

# Innovations involved in Champagne Production

## *circa 1700*

- still, unblended, low alcohol (~9%), low tannin, acidic, darkish rosé (*oeil de perdrix*)
- mild fruity/yeasty flavor (*verjus pétillant*)
- sold in barrels in the spring
- derived from crushed grapes & made from the first three pressings

## *today*

- sparkling, blended, 12.5% EtOH,
- low tannin, white, delicate complex
- minimally fruity, toasty flavor,
- 2<sup>nd</sup> fermentation in spring,
- released  $\geq 18$  m after production
- sold bottled
- derived from whole grape clusters & primarily from the first pressing

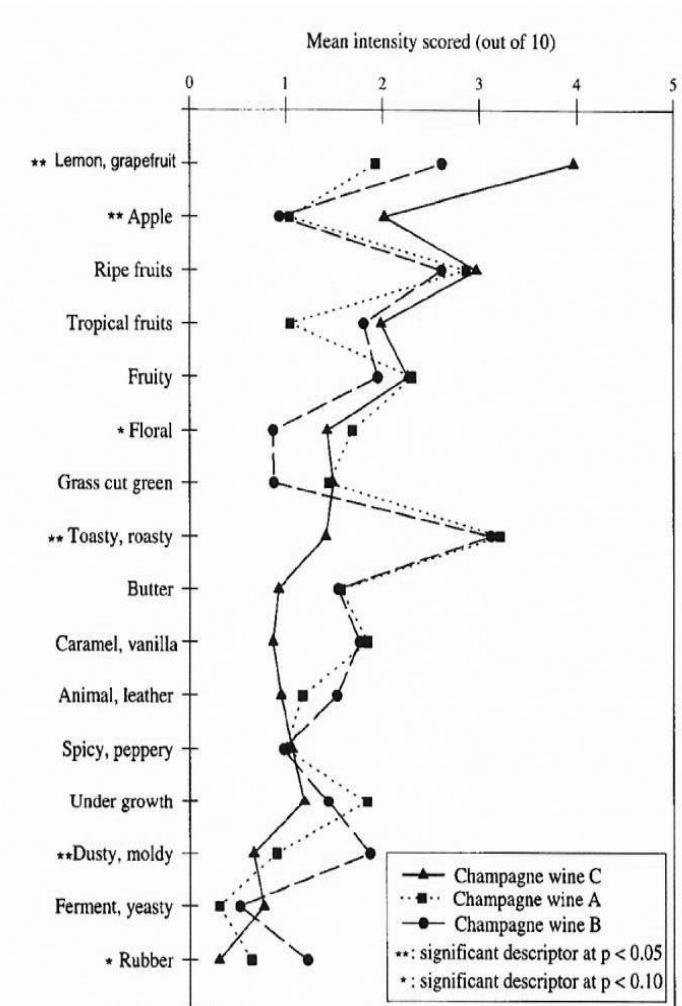
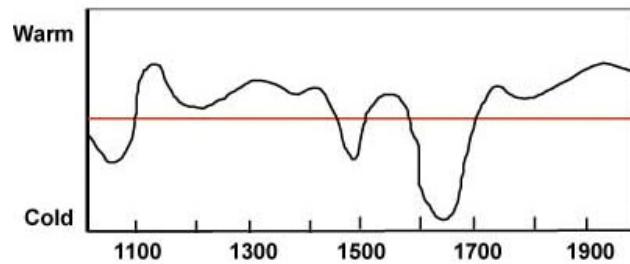


Figure 1. Sensory profile of champagne wines A, B, C.

## ***Knowledge and conditions ~ 1700***

- the role of yeasts and bacteria in fermentation and wine ‘diseases’ unknown;
- no means of measuring the sugar content of wine (leading to variability in degree of effervescence)
- no tirage
- cork closures and availability of glass bottles just appearing
- extensive bottle rupture due to the glass irregularity and inability to sustain the carbon dioxide buildup
- occurrence of the “Little Ice Age,” (associated with early and late frosts, and poor grape maturation)
- riddling unknown; inefficient disgorging procedures



*Winter severity in Europe, 1000 - 1900. Note two cold periods in the 15th and 17th centuries. Based on Lamb, 1969 / Schneider and Mass, 1975.*

## ***Current procedures***

- manual harvest (aiming for low °Brix) and EtOH 9–9.5%
- slow pressing of whole grape clusters
- use of oak as fermentation or maturation cooperage individualistic
- malolactic fermentation (reduce excess grape acidity)
- maturation and clarification until spring
- blending to produce the *assemblage*
- addition of a *tirage* (sugar, yeast, yeast nutrients, fining agent)
- second fermentation (~10 °C)
- storage for at least 15 months in bottle
- *remuage* (riddling)
- degorgement (elimination of the yeast)
- adding of the *dosage*
- closure with cork, adding the wire cage, labeling

## ***Cultivars grown - 1700s***

Best reds: *Petit Plant doré, Gros Plant doré noir (Pineau), Perlusot, Couleux*

Poorer reds: *Meunier, Teinturier, Gouais, Gamet*

Best whites: *Blanc doré, Petit blanc, Chasselas, Gros Plant vert*

Poorer whites: *Marmot Gamet, Meunier, Gouais*

## ***Cultivars today***

Reds: *Pinot noir (38%), Pinot Meunier (32%)*

Whites: *Chardonnay (30%), Arbane, Petit Meslier, Pinot blanc, & Pinot gris (0.3%)*

## ***Unique needs re Champagne Production***

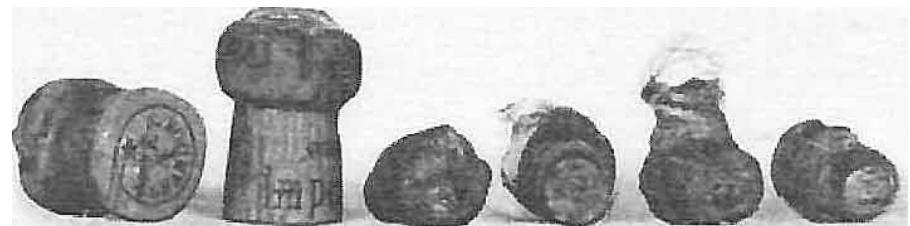
- pressing with minimal anthocyanin extraction
- bottles withstanding an internal >6 Atm pressure
- use of thick (32mm), long (48mm) corks
- means of effectively inserting corks in a 17.5 mm bore  
(and crushing the extruding portion)
- bottle necks designed to hold both a crown cap (or *agrafe*) and a wire mesh (*muselet*)
- efficient means of removing the lees (riddling, disgorging, and adding a dosage)
- cool fermentation and maturation conditions

## ***First reports of ‘sparkling’ (brisk) wines***

- in Rome (1596), but also supposed in Limoux (1531)
- if bottled, then earthenware and needing a tight closure
- fizzy champagne become frequently reported after 1660s (England), but supplied out of tightly closed barrels
- caused by reactivation of yeast and/or malolactic fermentation
- popularity soars during the French Regency (1715–1723)
- Rocheret 1<sup>st</sup> bottler of sparkling champagne (1713)
- most exported champagne remains still, *vin gris*, with white sparkling version accounting for 6% (1816) and 5.8% (1848)
- considered “*la foule des amateurs*”

## ***Use of cork as a ‘bottle’ closure***

- used for beer bottles (1573)—likely Bellarmine jugs
- reports of corks being shot out of bottles (1600s onwards)
- corks recommended for wine bottle closure (1650),
- became regularly used in Champagne (1718), and especially when export in bottles was permitted (1728)
- corks initially extended beyond the neck & rounded to permit removal
- corkscrew invention ~1688
- earlier, stoppers were of wood or hemp (soaked in oil)



## ***Origin of strong glass bottles***

- begins with the switch to coal furnaces, providing higher temperatures and  $\text{SO}_2$  (reacts to form a strong  $\text{NaSO}_4$  layer) (required post -1610)
- wood-fired kilns still used in Champagne *verreries* (1718)
- all hand blown (i.e., imprecision), even with the introduction of molds (1811)
- partial cause of the 15–20% cellar bottle-rupture (up to the early 1900s)
- cellar workers often wore wire-mesh facial protection
- machine production appears (~1920), only 50% automated by 1930
- better washing (vs. water with lead shot or *petit clous*) (1718)
- cellar bottle-rupture reduced to ~1% by 1970s
- development of polymer and metal oxide coating (and better quality control) has largely eliminated bottle rupture

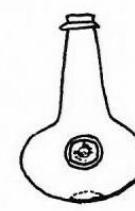
## ***General evolution of bottle shape***



1640-50



1650-60



1660-70



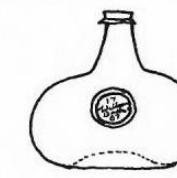
1670-80



1680-90



1690-1700



1700-10



1710-20



1720-30



1730-40



1740-50



1750-60



1760-70



1770-80



1780-90



1790-1800

## *Champagne Bottle Evolution*



~ 1650



Early 1700s



~1760



Late 1700s



1842–1843

## Bottle neck Modification

- not only was glass strength important for withstand the CO<sub>2</sub> pressures but the force exerted by the wider cork against the neck
- a strong neck ring was required to hold the cork in position (initially using twine (*trefoil* knot), then an *agrafe* & finally a wire *muselet* (with a cap))
- subsequently, the *agrafe* (for the 2<sup>nd</sup> fermentation) was replaced with a crown cap (needing a special neck lip)



~1760



~1900

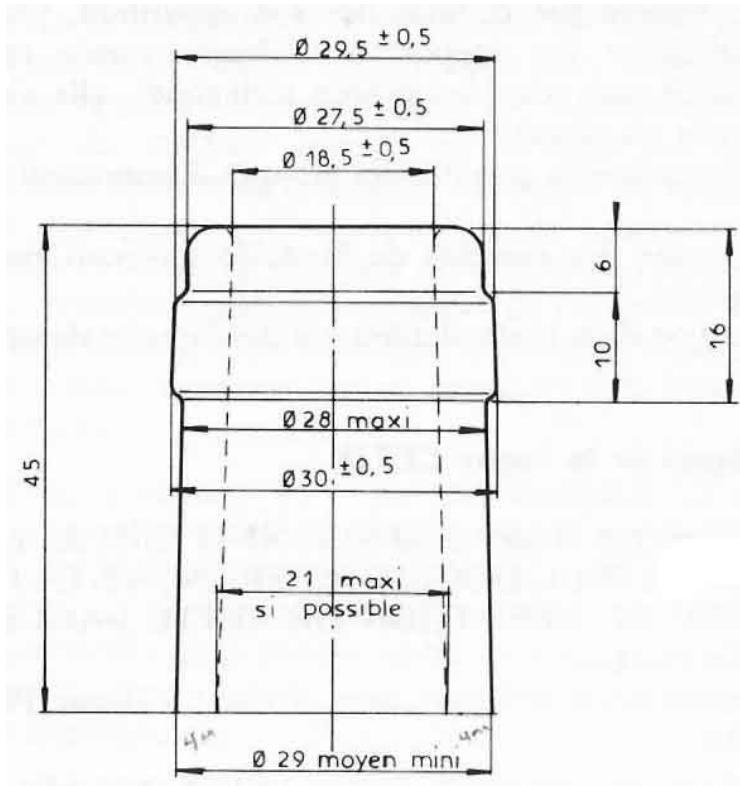


~ 1780

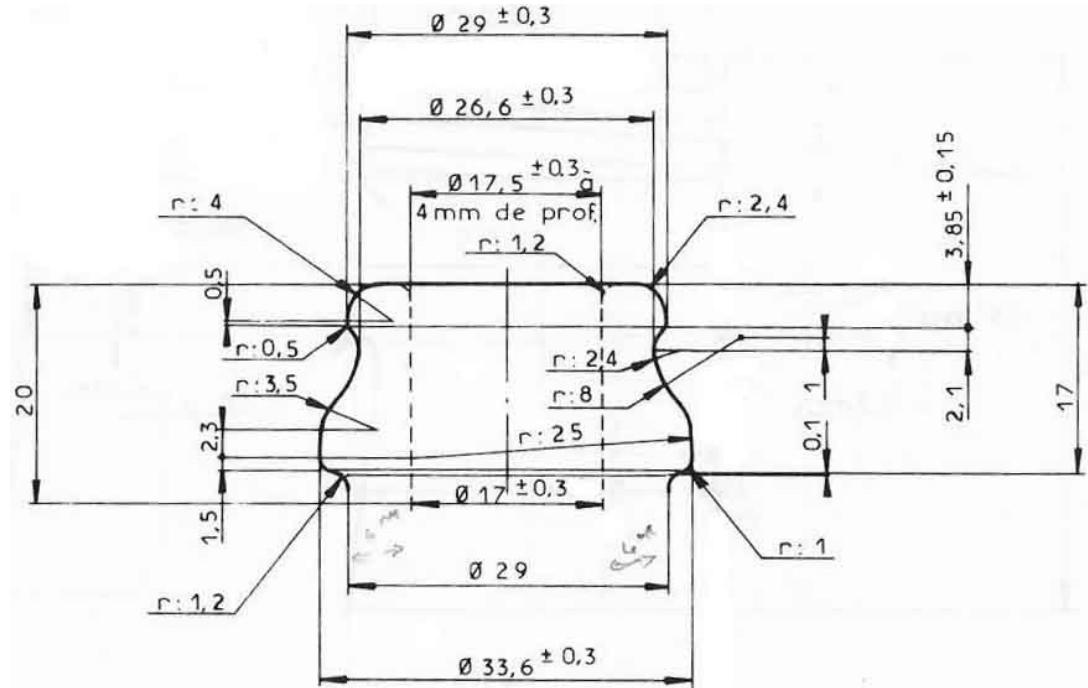


2004

## *Current neck dimensions*

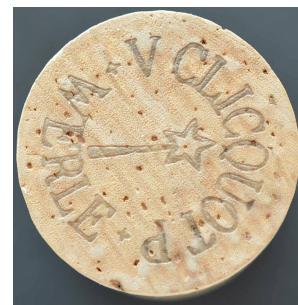
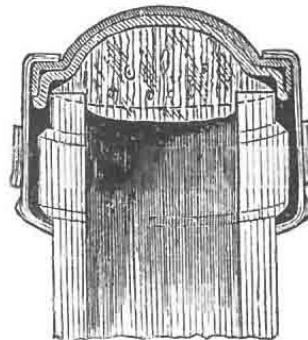


Still



Champagne

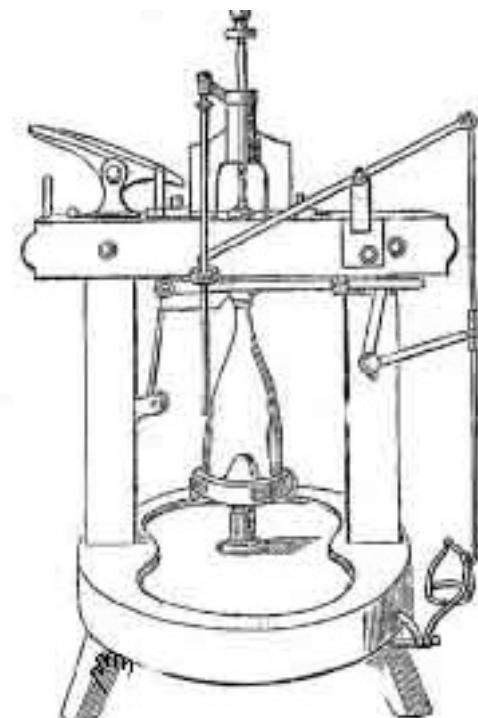
## *Corks and attachments*



# ***Advancement of Cork Insertion Devices***



Unknown



1866



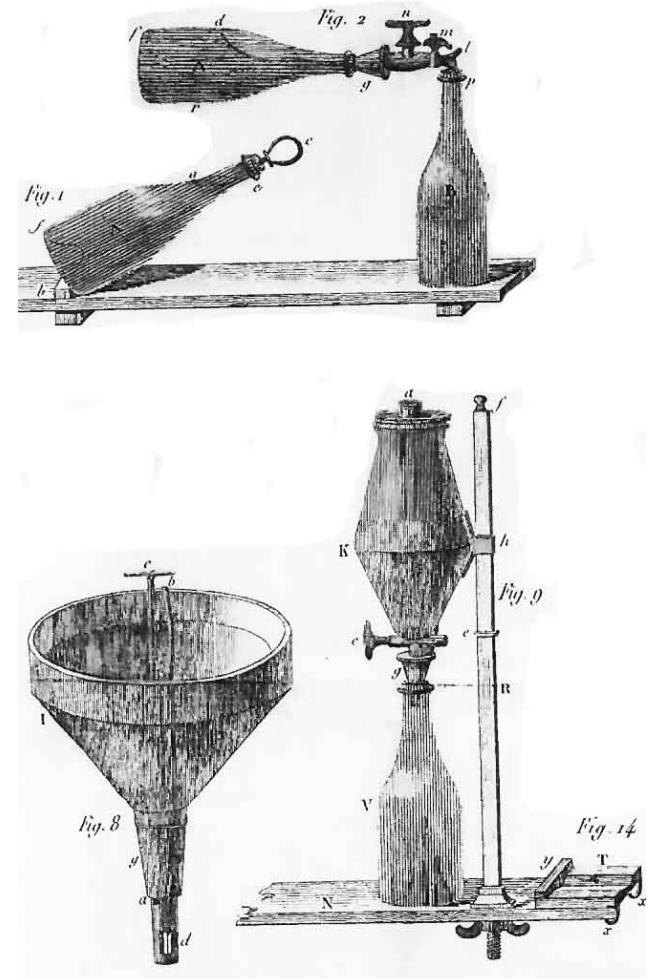
1872

## ***Discovery of sugar's role in the 2<sup>nd</sup> Fermentation***

- 1<sup>st</sup> report of the role of sugar in promoting effervescence noted by Merrit in his 1662 article (Royal Society of London)
- also mentioned in *The Art and Mystery of Vintners* (1682)
- not realized in France until recommended by Chaptal (1801) [for immature grapes] and Parmentier (1808) (recommended adding concentrated grape juice)
- François (1837) provided a method for detecting the residual sugar content of wine, and suggestions on the amount of sugar to add to obtain a fully *mousseux* wine
- aided by the invention of the hydrometer
- when implemented, it allowed the selection of the degree of CO<sub>2</sub> desired (and avoiding excessive bottle rupture in the cellar)

# *Disgorging Champagne*

- all early “brisk” champagnes were cloudy (out of the barrel)
- first attempts at yeast removal involved inverting the bottle in 2–3" sand (to movee *la fleur blanche* next to the neck) (1718)
- 1<sup>st</sup> clear description of ‘disgorging’ (1813)
- before removing the cork, place the bottle in ice-water, slowly invert, remove the cork, lees shot out,
- subsequently only the neck placed in a brine solution (-20 °C)
- adding the dosage and topping the volume from another bottle of champagne



## **Riddling**

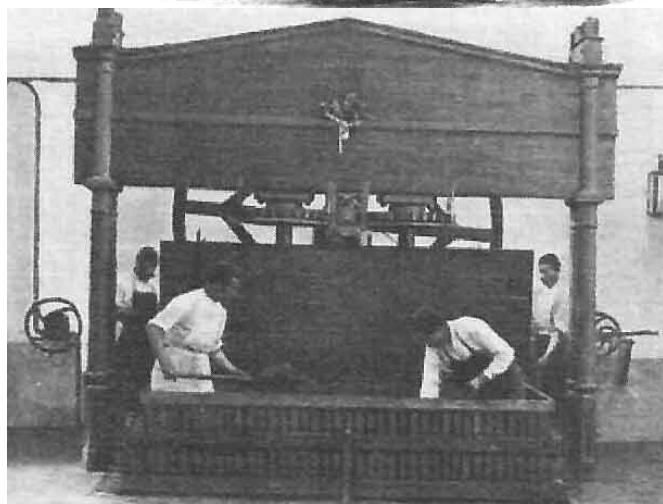
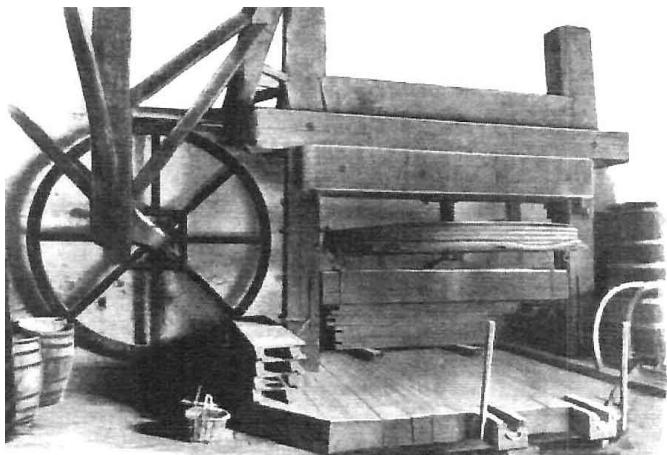
- the idea is first mentioned in 1718
- the invention of the *planche percée* (ascribed to Muller, 1818)
- development of a riddling table (ascribed to Thomassin)
- the *pupitre* 1<sup>st</sup> patented by Cichelot (1864) & use becoming standard (1889)
- the first crank operated version appears (1920) & an automated version (1966)
- the first gyropalette appeared in 1973, its automation (1982)



1889 Illustration



## *Press development*



## ***Microbial origin of fermentation***

- Pasteur study of wine ‘diseases’ established the action of yeast (and bacteria) as fermentative and spoilage agents
- as a consequence the *fleur blanche* came to be recognized as the autolysed remains of the fermentative yeasts
- the value of adding yeast, and nutrients for their growth to the *tirage* recognized
- subsequent pure culturing permitted the selection of yeasts adapted to recommencing fermentation at cool temperatures, in the presence of 9–10% EtOH, and effectively flocculating
- development of dehydration techniques lead to the availability and convenience of active dry yeast
- subsequently, this was applied to malolactic bacteria
- techniques such as yeast encapsulation in a gel or cartouche (Millispak) have been developed but not adopted

## ***Evolution of Dosage level***

- initially champagnes were sweet, not being consumed with a meal
- the degree of sweetness supplied with the dosage depended on the perceived desires of the importing country (highest in Russia -1800s)
- slowly (~1850), the *goût anglais* for dryer and *brut* champagnes began to take hold, and champagne began to be taken serious by aficionados, and seen as a refined accompaniment for dinner
- thus, the origin of the apparently strange terms for champagne dryness (grams of sugar/L wine) that reflects the evolution from sweet to dry:
  - doux (50 g), demi-sec (32–50 g), sec (17–32 g), extra dry (12–17 g), brut (< 12 g), and extra brut (< 6 g), nature (<3 g) (residual sugars, but no sugar added)

## *Champagne Glass Shape*



*Vive le  
Champagne*

















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