
  – Each year for its own use

• Spontaneous conversion
  – If the "fruit juice" converted spontaneously to wine…
  – If the cider spontaneously became "hard"…

• Well, who would complain?
  – Thus, thousands of otherwise law-abiding citizens became illegal home winemakers

Enforcement at breweries, wineries, and warehouses was vigorous

Bye, Bye, Brewskis

Los Angeles, California: U.S. Federal Agents pouring wine into the gutter in front of the Federal Building, Los Angeles, October, 1920

Dumping illegal alcohol in California, 1932

10,000 barrels of beer are dumped into New York harbor, 1925

33,000 gallons of wine are pumped into the sewers of Los Angeles, 1920

Workers roll away beer vats at a brewery in Washington, D.C. switching from brewing beer to making ice cream.

Impact on the Wine Industry

• The wine industry was devastated
  – Wine production fell by 94%
  – 2500 wineries (1920) shrank to 100 (1933)
• California had 713 wineries before Prohibition
• It took until 1986 to reach the number again

Survival Strategies

• Some grape growers survived
  – By replanting to juice varieties
• A few wineries struggled along providing...
  – sacramental
  – medicinal
industrial non-beverage wine

Doctors were allowed to prescribe whiskey for medicinal purposes

Whiskey for Medicinal Use
  • If you could get your doctor to prescribe whiskey for your condition
    – Good quality whiskey was available

Some Grape Growers did OK
  • They sold grape concentrate or “wine bricks”
    – To make grape juice, the brick was dissolved in water
    – Buyers were cautioned not to place the juice in a dark place for 21 days
    – Lest the juice turn into wine (illegal)
  • Agricultural land devoted to juice varieties did well during Prohibition
    – And juice varieties were shipped around the country

Advertising Grape Juice Varieties
  • The National Fruit Co.
    – In Washington, D.C.
    – Announces the arrival of juice grapes
  • For juice, jelly and "Other Purposes"
  • The ad was from the Washington Post, 1921

Kosher wine was available during Prohibition
  Wine Kosher for Passover

Prohibition in Practice
  • There was widespread abuse
    – “Speakeasies” flourished
  • Alcohol was supplied by bootleggers and rum-runners who operated...
    – Out of Canada and across the Great Lakes
    – Along the northern and southern U.S. borders
    – At New Orleans and up the Mississippi
    – Regularly along the California coast

Canadian whisky being transported in cars from Ontario, Canada, across the frozen Detroit River to Michigan, 1930. The cars are driven with one door open, so if the car goes through the ice the driver can scramble free. (AP Photo)

Mr. McCall looks at the Rum Runner which crashed on his farm near Crotonville, New York, May 17, 1922, loaded with illegal alcohol.

The Canadian Schooner I'm Alone
  • Built in 1923
    – 200 tons, 125 feet long
    – Powered by twin 100-horse-power diesels
    – Aided by sails, one of the fastest ships off the Atlantic coast
  • It loaded up with alcohol in Canada
Cruised down the coast offloading its cargo to smaller rumrunners that would dash for shore
When spotted, the *I'm Alone* would simply outrun Coast Guard ships
And head to international waters
• In 1928, it was fired on and sunk by U.S. vessels
  Probably illegally

The United States Coast Guard cutter *Acushnet* tows the *Silvtrice*, after contraband alcohol was discovered as its cargo.

"Torpedoes" filled with contraband whiskey

Smuggling Whiskey in Fuel Truck, New Orleans, 1925

“Load of Lumber” Bootleggers Truck, 1926

A vehicle fuel tank and the 250 bottles of tequila, which were hidden in it and smuggled into the US from Mexico, circa 1930

The Booze Cruise
• For the affluent, cruises to nowhere were available.
  The ship would sail out to international waters
  Here, alcohol was not prohibited
  The ship would simply cruise in a big loop
  Then return to port, passengers satisfied

Speakeasies were common in urban areas

New York City, 1932
New York City, 1933
New York City, 1933

One of New York's fancy speakeasies

The Billows speakeasy at Playland at the Beach, San Francisco

Prohibition in San Francisco
• In 1922, there were 1400 speakeasies in the city
• By 1933, the estimate was 6000
  Every hotel had one
  Most restaurants contained one
  Playland at the Beach had one in the Billows restaurant
• Historically, San Francisco had more bars per capita than any other city in America.
  So when the nation went dry, liquor simply went underground
  San Francisco remained the wettest city in the West

Prohibition in San Francisco (continued)
• Enforcement of the liquor laws was so lax...
  Shanty Malone’s bistro on Turk Street staged phony police raids
  “Got to keep the customers amused”
• Marin, Sonoma and San Mateo counties were havens for smugglers operating out of Canada
All had direct access to the bay and the coast
Thus, water routes were accessible
- Sausalito was perfectly situated
  - It was renowned as a haven for rum runners

And Moonshiners provided liquor in rural areas
Federal Agents Capture "Moonshine" Still, about 1925

How Are We Doing?
- In 1931, we are eleven years into the Great Experiment
- How is it going?
  - Bootlegging and rum running are extensive
  - Home brewing is flourishing
  - Moonshine liquor is made everywhere and readily available
- Is this a successful program?

A Look at 1931
The Point: Prohibition had largely failed

The Lead-up to Repeal
- By 1932, there had been 12 years of flouting the law
- Organized crime had flourished
- The nation was in a deep economic depression
- Prohibition wasn’t working anyway
- Inevitably, public sentiment turned to repeal

“Restore the Constitution” “Mass. Leads Repeal” “Save Our Children”
"Vote for Wet Candidates" "Protect Our Youth" "Stamp out Prohibition"

Anti-prohibition parade in Newark, N.J., Oct. 28, 1932. More than 20,000 people took part in the demand for the repeal of the 18th Amendment.

"Use a little wine for thy stomach's sake" 1 Timothy 5th Chapter 23rd Verse

Repeal
- By 1932, Repeal was favored by...
  - Three fourths of voters and...
  - Forty-six states
- It was a plank in the Democratic platform
- FDR promised it
- In 1933, the states ratified the 21st amendment
- Note: The 18th is the only amendment to be repealed by a subsequent amendment

Tuesday, December 5, 1955 Prohibition Ends

Amendment XXI
• Section 1. The eighteenth article of amendment to the Constitution of the United States is hereby repealed.

• Section 2. The transportation or importation into any state, territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited.

• Section 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by conventions in the several states, as provided in the Constitution, within seven years from the date of the submission hereof to the states by the Congress.

But, there is a caveat!

21st Amendment, Section 2
"The transportation or importation into any state, territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited."

• In other words…
  — The states retained the right to impose prohibition, or any other restrictions, on a state-wide basis

Old Man Prohibition, Hung in Effigy, New York, 1933

The Fauerbach Bar, Madison, Wisconsin, celebrating Repeal

Line outside the Department of Health office, New York, for licenses to sell alcohol shortly after the repeal of prohibition.

Italian Swiss Colony trucks carrying cartons of Tipo Chianti drive to San Francisco's Civic Center in December 1933 after Prohibition ended

Prohibition—the Aftermath
• The 21st Amendment...
  — Repealed the 18th Amendment
  — But it also...
• Allowed the states to...
  — retain prohibition (or local option)
  — regulate the sale of alcohol
  — regulate the importation of alcohol
• And many counties chose to go dry

“Dry” US Counties

Prohibition Currently
• A few states remained “dry” after Repeal
• Kansas until 1948
• Oklahoma until 1957
• Mississippi until 1966
  • “Local Option” [counties may impose prohibition]
    – 34 states allow it, 16 states forbid it
  • Most of the dry counties are in the South
    – They account for about 10% of US area
    – And about 6% of US population
  • 17 states have monopoly liquor stores
    – Limited hours and limited selection
  • 12 states ban the sale of liquor on Sundays

Where you can't buy liquor on Sundays
Alabama
Indiana
Minnesota
Mississippi
Montana
No. Carolina
Oklahoma
So. Carolina
Tennessee
Texas
Utah
W. Virginia

Where you can only buy liquor in a state store
(or a state-controlled store)
Alabama
Idaho
Iowa
Maine
Michigan
Mississippi
Montana
New Hampshire
North Carolina
Ohio
Oregon
Pennsylvania
Utah
Vermont
Virginia
West Virginia
Wyoming

Wine Shipments
• Wine shipments to individuals are financially very important, especially to small wineries
• State laws on wine shipments to individuals vary
  – Most allow it
Some forbid it
Some allow it with restrictions

**Direct Shipment Laws** (June 1, 2008)

**Discriminatory Shipping Laws**
- Some states allowed in-state, but not out-of-state shipments to individuals
  - The purpose: to protect state wholesalers
  - Consumers filed suit to overturn these latter rules
- One state court ruled for consumers, one for the state
- On to the Supreme Court
  - The case was known as Granholm v. Heald (2005)

**The Supreme Court Must Resolve…**
- Section Two of the 21st Amendment reads:
  > The transportation or importation into any State, Territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited.
- The Commerce Clause of Article One of the Constitution grants Congress the power:
  > To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes.
- Provisions in conflict?

**5 to 4 Against the States**
- The Supreme Court decided…
  - The discriminatory state laws were unconstitutional
- Before Prohibition…
  - The states had no power to violate the Commerce Clause
  - The 21st Amendment was not intended to grant them this power.
  - The decision required changes is several states’ laws
- As of 2017, 42 states permitted at least some form of direct shipping from wineries to consumers
- Laws forbidding all shipments were allowed to stand
  - In violation of the Commerce Clause (?)

**Direct Shipment Laws** (as of August 1, 2016)

**Changes in state laws continue…**

**Winery Direct Shipping Laws** (as of November, 2017)

**Other Regs**
- In addition
  - Some states require special permits or licenses to ship directly to consumers
- For some wineries, it is not practical to satisfy all the requirements

**Clos du Bois**
- On their website, they list the states that they cannot ship to because of licensing or legislation
  - "We are sorry. We cannot ship to the following:"
    - Alabama, Arkansas, Connecticut, Delaware, Indiana, Kentucky, Louisiana, Maine, Mississippi, New Jersey, North Dakota, Ohio, Oklahoma, South Dakota, Utah, West Virginia
- As you can see, a major headache for the small winery
Here is the Point!
85 years after Repeal, the provisions of Section 2 of the 21st Amendment are still being disputed.

Alcohol Consumption during Prohibition

- What was the lasting effect of Prohibition?
- Sales of illegal alcohol are difficult to estimate
  - Since no tax was paid on it
  - And records of consumption are sketchy
- The following chart (estimates) shows…
  - A sharp decline in 1921
  - Then, gradual recovery to about 75% of pre-Prohibition levels

Note: Within a week after Prohibition went into effect, portable stills were on sale throughout the country.

Per Capita Consumption of Alcohol 1910-1929

Lasting Effects

- Impact on alcohol consumption
  - Modest
  - Perhaps a 25% decline
- Biggest effects of Prohibition
  - Criminal control of areas of business and labor
- After repeal, bootlegging gangs became syndicates in…
  - Gambling, prostitution, protection rackets, and narcotics
- Equally devastating…
  - The custom of bribing police had become accepted

U.S. Alcohol Consumption
Changing Alcohol Preferences 1992-2014
Preferred Beverage by Various Characteristics (2011)

Who are the big wine drinkers?
$75,000 or more
College graduate

Wine Drinking in the U.S.
Here is a bi-coastal effect

U.S. Alcohol Consumption (Gallons per capita)
Compare and contrast…

Wine Consumption Alcohol Consumption

Per Capita Wine Consumption

Alcohol Laws after Prohibition

- Federal Alcohol Control Administration (FACA)
  - Established by FDR in 1933 to fill the void
  - Soon superceded by...
- Federal Alcohol Administration (FAA) Act
Established by statute, 1935
The FAA was assigned to the Treasury Dept.
To set license and tax regulations

- Alcohol, Tobacco and Firearms (ATF)
  - Established in 1968 following passage of the Gun Control Act
  - Also housed within the Treasury Dept.

- As part of a revision of security regulations, the functions of the ATF were divided
  - Law enforcement transferred to Justice
  - Alcohol and tobacco tax remained in Treasury
- The ATF was now known as the Bureau of Alcohol, Tobacco, Firearms, and Explosives
- The tax and regulation bureau was renamed Alcohol and Tobacco Trade and Tax Bureau, TTB

Functions of the TTB
- Ensure only qualified persons engage in the production of alcohol (!)
- Ensure a fair marketplace
- Examine Certificates of Label Approvals (COLAs)
- Ensure labels and advertising are not misleading or illegal
- Protect consumers against contaminants
- Enforce the alcohol tax regulations

Current Federal Taxes on Alcohol (2018)
14% Alcohol or less, 750ml bottle, Tax is 21¢
(States add excise taxes)

Legal Limits for Wine Constituents
The Federal Government…
- Has established limits for certain wine constituents
  - To ensure the wine is sound
  - It regulates them through the TTB
- The State of California similarly…
  - Regulates California wine
  - Via the Dept. of Alcoholic Beverage Control (known as the ABC)

Legal Limits for Certain Wine Constituents

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Wine Type</th>
<th>Alcohol (%)</th>
<th>*Volatile Acid</th>
<th>Fixed Acid</th>
<th>SO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>White</td>
<td>10-14</td>
<td>1.1</td>
<td>3.0</td>
<td>350</td>
</tr>
<tr>
<td>California</td>
<td>Red</td>
<td>10.5-14</td>
<td>1.2</td>
<td>4.0</td>
<td>350</td>
</tr>
<tr>
<td>Federal</td>
<td>White</td>
<td>14 max</td>
<td>1.2</td>
<td>--</td>
<td>350</td>
</tr>
<tr>
<td>Federal</td>
<td>Red</td>
<td>14 max</td>
<td>1.4</td>
<td>--</td>
<td>350</td>
</tr>
</tbody>
</table>

Notes:
*Volatile Acid refers to acetic acid (vinegar acid), a sign of spoilage in wine. In a properly made wine,
- VA will be 0.5 g/L or less
- Fixed acid will be 7-8 g/L
• SO₂ will range from 50-100 ppm

Establishing a Winery
• You must apply to TTB for a permit
• TTB has four kinds of permits
  – Bonded Winery
    • Crush, ferment, age, blend, bottle, store
  – Bonded Wine Cellar
    • Store, blend, or bottle wine only
  – Alternating Proprietor
    • Share a winery facility with other companies
  – Custom Crush Client
    • Others produce wine from your grapes
    • All functions to produce wine for sale

Required Documents in Support of your Application
• Application to Establish and Operate Wine Premises
• Application for Basic Permit Under the FAA Act
• Wine Bond (Insurance Policy)
• Environmental Information
• Information on Water Quality Factors
• Signature Authority (Power of Attorney)
• Tax Registration
• Trade Name Registration
• Organizational documents (articles of incorporation, partnership agreement, etc)

What the TTB Does…
• The approval process may include:
  – Evaluation for completeness
  – Background checks
  – Field investigations
  – Examination of equipment and premises
  – Legal analysis of proposed operations
• How long?
  – Applications are processed in roughly 60 days
• How many?
  – As of 12/31/17, there were 12,335 US wineries
  – 4,836 were in California

Where the Wineries Are

In Order to Operate a Winery...
• You must carry out the following functions
  – Record keeping
  – Excise Tax Payments
  – Operations Reports
  – Label Approval
• And of course you must make wine

Record Keeping
For label verification, you must keep complete records on
- Origin of the grapes
- Weight of grape varieties crushed
- Vintage
- Method of vinifcation
- Alcohol analysis

And so on

Excise Tax Payments

- Tax is due when
  - The wine leaves the winery
  - For consumption or sale

- Payments are made
  - Twice monthly, quarterly, or annually...
  - Depending on the size of the operation

Current Tax on Wine

<table>
<thead>
<tr>
<th>Alcohol Level</th>
<th>Tax per Gallon</th>
<th>Tax per Pkg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to 14%</td>
<td>$1.07</td>
<td>21¢</td>
</tr>
<tr>
<td>14 to 21%</td>
<td>$1.57</td>
<td>31¢</td>
</tr>
<tr>
<td>21 to 24%</td>
<td>$3.15</td>
<td>62¢</td>
</tr>
<tr>
<td>Artificially Carbonated</td>
<td>$3.30</td>
<td>65¢</td>
</tr>
<tr>
<td>Sparkling</td>
<td>$3.40</td>
<td>67¢</td>
</tr>
<tr>
<td>Hard Cider</td>
<td>$0.226</td>
<td>4¢</td>
</tr>
<tr>
<td>Beer</td>
<td>$0.56</td>
<td>5¢</td>
</tr>
</tbody>
</table>

Operations Reports

- A report that shows
  - Receipt, production, and removal of all tax-not-paid wine.
- The report is submitted either monthly, quarterly, or annually, depending on the size of the operations.

Label Approval by TTB

- Prior to shipping, the label must be approved
- Winery submits a form with information on
  - Brand name
  - Vintage
  - Appellation
  - Alcohol content

- Sample labels are printed and attached to the form

Label Approval (COLA) Certificate Of Label Approval

- TTB may suggest modifications
- After approval, the label is affixed to bottles
- The process is straightforward, but
  - The label copy must conform to TTB rules
  - For example, no health claims are allowed
    • On the label or
    • In advertising
  - Moderate use of alcohol is healthful(?)
  - Maybe, but TTB doesn't allow this info

Field Audits or Investigations
• In order to
  – Enforce the regulations and...
  – Verify the label claims
• TTB may conduct an investigation or audit
• It may schedule an examination of
  – Production, tax, labeling, advertising, or other required records
• TTB is not required to give prior notice of a visit

Misleading Label Copy
• Label copy may not mislead consumers
  – Mont-Rouge California “Medoc”
  – Roma California "Burgundy"
  – Old Mojave California "Sauterne"
• These labels would not now be approved
  – But are allowed if in use before 2006

The Current Law Regarding Misleading Place Names
• A label may not mislead as to the origin of the wine
• Exceptions are allowed for brand names established before 1986 (TTB)
  – A 2000 California law removed this exception
• This Napa Ridge label is considered misleading
  – It suggests the wine is from Napa
  – But the AVA (or region) is clearly "Central Coast"

A Case History: Bronco Wines and the Napa Ridge Brand
• Bronco Wine Company
  – 4th Largest US Wine company
  – Owned by Fred Franzia (a Gallo relative)
  – Producer of “Two-Buck Chuck”
• Acquired the defunct brand "Napa Ridge" in 2000
  – In existence before 1986
• Bronco made "Napa Ridge" wines from non-Napa grapes
  – A clear intention to mislead consumers, said the Napa Valley Vintners Association
  – But, in compliance with Federal law
  – However, this practice violated the 2000 California law

Fred Franzia, owner of Bronco Wines
(believes a great wine should not cost over $10)

The California Law is Enforced
• The California ABC filed suit
  – Against Bronco Wines
  – The claim was the Bronco had violated the California law
  – Which requires that at least 75% of the grapes in a wine come from the county named on the label
• Bronco wines filed suit in Federal Court
  – Claiming federal law superseded state law
  – The labels were not misleading because...
  – The label did not say the wine came from Napa (true)
  – Bronco lost in federal court
  – The Supreme Court declined to hear the case

Result
• Bronco Wine Company
  – Now makes Napa Ridge with Napa grapes
• The former Napa Ridge wines…
  – Are now marketed under the Harlow Ridge label
• A victory for truth in labeling

Other Legal Problems for Fred
• Fred had a prior brush with the law
• In 1993 Franzia and Bronco Wine Company were indicted on federal charges of conspiracy to defraud:
  – Misrepresenting cheaper grapes as premium Zinfandel and Cabernet Sauvignon
  – Franzia had directed employees to sprinkle zinfandel grapes on top of a load of cheaper non-zinfandel grapes.
  – Zinfandel grapes sold for $800 to $1,200 a ton. The cheaper grapes sold for $100 to $200 a ton
• Bronco pleaded no contest and paid a $2.5 million fine

Franzia—Felon
• Franzia also pleaded guilty to his part in the scheme
  – Paid a $500,000 fine
  – Stepped down as Bronco's president
  – And agreed to refrain from active participation in the wine business for five years
  – In lieu of prison time
• In 2008, Franzia sought a pardon
  – Purportedly, he wished to purchase a gun (not allowed to convicted felons)
  – Request denied, December 22, 2008

The COLA Process
• The Bronco Wine case is an exception
• Most vintners want their labels to be accurate and valid
• The COLA process works smoothly
  – In 2017, there were 175,404 COLA applications through December 2017
  – Virtually all approved
  – Average turn-around time: 7 days when the application is submitted online

COLA Application Growth Selected Years

Wine Labels
• California labels first
• Then, briefly
  – Australian
  – French
  – German
  – Italian
• As we shall see, laws and customs differ

California and Other U.S. Wine Labels Required Elements
• The following elements are required (TTB)
  – Brand name
  – Appellation of origin
— Name and address of bottler
— Alcohol content
— Sulfite statement
— Health warning
— Net contents of the bottle

**California and US Optional Elements**
- The following elements are often present but not required
  - Varietal Designation
  - Vintage Date
- Sometimes present
  - Vineyard name
  - "Estate Bottled"
- If any of the above is present
  - Specific requirements as to grape composition come into play

**Illustration**
- Rock Pile Winery
  - In 2006, I invented a winery for illustration
  - I called it Rock Pile Winery
- Shortly afterwards, "Rockpile Wines" appeared
- There is no relation between "Rock Pile" and "Rockpile"

**Rock Pile Winery**
Some of these elements may appear on the rear label

**Rock Pile—Label Entries**

We'll look at each of the elements
• Required
  – Brand name
  – Appellation of origin
  – Name and address of bottler
  – Alcohol content
  – Sulfite statement
  – Health warning
  – Net contents of the bottle

• Optional
  – Varietal Designation
  – Vintage Date
  – Vineyard name
  – "Estate Bottled"

Brand
• Normally, the Winery (Rock Pile)
• But also can be
  – A restaurant (Bay Wolf Zinfandel)
  – A store (Trader Joe’s wines)
  – A proprietary (made up) name (Opus One)
  – A whimsical name
• As long as it’s not misleading

Sample Brands

Varietal Designation
• The primary grape
  – Syrah, Chardonnay, Pinot Noir, Sangiovese, and so on
• The primary grape must comprise 75% or more of the component grapes
• Significance
  – A “Cabernet Sauvignon” may contain 25% of blending grapes
  – Blending grapes are not usually specified on the label
• Two or more varieties—percentage of each

Appellation of Origin
• The place where the primary grape is grown
• May be
  – A country, state, county or a viticultural area (AVA) such as Anderson Valley
  – Up to three counties may be listed
• If country, state, or county, 75% grapes required
• If a viticultural area, 85% grapes required (more on viticultural areas soon)

Vintage
• The year in which the grapes were harvested (2006)
• A vintage date is not required but...
  – If it is used, an appellation smaller than a country must be indicated (state, county, or AVA)
• If the appellation is a state or county...
  – 85% of the grapes must be from that year
• If the appellation is an AVA
  – 95% of the grapes must be from that year

Vineyard Name
• A vineyard name is optional
• Here, Hidden Horse Vineyard
• If used, 95% of the grapes in the wine must come from it

Identification
• "Grown, Produced and Bottled by Rock Pile Vineyards”
  – Means that 100% of the grapes were grown, vinted, and bottled on their property.
• "Estate Bottled" has further requirements
• Only the Bottler must be identified on the label by name and address; other identifications are optional

<table>
<thead>
<tr>
<th>Other Terms with Legal</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced by / Made by</td>
<td>Crushed at least 75% of the grapes</td>
</tr>
<tr>
<td>Blended by</td>
<td>Blended wines before bottling</td>
</tr>
<tr>
<td>Cellared by / Vinted by</td>
<td>Carried out various cellar treatments before bottling</td>
</tr>
<tr>
<td>Prepared by</td>
<td></td>
</tr>
</tbody>
</table>

Optional Terms
• Additional terms may be used…
  – If they are not misleading
  – Note: They are not legally defined
• Examples
  Dry or Sweet
  Special Selection
  Reserve
  Proprietor's Reserve

Vintner’s Reserve
Private Bin
Barrel Aged
And so on

Alcoholic Content
Important for several reasons
– The tax rate increases as alcohol increases
– The intoxicating effect increases
– The bouquet and texture of the wine change

<table>
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<td>&gt;21 to 24%</td>
<td>$3.15</td>
</tr>
</tbody>
</table>

Alcoholic Content
• The alcoholic content must be analyzed by a TTB-approved method
  – Shown is the DuJardin-Salleron Ebulliometer
  – French made, TTB-approved, about $1100
  – The ebulliometer accurately measures the boiling point of the wine
– From this, the alcohol content can be determined

Definition of % v/v
- The result are always given in % v/v
- What is % v/v?
  \[
  \% \text{ v/v} = \frac{\text{volume of alcohol}}{\text{total volume of the wine}} \times 100
  \]
- For example, a 750-mL bottle of wine at 13.5% v/v of alcohol will contain \((.135)(750) = 101\frac{1}{4}\) mL (about 3\(\frac{1}{2}\) ounces) of pure alcohol

Ranges of Acceptable Alcohol Values (TTB)
- For alcohol less than 14%, a range of ±1.5% is OK
- For alcohol greater than 14%, a range of ±1% is OK
- Example
  - A bottle that says 12% alcohol may legally have from 10.5% to 13.5% alcohol
- If the alcohol content is between 7 and 14%, the label may read simply “Table Wine”
- Rationale: By allowing these variations, the TTB does not require a new COLA if alcohol varies slightly

Other Required Label Information
- The following health warning must appear:
  Government Warning: (1) According to the surgeon general, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects. (2) Consumption of alcoholic beverages impairs your ability to drive a car or operate machinery, and may cause health problems.
- Sulfite Statement
  - If the wine contains 10 ppm or more of sulfites, the statement “Contains Sulfites” must appear

Net Contents
- On the label or on the bottle, there must appear
  - Net contents (volume) in metric units
  - Only the following size containers are allowed: 50 mL, 100 mL, 187 mL, 375 mL, 500 mL, 750 mL, 1 L, 1.5 L, 3 L.
    Containers over 3 L must be in even liters.
- The standard bottle is 750 mL (25.36 fl.oz.)
- The standard bottle formerly was 4/5 qt. or 25.60 fl.oz. (The reduction in volume is just about 1%).
- The changeover was effective 1-1-79 and met little industry resistance

Estate Bottled
- To use the term “Estate Bottled”, the following conditions must be met
  - 100% of the wine must come from grapes grown on land owned or controlled by the winery
  - The winery must be located in an AVA
  - The winery must crush, ferment, finish, age, and bottle the wine on their own premises
  - The winery and the vineyard must be in the same AVA
- Does it matter?

The Viticultural Area (AVA)
- An Appellation is
  - A country, state, county or...
A viticultural area

- **A Viticultural Area** (or AVA for American Viticultural Area) is…
  - A region with distinctive geographic features such as soil, climate, or topography
  - It will not generally coincide with political boundaries

- Napa County, while an appellation, is not an AVA, but Napa Valley is an AVA
- Vintners often prefer to use an AVA
  - It identifies precisely the geography of their wines
- There are 238 approved AVA's (as of 11/2016) (107 in CA)

**American Viticultural Areas**
The largest concentration is on the West Coast

**The First AVA**
- The Augusta AVA surrounding the area around the town of Augusta, Missouri
  - Was the first federally approved AVA
  - Gaining the status on June 20, 1980
- Located in Missouri
  - It encompasses 15 sq mi

**Sonoma County—Appellation or Viticultural Area?**
- The appellation Sonoma County is not an AVA
  - Its topography and soil vary greatly
    - Valleys, mountains, coastal slopes
- Its climate varies greatly
  - From the cool southern region
  - Through the warm central section
  - To the cool coastal slopes

**Sonoma County AVA’s**
- Within Sonoma County, there are several sub-regions
  - These are coherent in climate, soil, and topography
  - Three examples of these are:
    - Sonoma Valley, Sonoma Mountain, and Sonoma Coast
- These are all AVA’s.

**AVA’s of Sonoma county**

**Similarly in Napa County**
- Wide range of climatic conditions
  - Cool hills of Carneros to…
  - Very warm valleys near Calistoga
- So, there are 16 sub-appellations or AVA’s within Napa County

**AVA’s of Napa County**
- The First Napa AVA sub-appellation was approved in 1983
  - Los Carneros
- The most recent was approved in 2011
  - Coombsville

**The AVA on a Label**
How a New AVA is Formed

• One or more vintners or growers…
  – Apply to the TTB for approval of an AVA
  – They believe their district is distinctive
• The TTB invites comments from all growers and vintners in the area
• It examines the area for coherence of geography, topography, and climate
• If these criteria are met and there are no objections…
  – The request is granted

An Example

• Posted on the TTB web site
  – Proposed Tulocay Viticultural Area. TTB sought comments on the proposed establishment of the 11,200-acre “Tulocay” viticultural area in southern Napa County. Comments were due on or before January 8, 2007.
• Failing adverse comment, the AVA would be approved
• Seems straightforward, right?

“Tulocay” Goes Down

• TTB received 23 comments
  – 9 for, 14 against
• Principle reason against
  – “Coombsville” was the preferred name of the area
  – “Tulocay” would cause confusion
• Result
  – The TTB proposal was withdrawn
  – Dated June 19, 2008
• Coombsville was approved instead in 2014

Proposed AVA “Coastal”

• In 1998, Kendall-Jackson and others proposed
  – New AVA “Coastal”
  – Comprising all the coast-facing regions
• Reason?
  – K-J was must use “California” on its wines because…
  – They come from more than three counties
• Preferred to avoid “California”
• Why?

K-J Request (cont)

• In 2002, after four years of hassle, TTB rejected the request
• It was noted that...
  – The length would be about 1600 miles
  – Area would be 22,000 sq. mi. (about 14% of the state) (for comparison, Napa County is 788 sq.mi.)
• TTB stated...
  – “The area's geographic and climate features are too diverse for it to be considered a delimited grape-growing region distinguishable from surrounding areas”
• Wines and Vines called the ruling...
  – “a welcome whiff of common sense”
A Recent Case—Calistoga

- Calistoga
  - The last remaining part of Napa Valley
  - Without its own AVA
- Applied in October 2004
  - This area would seem to be a natural
- Problem—two existing wineries
  - Both use "Calistoga" in their names
  - But neither use 85% of required local grapes
  - They are "Calistoga Cellars" and "Calistoga Estate"

Calistoga Cellars

- Made its wine near Ukiah
  - in Mendocino County
- Used less than 50% of Calistoga grapes
  - Most from other parts of Napa Valley
- Under TPP regulations…
  - The winery must relocate to Calistoga
  - And must use 85% grapes from Calistoga, or…
  - Discontinue using the name

Calistoga Estate

- Made its wine in Santa Rosa
  - Had no apparent connection to Calistoga
  - Other than the name
- It too would have had to move its winery
  - And use grapes from Calistoga in order to conform to TPP regulations
- Both wineries were given until 2013 to conform
  - Neither did, and changed their names

Another Recent Case—Expansion of Russian River Valley AVA

- E&J Gallo requested expansion of RRV AVA
- 14,044 acres to be added
  - Gallo's Two Rock Ranch Vineyard (350 acres) included
  - Located outside the current boundaries
  - Along Highway 101 near Cotati
- Opposition is guarded
  - Gallo is very powerful
  - Many wine makers in the region do business with Gallo

Addition Proposed by Gallo

- In December, 2008
  - RRV Growers voted
  - 71 to 18 against
  - By a secret ballot
- Gallo is pressing on
- Why bother?
  - Wines with the Russian River Valley appellation average $6/bottle more than wines with the Sonoma County appellation

Addition to RRV AVA (cont.)

- Public comments were numerous, 171
– 26 in support
– 133 in opposition
– 12 others

• Nevertheless, TTB approved the addition
  – To take effect December 16, 2011
• "The TTB deferred to Gallo and made a formerly great Sonoma County appellation less meaningful" wrote one wine columnist

Another Label Dispute
• Kendall-Jackson vs. Gallo in Court
  – In 1996, K-J filed suit against Gallo
  – Claim: Gallo’s Turning Leaf label was a copy
  – And an attempt to confuse consumers

The Result
• In April of 1997, a Federal jury found for Gallo
• Kendall-Jackson appealed, but lost in 1998.
• Gallo called the suit a publicity stunt
• Industry analysts called the dispute “wine industry hardball”

Legal Battles Continue
Gallo vs. Kendall-Jackson
• At about the same time (1997)
  – Gallo filed suit in Stanislaus County
  – Accused K-J of hiring a Gallo marketing executive
  – And pressuring him to divulge Gallo trade secrets
  – Which were used in K-J’s suit against Gallo
• Settled in 2001
• Results of the settlement not disclosed

Conclusion
• Gallo Plays Rough
  – It has vast resources
  – No hesitation to flex its enological power through litigation
• Further reading
  – *Blood and Wine*—Ellen Hawkes
    • "The unauthorized story of the Gallo wine empire"
  – *Gallo Be Thy Name*—Jerome Tuccille
    • "The Story of how Gallo rose to dominate the U.S. wine market"
A Complete California Wine Label

- Brand name
- Appellation of origin
- Name and address of bottler
- Alcohol content
- Sulfite statement
- Varietal Designation
- Vintage Date
- Vineyard name
- "Estate Bottled"
- Health warning
- (Net contents of the bottle)

Now, Labels from Other Countries— France, Italy, Australia

France

On the French label...

- The name of the wine is typically a region or village
- The grape variety may not be named at all
- There is a quality level indicated on the label by one of the following terms (in ascending order)
  - Vin de table (12% of wines)
  - Vin de pays (34% of wines)
  - Vin Délimité de Qualité Supérieure (VDQS)
    - This category was abolished December 31, 2011. Wines were either promoted or demoted. Only 1% of wines remain.
  - Appellation d'origine contrôlée (AOC) (53% of wines)
- Other elements are similar to US labels

First we will look at the highest quality French Wines

- These are the appellation d'origine contrôlée (AOC) "protected designation of origin")
- We will look at two Burgundy wines and two Bordeaux wines
- Incidentally, cheeses, butter, and other agricultural products, regulated by the government, may also be designated as AOC

A White Wine from Burgundy

The famous White Burgundy made from Chardonnay grapes only

Pouilly-Fuissé

- Name of the wine is Pouilly-Fuissé
  - These are two villages in Burgundy where the wine is made
- "Appellation Pouilly-Fuissé Contrôlée." indicates...
  - The wine is the highest level of quality wine produced in France (appellation d'origine contrôlée or AOC)
- The term AOC is similar to our use of the term “Estate Bottled” (more later)
- Missing: It is made only from chardonnay grapes
Note: For the American market, the Health Warning and the Sulfites Statement would appear on a back label

The Négociant

- **Négociant** is the term for a wine merchant who...
  - Buys wine from several small scale winemakers
  - Blends, finishes, and ages the wine, and...
  - Bottles it under his own name
- Names of individual producers or vineyards are not mentioned because...
  - Holdings are very small, often less than an acre, and...
  - Identifying them would not be practical
- This system is unique to Burgundy
- Wines from this appellation run $25 to $30

Pouilly-Fuissé again

- A wine from the same region (same grapes) but…
- A different négociant (Georges Duboeuf)
- The reputation of the négociant is what will matter in the choice

There are many wines from Pommard in Burgundy

- They are all from the same commune or village
- They are all 100% pinot noir
- These are “Domaine” wines meaning they were made and bottled by the owners of the vineyard instead of a négociant
- A “clos” is an enclosed vineyard

Two More Pommards

- But these were bottled by the négociants, Joseph Drouhin and Louis Jadot
- Their level of quality depends on the standards of these houses
- Pommard: $60 and up

Bordeaux

Chateau Margaux

- A château (castle) is an individual holding
  - Moderate size (to 100A)
  - Individual vinting and bottling are practical
- With Margaux, both the Château and the region have the same name (not usually the case)
- Like a California Estate Bottled wine
  - The grapes are grown at the Château
  - Wine made by the vigneron of the Château
  - The wine is bottled at the Château (Mis en Bouteille….)

The Wine of Château Margaux

- The composition of the wine
  - No indication of the grape varieties on the label
- Their web site reveals the wine is a blend of
  - 75 % Cabernet Sauvignon
  - 20% Merlot
  - 5% Petit Verdot and Cabernet Franc
- The average vine age at Château Margaux is 35 years
Recent vintages sell above $400 a bottle

**Bordeaux-Graves**

**Château Pape Clément**
- A Bordeaux wine from the region of Graves
  - The oldest producing vineyard in Bordeaux
- Named after Pope Clément V, owner in 1300
  - After the French Revolution, confiscated and sold into private hands
- Their website says that the wine is a blend
  - 60% Cabernet Sauvignon
  - 40% Merlot
- The Château has about 80 acres
- Vines range from 25 to 50 years old
- Price varies greatly with vintage ($35 to $200)

**VDQS Wines**
- The former second level of quality in France
  - Coteaux du Vendômois was elevated to AOC in 2001
  - Gros Plant du Pays Nantais was elevated to AOC in 2012

**Low End of the French Quality Ladder**—Vin de Pays, Vin de Table

**Germany**
- German wine labels share features with American labels
  - They show the grape, the region, the producer, etc.
- In addition, they show two more characteristics:
  - They designate a quality level (in increasing order)
    • Tafelwein, Landwein, Qualitätswein, and Prädikatswein (renamed from Qualitätswein mit Prädikat, in August 2007)
  - The highest category, Prädikatswein, is subdivided by level of ripeness and body (in increasing order)
    • Kabinett, Spätlese, Auslese, Beerenauslese, Trockenbeerenauslese, and Eiswein
- The quality levels are verified by a test number (A.P.Nr.)

**Some Characteristics of German Wines**
- Germany is the northernmost of the large wine producers
  - It is therefore cooler than the Mediterranean countries
  - Grapes often do not ripen sufficiently so Chaptalization is allowed
  - And a premium is placed on sweet and semi-sweet wines
- Alcoholic contents are often low
  - 10.5%, 9%, 8% and even lower alcohol levels are common
  - This can be due to incomplete fermentation in order to retain some sweetness
- Many of these wines are rich, complex, and worth trying

**Typical German Wine Label**—J.P. Reinert Riesling (Saar)

**Italy**—The typical Italian wine label will have the following information
- Name of the producer
- Name of the grape and/or region
- Level of quality
- Alcohol level, volume, etc.
Quality Levels of Italian Wines

- **Vino da Tavola (VdT)**
  - Table wine, the simplest style
- **Indicazione Geografia Tipica (IGT)**
  - Equivalent to the French Vin de Pays
- **Denominazione di Origine Controllata (DOC)**
  - Similar to the French AOC
- **Denominazione di Origine Controllata e Garantita (DOCG)**
  - Similar to DOC, but with stricter controls, especially on yield

An Italian Wine Label

- Producer
- Grape and region (contains 10% sangiovese)
- DOC designation
- Wine type
- Estate Bottled, name and address of bottler

Australia

- Australian label regulations are similar to American
- Typical terms include
  - Brand, variety (85%), vintage (85%), appellation (85%), bottler, contents, alcohol level, sulfites, etc.
- Grape blends are common in Australia
  - Varieties (up to three) are listed in descending order of percentage
- “Australian Wine” or “Product of Australia” must appear
- As in the US, no quality designations are used

Australian Labels

The French Wine Laws

French Attitude Towards Alcohol

- Traditionally very lax
  - Teenagers and younger allowed to drink wine
- Belief it encourages responsible drinking later
- More recently, a change
  - Advertising is now partially restricted
  - *Le binge-drinking* is now a French problem
  - Restrictions on internet advertising being considered
- Result: wine consumption is falling

French Wine Laws

- French wine laws are very complicated—the complexity arises from two things…
  - The desire to protect a world famous industry, and...
  - The fact that
    - French winemakers
    - French wine merchants
    - French consumers
The French government
All have a deep mutual distrust of one another
• They believe greed and unscrupulousness will rule if not checked by laws

The Origin of the Wine Laws—the Phylloxera Scourge
• The wine laws followed the phylloxera infestation, about 1860
  – There was little wine to buy
  – The demand was satisfied by fake wine (faux vin)
• One recipe:
  – Grape juice concentrate from abroad
  – Water, sugar, and color added
  – Fermented and sold as wine
• Other recipes included fruits, raisins, industrial alcohol, animal blood, dyes, and so on

Recovery of the Wine Industry
• Grafting v.vinifera scions onto American rootstocks was the solution
• Beginning about 1875
  – The wine industry began to recover
  – Now, natural wine began to be available
  – But faux vin was still being made
• Consumers and legitimate wine producers had a common interest
  – Protection from faux vin

The Law of 1905
• In August, 1905, a law was passed
• Its intention: Protect consumers from fraudulent vin ordinaire
• The law specified
  – Where wines could come from
  – How much wine a winemaker could make
  – What were the acceptable appellations
• The law successfully protected consumers from false vin ordinaire
• But it was no help for the fine wine business.

Developments after 1905
• Little happened before the end of WW I (1918)
• Law of 1919
  – Local courts could decide regional boundaries of wine villages and communes, but
  – Regional grape varieties were not specified
  – There was no maximum yield per acre
• In France, it was felt, varieties and wine styles should be in accord with their 1000-year-old tradition
• Minor revisions proposed in 1927
• Then, finally, the currently existing law was enacted

The Law of 1935
• This law established the rules that have been in effect for over 80 years
• These are the laws that created the Appellation d’Origine Contrôlée or AOC
• This system has been successful in protecting and preserving the French wine industry

The Requirements for an AOC Designation
• In order to qualify for an AOC designation, a wine grower (vigneron) must comply with rules on
Land, alcohol content, grape varieties, winemaking methods, viticultural practice, yield per acre, and agree to regional wine tastings

The Criteria

• Land
  – Precise acreage for each holding is defined based on centuries of recorded usage
  – Unsuitable soils are disqualified

• Grape Varieties
  – Grape varieties are specified based on historical precedent

• Viticultural Practice.
  The following are specified:
  – Number of vines per acre
  – Pruning techniques
  – Fertilization methods

Criteria (cont)

• Yield
  – Maximum yields per acre are established

• Alcohol Content
  – A minimum alcohol level is specified
  – Only in certain areas, chaptalization is allowed

• Winemaking and Cellar Practices
  – Racking, clarification, aging, and so on, are specified for each region

• Official Tastings
  – Local tasting panels ensure that wines conform to accepted tastes and styles

The Result

• If a wine meets all these criteria
  – Appellation Contrôlée can appear on the labels
  – If not, it is disqualified
  – Disqualified wines may be sold under another (non AOC) name or exported

• About 55% of French wine is labeled with AOC designations, and 99% of the wines submitted are approved

• Administration of the law is in the hands of
  – The Institute National des Appellations d'Origine (INAO)
  – The system is financed by a wine tax

Other French Quality Designations

• Category 2—Vins Délimités de Qualité Supérieure (VDQS)
  – Now abolished
  – They have been recategorized as AOC or Van du Pays wine

• Category 3—Vin de Pays
  – Wines from specific but broadly defined regions, for example Vin de Pays d'Oc
  – Often used for experimental or varietal wines

• Category 4—Vins de Table
  – Any blend of wines from anywhere
  – Only requirement—Must not violate France's pure food laws

Do the French Wine Laws Work?

• Reasonably well...

• As long as the vigneron agrees to make wine
  – In only one way
  – With the required grapes
  – In the required style
• If not, he can go to...
  – California, Chile, or Australia

The 2012 Revisions
• There are now three categories in line with EU regulations
  – Vin de France
    • Replacing Vin de Table
  – Indication Géographic Protégée (IGP)
    • The intermediate category replacing Vin de Pays
  – Appellation d'origine protégée (AOP)
    • Replacing AOC
• Labels will change gradually

Summary of Grape Growing Regulations in Four Countries

<table>
<thead>
<tr>
<th>Regulation</th>
<th>France</th>
<th>Germany</th>
<th>Australia</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limits on area planted</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Max. no. of plant/acre</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Max. wine marketing</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Limitation on varieties planted</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Limits on irrigation</td>
<td>Yes(1)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

(1) Irrigation in France is legal during three months in summer

As you can see, Australia and the USA are wide open in vineyard regulations

Case History
• Ardèche is in the Rhone region
• Produces several wines including a Viognier in the Vin de Pays category
• Jean-Marie Guffens (a Belgian) made a viognier, but used the style of Burgundy whites
• The Ardèche tasting committee refused to approve it
• Guffens labeled it “Cépage Viognier” and shipped it to the US (about 1000 cases)

A Massive Wine Fraud—2017
• Police in Marseille
  – Arrest Guillaume Ryckwaert
  – Chairman of "Raphaël Michel" (wine house)
  – €1.2 million bail
• The charge
  – Four million cases of "vin de table"
  – Re-labeled and sold as premium wines
  – Côtes du Rhône and Châteauneuf-du-Pape
• "Fraud in the millions"

How Could It Happen?
• With the AOP safeguards in place
  – How could such a massive fraud occur?
• Raphaël Michel was investigated in 2016
  – Irregularities were found
  – The fraud was found to extend from October 2013 to March 2017
• The investigation is on-going
  – Stay tuned

Fake bottles of Chateauneuf-du-Pape have been sold for £20 to £100, it is alleged

Part 6—Evaluating, Serving, and Buying
Evaluating Wine
• The primary factors in wine evaluation
  – Appearance
  – Smell (aroma-bouquet)
— Taste

• We’ll look at each in turn

The Appearance of Wine
View the wine against a white background for...

• Clarity—Quality wines are clear
• Color—A guide to age and health

White Wine Colors

<table>
<thead>
<tr>
<th>Color</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green-tinged</td>
<td>Young</td>
</tr>
<tr>
<td>Straw</td>
<td>Most dry whites</td>
</tr>
<tr>
<td>Gold</td>
<td>Sweeter, richer whites</td>
</tr>
<tr>
<td>Light brown</td>
<td>Wine may be “off”</td>
</tr>
<tr>
<td>Brown/amber</td>
<td>Old/Spoiled</td>
</tr>
</tbody>
</table>

Red Wine Colors

<table>
<thead>
<tr>
<th>Color</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple</td>
<td>Youth</td>
</tr>
<tr>
<td>Ruby red</td>
<td>Some aging</td>
</tr>
<tr>
<td>Deep Red</td>
<td>Several years of aging</td>
</tr>
<tr>
<td>Red Brown</td>
<td>Maturity</td>
</tr>
<tr>
<td>Mahogany</td>
<td>Much age/ some spoilage</td>
</tr>
<tr>
<td>Brown</td>
<td>Spoiled</td>
</tr>
</tbody>
</table>

Smelling the Wine

• You are seeking
  – Fruitiness
  – Subtle notes
  – Oak
• This is “the nose“
• You may also identify
  – Faults
• Let’s look at the faults

Wine Faults Detectable by Smell

<table>
<thead>
<tr>
<th>Odor</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegary</td>
<td>Acetic acid</td>
</tr>
<tr>
<td>Burning match</td>
<td>Sulfur dioxide</td>
</tr>
<tr>
<td>Rotten egg</td>
<td>Hydrogen sulfide</td>
</tr>
<tr>
<td>Horse Blanket</td>
<td>Brettanomyces</td>
</tr>
<tr>
<td>Moldy</td>
<td>Cork taint (TCA)</td>
</tr>
<tr>
<td>Sherry</td>
<td>Maderization</td>
</tr>
</tbody>
</table>

Vinegary

• Vinegar smell is from acetic acid (CH₂COOH)
• Arises by bacterial action on alcohol
  C₂H₅OH + Acetobacter → CH₂COOH
A small amount is usually present
- A healthy wine will contain less than 0.4 g/L
- Above 0.7 g/L, it is just detectable by smell

If noticeable by smell (1.2 g/L), the wine is spoiled

**Legal Limits for Volatile Acid**

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Wine Type</th>
<th>Volatile Acid Max g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>White</td>
<td>1.1</td>
</tr>
<tr>
<td>California</td>
<td>Red</td>
<td>1.2</td>
</tr>
<tr>
<td>Federal</td>
<td>White</td>
<td>1.2</td>
</tr>
<tr>
<td>Federal</td>
<td>Red</td>
<td>1.4</td>
</tr>
</tbody>
</table>

- Neither the Federal nor the California limit is severe
- A wine exceeding these limits will certainly be a spoiled wine

**Ethyl Acetate**

- Rare but possible
  - Two naturally occurring wine components, acetic acid and ethyl alcohol, may combine…
  $\text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COOC}_2\text{H}_5$
  - The product, ethyl acetate, has a distinct smell of nail polish remover
  - This will occur in a very old wine which has not been stored properly

**Burning Match**

- Sulfite smell from sulfur dioxide (SO$_2$)
  - A sharp and acrid smell
  - SO$_2$ is often used in preserving dried fruits

- Sulfites are used extensively in wine making
  - But an excess should not be present
  - Although a fault, allowing the wine to stand open will usually dissipate the odor

**Rotten Egg**

- The familiar rotten egg smell of some natural mineral waters is due to hydrogen sulfide, H$_2$S
- In wine, this material arises from the use of sulfur (S) in the vineyard
  - It is applied to vines to inhibit mold
  - Some yeasts convert it to H$_2$S
- It too will be dissipated by allowing wine to stand

Note: There is often confusion between hydrogen sulfide (not intentionally added to wine) and sulfites (intentionally added). These materials have quite different smells.

**Horse Blanket**

- Brettanomyces or "Brett"
  - A wild yeast often present in wineries
- Gives off flavors sometimes described as...
- Horse barn, wet dog, creosote, burnt beans, rotting vegetation, plastic, mouse cage

- More common in European wines
  - Some winemakers even prefer a trace of it

- Can usually be controlled by SO$_2$
- Sometimes confused with cork taint

**Moldy Odor**

- Cork Taint—“Corked Wine”
  - Frequency 2 to 5%
- Smells moldy, earthy, medicinal
- There is no cure
- The smell is due to a clearly identified chemical, 2,4,6-trichloroanisol, TCA
  - Human sensitivity 5 ppt (trillion, that is)
- Its origin is less certain
  - Naturally occurring molds (?)
  - Pesticides (?)
  - Chlorine bleaching of corks (?)

**Possible Origin of "Cork Taint"**

Lignin (cork tree bark) $\rightarrow$ phenol $\xrightarrow{\text{chlorine bleaching}}$ trichlorophenol $\xrightarrow{\text{microbiological}}$ TCA

**Sherry or “Cooked”**

- Maderization
  - Refers to a wine, usually white, that has become oxidized
  - The color, instead of light, is amber or brown
  - The flavor is like sherry or Madeira
- The cause is usually improper storage under warm conditions

**Taste**

- In wine the primary tastes are
  - Sweet—alcohol, glycerine, residual sugar (RS)
  - Sour—wine acids
  - Drying or puckering sensation—tannin
  - Burn—alcohol

**Sweetness**

- A universally enjoyed sensory experiences
  - Probably an adaptive response to safe foods
- Sweetness is due primarily to sugars
  - Sucrose (table sugar), Glucose, Fructose, Lactose
- The sugars present in grapes
  - An equal mixture of glucose and fructose
- Both are converted to alcohol and CO$_2$
- Unfermented sugar called "residual sugar" or RS

**Sensitivity to Sugar in Wine**

- Perception of sugar
  - Human perception, ca 1%
Depends on age of the taster, temperature, etc

- Complete fermentation leaves almost no RS
  - From 0% to 0.2% RS
- To make a sweeter wine (one with a higher RS)...  
  - Fermentation may be interrupted
    - By the addition of SO$_2$
    - By the addition of brandy
  - Or, sugar or must-concentrate may be added afterwards

**European Union Definitions for Sweetness in Wine**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>less than 0.4% RS</td>
</tr>
<tr>
<td>Medium dry</td>
<td>to 1.8% RS</td>
</tr>
<tr>
<td>Medium sweet</td>
<td>to 4.5% RS</td>
</tr>
<tr>
<td>Sweet</td>
<td>above 4.5% RS</td>
</tr>
</tbody>
</table>

- Examples
  - The “halbtroken” (half-dry) wines of Germany, about 1.5%
  - Port has about 7% RS
  - Sauternes about 10% RS

- Note: The TTB does not define these terms
  - They may appear on U.S. labels but are undefined

**A Scale of Relative Sweetness in Wine**

<table>
<thead>
<tr>
<th>Dry Reds</th>
<th>Dry Whites</th>
<th>Champagne</th>
<th>Off-Dry</th>
<th>Port or Late</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(German)</td>
<td>Sherry Harvest</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Riesling</td>
<td></td>
</tr>
</tbody>
</table>

**Other Contributions to Sweetness**

- Dry wines may seem sweetish because other compounds suggest sweetness
  - Alcohol
  - Glycerol (glycerine)
  - Fruit flavors
  - Oak
- Kendall-Jackson Chardonnay with an RS of 0.4-0.5% (normal 0-0.2%)
  - Created a new style of Chard’s
  - The RS value does not appear on the label

**Acidity and Sourness**

- Grapes contain 0.7% acid
  - Give tartness to grapes
- But balanced due to sugar
- An example of this balance
  - Lemon juice + Sugar water = Lemonade
    - sour simple sweetness pleasant
    - (not palatable)

**Tartness in Wine**

- In wine
  - Sugar is gone
Acids remain
• But the tartness is offset by
  – Alcohol
  – Glycerine
  – Fruitiness
  – Other complex flavors
• Result: a non-sour perception (usually)

The Wine Acids
• Three main wine acids
  – Malic acid (from apples) \([\text{HOOC-CH(OH)CH}_2\text{-COOH}]\)
  – Tartaric acid (from grapes) \([\text{HOOC-CH(OH)-CH(OH)-COOH}]\)
  – Lactic acid (from milk) \([\text{HOOC-CH(OH)-CH}_3\text{]}\)
  – Citric acid—just a trace (from lemons) \([\text{HOOC-CH}_2\text{-C(OH)(COOH)}_2\text{]}\)
• The other acid
  – Acetic acid (vinegar)
  – Indicates spoilage

Wines Low in Acid
• As grapes mature
  – Acids are converted into sugar
  – Grapes become sweeter, less tart
• If allowed to proceed too far
  – Resulting wines lack sharpness
  – These wines are termed "flabby"

Flabby Wines
• Such wines arise in very warm grape growing climates
  – Southern San Joaquin, Southern Spain, etc
• There, loss of acid is impossible to inhibit
  – The weather never cools off
• Balanced wines come from cooler parts of temperate zones
  – Along coasts, river banks or lakes
  – Or in highlands or mountain valleys
• There, evenings are cool
  – Acid loss can be controlled

Tannin
• Present in fruit skins, stems and seeds
• Strong tea—also a good example
• Sensation in the mouth of
  – Dryness or
  – A sandy coating
• Explanation
  – Tannin plus mouth proteins…
  – Form a precipitate (solid)

Source of Tannin in Wine
• Contact of must with skins—main source

A "flabby" wine is a negative term describing a wine with low acidity, high alcohol, and lacking balance
Red wines are kept in contact with the skins
– Thus, red wines contain tannin
White wines are made with little skin contact: result
– White wines contain little tannin
Note: Stems and seeds contain the most tannin but they do not contribute it to the wine

Roles of Tannin in Wine
• As red wines age
  – Tannins are converted to by-products
  – Thus, red wines "soften"
• Wine preservation
  – Tannins absorb oxygen and…
  – Remove other spoilage agents
  – Thus, tannins retard spoilage and preserve wine
• So, tannins in wines both require aging and allow aging
• White wines lack tannins, so
  – Do not “soften” with aging, and…
  – Are more vulnerable to spoilage
• Chemical reactions continue adding to wine complexity

The Sensory Impact of Alcohol
• Alcohol alone
  – A 10% solution of alcohol in water
    • Equivalent to one shot of vodka plus five ounces of soda—a typical drink
    • Tastes sweet
    • Produces a mild burning sensation
• Alcohol in wine (typically 12%)
  – The sweetness and burn may be masked
  – But, the burn may be perceptible in high alcohol wine, sometimes called “hot”
• Body
  – Alcohol gives the wine more “body”
  – In physical term, greater viscosity

Review
• The primary wine tastes are
  – Sweet—alcohol, glycerine, residual sugar (RS)
  – Sour—wine acids
  – Drying or puckering sensation—tannin
  – Burn—alcohol
• The secondary tastes
  – Fruitiness
  – Non-fruit flavors
  – Oak

Fruitiness
• Wine is made from fruit
• Some wines are very grapey (Beaujolais)
• Hints of other fruits may be sensed
  — blackberry, plum, grapefruit, melon
• Fruitiness is lost with age, and in general...
  Whites > reds
  Light reds > heavy reds
  Young > older

Other flavor notes might be floral, herbal, earthy, spicy, or nutty

Flavor Notes
•
  • White
    – Apple
    – Lime
    – Apricot
    – Rose
    – Thyme
    – Ginger
    – Honey
    – Almond
    – Mushroom
  • Red
    – Cranberry
    – Cherry
    – Plum
    – Rose
    – Rosemary
    – Mint
    – Smoke
    – Clover
    – Coffee

Complexity: Must vs Wine
• The process of fermentation increases…
  – The number of compounds present
  – And the perception of complexity
• Each line represents a different compound, and each adds to the overall flavor profile. Thus, wine is not just grape juice with alcohol

The Role of Oak
• Oak is an added flavor
  – Achieved by aging in oak barrels
  – Or adding oak staves or chips
• Oak adds notes described as…
  – Woody or smoky…
  – Depending on the age of the barrel
• Variety of the oak—French or American
  – American oak is more intensely flavored than French oak
  – Some wine makers prefer it for that reason
• Cost for a barrel
  – About $900 for French oak
  – About $400 for American oak
  – Barrel life—up to seven years
  – Flavor intensity diminishes after each use

**Fabricating Oak Barrels**

- Barrel Hoops are Driven
- Barrels are Toasted
- Hot Barrels Compressed and Banded

The final hoops are added and and heads fitted

**Oak Barrels in Action**

**How to Taste Wine**

**Look**

- Swirl
- Sniff
- Taste
- Savor

**Or, the euphonious…**

**Look**

- Swirl
- Sniff
- Sip
- Savor

**Swirl the Wine**

- The wine mixes with air
- Walls are coated
- Aromas are released

**Sniff**

- You are seeking "the nose“ Faults?

**Taste**

- Primary tastes
- Secondary tastes

**Savor and Reflect**

- Aftertaste
  - All the tastes should emerge
  - The "finish“ is perceived
- Reflect and Savor
  - Aroma-bouquet
  - Flavors (sweet, tart, tannic)
  - Balance
  - Complexity

**Overall Impression**

- The overall impression is due to the participation of
  - Smell sensors
  - Mouth surfaces
  - Tongue surfaces
- And the interaction of
– Flavors
– Aromas
– Tactile sensations
• Gives the overall taste of the wine
• The price? Relevant to the overall impression!

How much to drink?

Storing and Serving
•
  • Wine storage
  • Serving temperature
  • Opening the bottle
  • The wine glass
• The pour
• Decanting
  – Breathing
• Order of wines

Wine Storage
The Ultimate Wine Rack

Proper Storage
• Wines should be stored in the dark
• Temperature 55°F
• Bottles on their sides
• A wine storage cooler(?)
• Avoid warm places
  – Over the refrigerator(?)

Should red wine be served at room temperature?

Serving Temperature
• White wines at 40-50°F
  – Two hours in the fridge
  – 20 minutes in an ice bucket.
• Rosés the same as whites.
• Reds at 60 to 70°F
  – 15 minutes in the fridge on a warm day
• Sparkling wine, very cold, 40-45°

Serving Temps
How long in the fridge? (another critics recommendations)
  Sparkling wines    2:45 hrs
  Rosé-Light white & red 2:30
  Vintage Champagne  2:05
  White wines        1:55
Red wines

Opening the Bottle
Corkscrew Anyone?

Opening the Bottle (The Restaurant Way)
Cut the Capsule  Remove the Top  Insert Corkscrew  Lever out Cork  Remove it

Other Openers

Best Avoided (Why?)

Fancy Schmancy

For the Connoisseur—the Coravin
• The needle penetrates the cork
• Wine is poured through the needle
• When the needle is removed, the cork seals
• Downside, $200 to 400

How long does an open bottle of wine last? It is something of a mystery, isn't it?

Some Suggestions
Sparkling Wine  1–3 days in the fridge with a sparkling wine stopper
Rosé Wine  5–7 days in fridge with a cork
Light White  5–7 days in fridge with a cork
Full-Bodied White Wine  3–5 days in fridge with a cork; e.g., viognier or chardonnay
Red Wine  3–5 days in a cool dark place with a cork, longer in the fridge

The Wine Glass—Form and Function
• A proper wine glass is designed to
  – Allow the wine to be clearly seen
  – Maintain the serving temp
  – Allow the wine to be easily swirled
  – Conserve the wine vapors for sniffing
  – Allow the taster to drink comfortably

Thus, a proper wine glass should have
• No color or decoration
  – To allow the wine to be clearly seen
• A stem for holding
  – And not warming the wine
• A closed bell, curve-sided shape
  – To contain the vapors
  – To allow for easy swirling
• A volume of twelve to sixteen ounces
  – To allow a generous pour and not be more than one-third full

Wine Glass Shapes
Sides too straight?
Bowl too open?
The tulip shape is very popular, but it does a poor job containing aromas
The round bowl shape is sometimes recommended for Burgundy reds
The classic Champagne flute preserves the bubbles

For general serving and tasting, this is the best all-purpose shape
Or...take your choice!
Do you have an enophile friend who is also a science geek?

A Special Purpose Glass
The official INAO tasting glass, used in most wine judgings

The INAO glass
• The Institut national de l'origine et de la qualité (previously Institut National des Appellations d'Origine) (INAO)
  – The French organization charged with regulating French agricultural products
  – And assigning Protected Designation of Origins
  – And establishing standards for wine tasting
  – The INAO glass was adopted in 1970

The INAO Glass in Action
• Filled with exactly 50 mL of wine (about 1 ¾ ounces), one-quarter full
• Held by the base for viewing and swirling

The Ultimate Blind Tasting
• Some wine connoisseurs do not want to be influenced by wine color
  – They prefer to use an opaque black glass for judging
  – This is the INAO glass in black

A recent arrival, the Stemless or Wine Bowl
A New Idea–The Silhouette
What's this about?

How to hold a glass…

The Right Way to Hold a Wine Glass?

Will this relationship survive? This one has!
Salud!

The Pour
How was your day?
The functional pour…

The Serving Size
• For drinking wine...
  – Four ounces in a 12-oz glass (one-third full)
• For evaluating wine...
  – Two ounces is sufficient
• In a tasting room...
  – A one-ounce pour is likely
• In restaurants...
  – A five to six-ounce pour is customary

Letting the Wine Breathe

Do Wines Benefit from Exposure to Air?
A subject of wide variation of opinion
• Some experts say “Nonsense!”
• Others believe that young red wines (under five years old)
  – Improve by exposure to air
  – Perhaps for an hour
• Enophiles say the wines "open up"
• Removing the cork alone does little. You must...
  – Decant into a carafe or...
  – Pour into glasses

Or, Aerate as you pour
Wine aerator by Vinturi

Other “Expert” Opinions
(1) Allow the wine to breathe one minute per dollar of cost
  – $10 wine—10 minutes
  – $60 wine—60 minutes
(2) The wine doesn’t change, the taster does
  – After 30 minutes and two glasses...
  – Everything tastes better

More Advice on Letting the Wine Breathe…
• Open the bottle to allow it breathe
• If, after five minutes, it does not look like it's breathing, give it mouth-to-mouth

Decanting Wines
When to Decant
• Cabs over 10 years old
  – Tannins form solids
  – Must be removed
• Procedure:
  – Bottle upright-4hrs
  – Remove the capsule and cork
  – Illuminate the bottle from behind
  – Pour the wine into the carafe continuously
  – Stop when you see sediment in the neck
  – Discard the rest of the bottle

A Slow-Tilting Decanting Machine

When Serving Wines…
What is the best order of service?

Order of Wines

• Less complicated before more complicated

<table>
<thead>
<tr>
<th>Sparkling</th>
<th>White</th>
<th>Rosé</th>
<th>Light Red</th>
<th>Bold Red</th>
<th>Sweet</th>
</tr>
</thead>
</table>

Therefore

white before red
light red before heavy red
dry before sweet

Wine with Food

• The Rules
  – Whites with white meat, fish, and light foods
  – Light reds with pasta
  – Bolder reds with beef, stews, other hearty dishes
  – Sweet wines with dessert or cheese

• Breaking the rules
  – Once you know what you like..
  – Drink whatever you like with anything!

A Dinner Sequence

• Oysters Chablis, Muscadet
• Salad Chard, Vouvray, Sauv. Bl.
• Pasta Beaujolais, Sangiovese
• Roast Cabernet, Zin, Syrah
• Fruit, cheese Sauterne, Port

Buying Wine

• The questions to ask…
  – What variety?
  – What appellation?
  – What brand?
  – What price?

• Where is a good place to buy wine?

Cost Breakdown of a Quality California Wine

- Cork — $1.50
- Glass — $1.50
- Label — $0.50
- Cost of Production — $5
- Winery Profit — $1
- Cost to Wholesaler — $9.50
- Cost to Retailer — $17
- Cost to Consumer — $28
- Cost in a Restaurant — $51 (3 x $17 = $51)
Points to note

- The winery makes $1.00 on the bottle
- Thus, retail sales at the winery are very profitable
- The wholesaler pays $9.50, charges $17
- The retailer pays $17, charges $28
- A restaurant typically triples the wholesale price

Comparing Cheap and Expensive Wines

- **Price ~ $7.50**
  - Bottle, cork, capsule, label—$1.08
  - Production—$2.58
  - Markup—$3.94
- **Characteristics**
  - Large production
  - American or no oak
  - Minimal aging
  - Machine harvested
  - Average quality grapes ($750/ton)

- **Price ~ $32.00**
  - Bottle, cork, capsule, label—$5.25
  - Production—$10.71
  - Markup—$17.54
- **Characteristics**
  - Small production
  - French oak
  - Extended aging
  - Hand harvested
  - Premium wine grapes ($3200/ton)

Have trouble choosing? Why not take the easy way out?

- Buy Two-Buck-Chuck — Pay $1.99
- Who cares what it tastes like?

Two-Buck Chuck, Properly Employed
(i.e., as a floor-cleaning solvent)

Wait a minute!
Two-Buck-Chuck
Was once a rhyme
But Two-Buck-Chuck's
Now Two-ninety-nine!

Seriously, which wines should you buy?
Advice...

- Choose an appellation that is
  - an AVA or, at minimum...
  - a county
• These suggest a better quality wine
• "California" often means Central Valley grapes
  – Remember, $750/ton vs $3200/ton

Mendocino Ridge Anderson Valley Yorkville Highlands, Redwood Valley McDowell Valley High Valley Red Hills Guenoc Valley El Dorado Shenandoah Valley Fairplay Fiddletown Howell Mountain Diamond Mountain St. Helena Rutherford Atas Peak Stags Leap Yountville Oak Knoll Mt. Veeder Coombsville Wild Horse Valley Los Carneros Chiles Valley Alexander Valley Rockpile Dry Creek Valley Sonoma Coast, Chalk Hill Russian River Valley Green Valley Sonoma Valley Bennett Valley Sonoma Mountain Los Carneros Lodi Santa Cruz Mountains Livermore Valley Santa Clara Valley Paso Robles York Mountain Edna Valley Arroyo Grande Valley Temecula

Brands?
• There are over 2000 wineries in California
• Some helpful terms
  – "Grown, Produced, and Bottled by"
  – "Estate Bottled"
  – "Produced and Bottled by"
• These terms mean the winery has been involved in several steps of the production
  – Suggests greater care(?)

Where to Shop for Wine
• Factors
  – Variety
  – Price
  – Proper handling
  – Convenient location
• Handling hardest to assess
  – Are the wines stored on their sides
  – Are the wines kept cool

The Best Wine Shop Would…
• Have a large variety
• Display and store bottles on their sides
• Keep the shop (and the wines) cool
• Have a helpful and knowledgeable staff
• Be conveniently located
• Be reasonable priced

Surdyk’s
• The Almost Perfect Wine Shop
  – All bottles are on their sides.
The variety is excellent
- The staff is knowledgeable and helpful
- The environment pleasant.

- What's not perfect?
- It's in Minneapolis!

If you’re in Minneapolis...

- Surdyk's
  303 East Hennepin Ave.
  Minneapolis, MN 55414
  - Phone: 612-379-3232
  - Fax: 612-379-7511
  - www.surdyks.com

What about the Bay Area?

- Your comments welcome

The Fires October 9 – October 15, 2017

Beltane Ranch, a winery in Sonoma County, October 9, 2017

Signorello Estate before the fire

Signorello Estate Winery after fire 10-9-17
The Signorello Estate Winery Afire

Melted bottles of wine at the Signorello Estate Winery
The Atlas fire burns near the Kenzo Estate winery in Napa, Calif.,
Paradise Ridge Winery, Russian River Valley
Winery, tasting room, and events center at the Paradise Ridge were gutted during the Santa Rosa fire
Paradise Ridge Winery after the fire
Flames burn along a ridge top behind a Partrick Rd. vineyard in Napa, Calif
Ziggy Gutierrez helps put out embers around the Solari Vineyards, Calistoga, Calif.
A fire burns at the fence line of a property at Bennett Lane and Evey Road, Calistoga
Flames moved through the hills near the a winery as the Atlas fire raged though the Napa County

Vineyard Burning
What will survive?

Mayacamas Winery The winery survived, but the hospitality center was destroyed
The burned remains of Mayacamas Vineyard’s hospitality center

Grapevines at the Gundlach Bundschu winery in the Sonoma Valley
Gundlach Bundschu after the fire

Grapes that survived the fire
The Effects of the Fires
Effects on Grapes and Wines

- The 2017 harvest was early
– Labor Day heat wave
– Earlier ripening
– 80 to 90% of the grapes were in and crushed

• Fruit still hanging may show…
  – Some "smoke taint"
  – Off flavors such as smoky or medicinal

Strategies
• Wineries are processing "after-fire" grapes separately
• The off-flavors may not be detectable at first
  – During or after fermentation…
  – The faults may become apparent
• Changes in vinification procedures are likely
  – Pumping over will be reduced
  – Pressing may be earlier (before F'n is complete)
  – Both actions to reduce skin-juice contact

Final Outcome
• If the wine is unsatisfactory…
  – Producers will sell it off
    • For the proprietary market (e.g., Trader Joe's)
    • For the bulk wine market (wine in a box)
• These alternatives will result…
  – In considerable loss of income for producers