# *Get Corked*:

## The intricacies of cork and alternative closures

To cork or not to cork? In reality, the question is what should a closure's ideal characteristics be?

- in the past that was not even a question – cork was it.

- with all the current options, wineries must decide between the advantages/disadvantages of these alternatives

- all closures are relative effective, at least in the short term (1–2 yrs)
  - they protect the wine from exposure to air-borne spoilage organisms &
  - limit the rate of $O_2$ uptake (oxidation) and slow the escape of $SO_2$, $CO_2$, and fat-soluble flavorants

- these basic requirements are sufficient for most consumers: the “buy & drink” crowd, with ease of removal (and possibly reinsertion) presumably of importance
- for the winemaker, it is a cost/benefit question **&** what ‘image’ does the intended buyer expect, the aficionado seeing in cork a symbol of prestige, offers the removal ritual, and has the stamp of approval (*tradition*)
- for the environmentalist cork is a renewable resource and is biodegradable (albeit slowly), whereas glass stoppers and screw caps have a large carbon footprint (but are recyclable), and plastic is inexpensive, easily moldable and can be colored, but may not be recyclable
- new closures, being man-made are highly consistent in their attributes (something not possessed by cork, being a natural product

- more intractable are issues as to what are the in-bottle conditions optimal for aging, as well as what does optimal aging actually mean, of these issues of gas permeability top the list:

- need of $O_2$ for color stability (red wine), but limitation to avoid early browning (white wine),fragrance degradation, and limit microbial degradation
- retain the antioxidant value of $SO_2$, but avoid development of a obvious reduced odor (shrimp, cabbage, rotten egg, struck flint)
- retain $CO_2$ (for effervescence in sparkling wines)
- retain fat-soluble volatiles vital to the wine's desirable fragrance
- importance relates to winemaker desires, the wine style intended, the cultivar, and consumer's wine-aging intentions

## Closure Options: Natural Cork

750 ml bottle

- vary in width: 24 (22–26) mm
  & length: 45 (40–55) mm
- vary in quality (porosity and lack of fissures)
- f$^{n}$ of cork growth rate (and # of growth rings in the cork)
- standard number ~8 (6–15)
- vary in coloration/bleaching
- lower grades are colmated,
- may be chamfered

## Cork options:

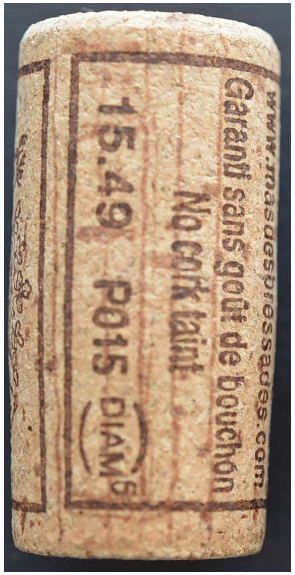
- made from cork chips glued with a polyurethane adhesive
- agglomerate (larger chips),
- microagglomerate (μ chips)
- Twin top (two natural cork discs on both ends
- champagne:thicker versions used for sparkling wines, with two discs on the inner side, glued with a polyurethane or polyvinyl adhesive

## Technical cork

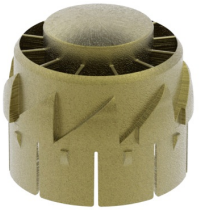
## Closure options: Synthetic corks

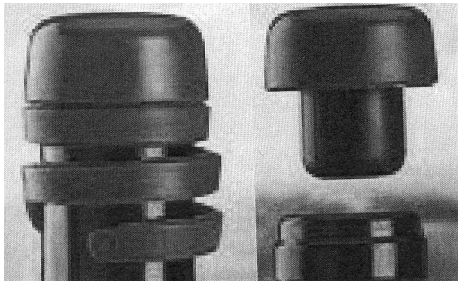
- produced from polyethylene injected (into a mold) or cut (from an extruded tube)
- the latter often have a harder outer coating marked and colored to resemble natural cork

- another version possesses a removable strip: for table wines, resemble a T-cork, or for sparkling wines, superficially resemble a champagne cork
- easily reinserted



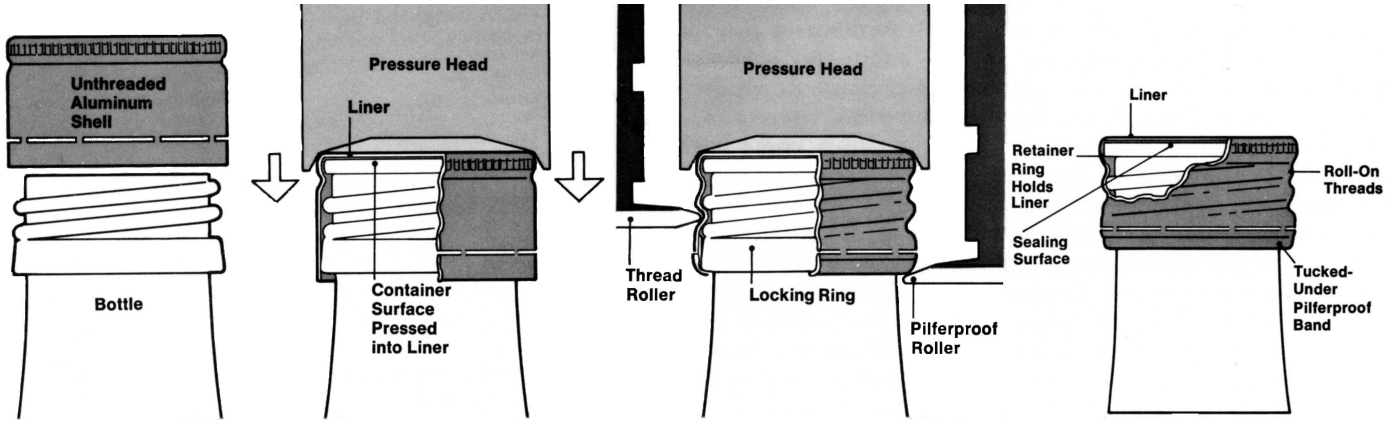






## Closure options: Screw cap

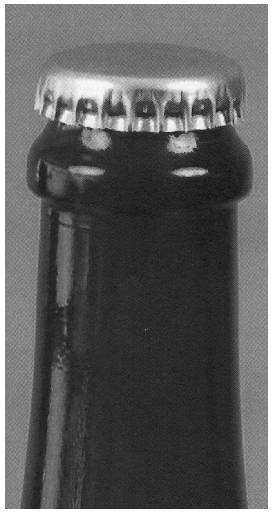
- an aluminum roll-on closure: easy to remove and reattach
- possesses a liner consisting of a spongeous portion next to the aluminum(2 mm polyethylene) and a 19 µm inner portion (Saran) component, with or without an innermost 20 µm tin foil layer
- these are respectively called Saranex or Saratin liners
- they differ markedly in their permeability to gases, thus giving the winemaker an option in this regard



## Closure options: Glass stopper and Crown cap

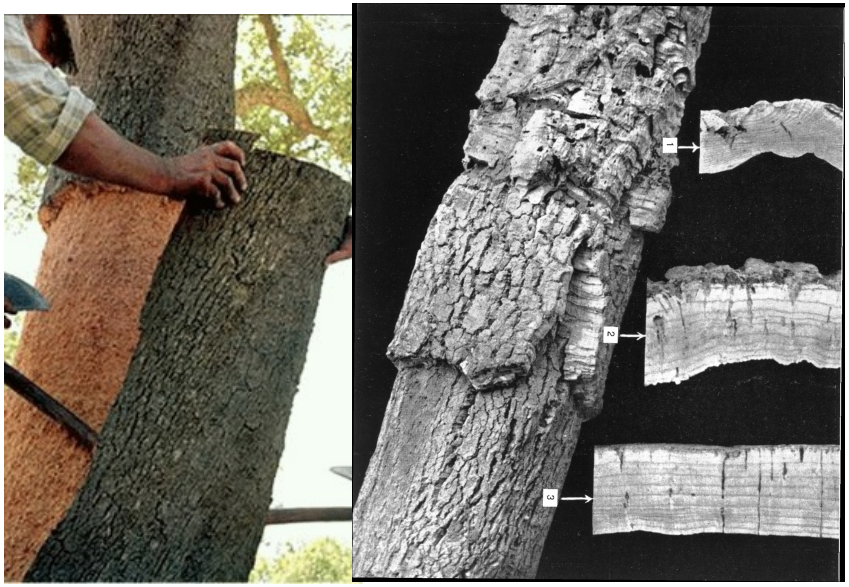
- glass stoppers resemble T-corks and seals to the bottle with a inert silicone o-ring

- crown caps are metallic closures familiar due to their use to close soft drink bottles
- only used to close sparkling wines for their in-bottle second fermentation
- replaced post-degorgement by an agglomerate cork with two natural cork discs on the inner end



## Cork Origin

- cork is the outer bark of a smallish oak tree that grows in savanna-like regions of the Mediterranean
- it can live to ~500 yr, but its most productive phase is from 50–250 yr
- stripping of bark occurs about every 9 yr (but based on growth rate thatcan go up to 15 yr)
- it occurs in late spring when new (soft) cells permit easy separation
- bark slabs need to be 3 cm thick
- only bark from the 3rd stripping and onwards is of uniformstructure adequate for producing corks

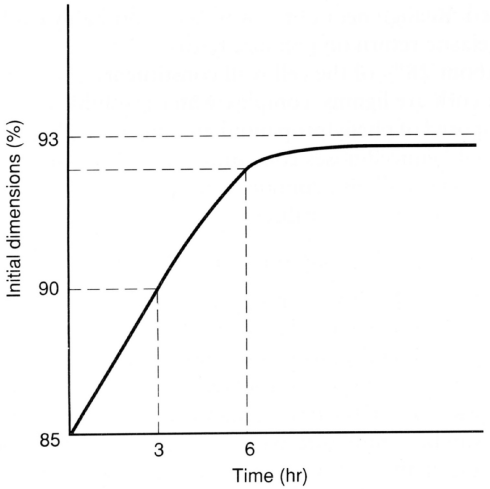


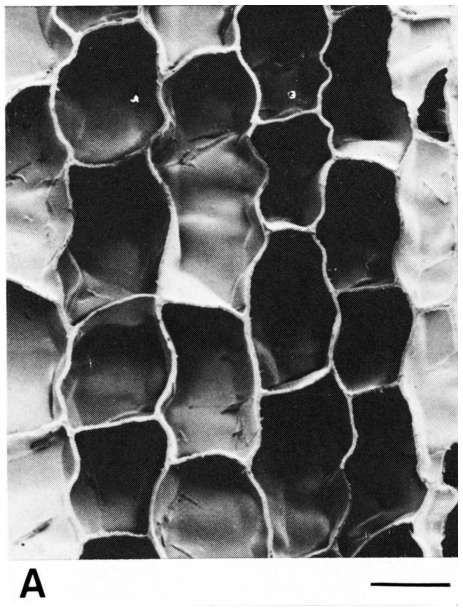
# Processing of Cork

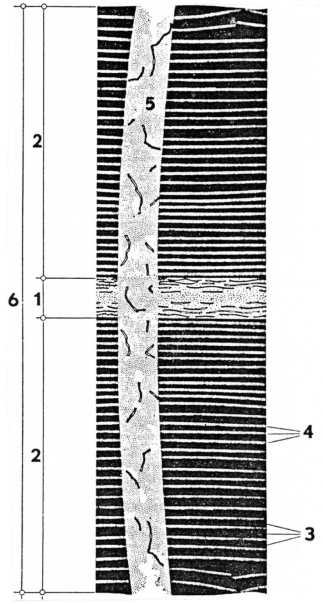

- the bark is boiled to permit flattening before maturation for several months
- subsequent additional boiling, cutting into strips, and punching out
- the corks are washed, surface sterilized (peracetic acid), rinsed and dried down to ~ 5–8% RH
- coated with paraffin (to replace waxes lost in processing) and silicone (ease insertion)
- finally sorted into grades (based on porosity), placed in plastic bags (with some $SO_2$) and stored in boxes


## Positive attributes of cork

- compressible without lateral expansion
- resilience (rapid rebound, high elasticity)
- chemical inertness (e.g., acids)
- impervious to liquids
- slow diffusion of gaseous compounds
- high coefficient of friction
- minimal transfer of compounds into or out of the wine
- resistant to microbial decomposition

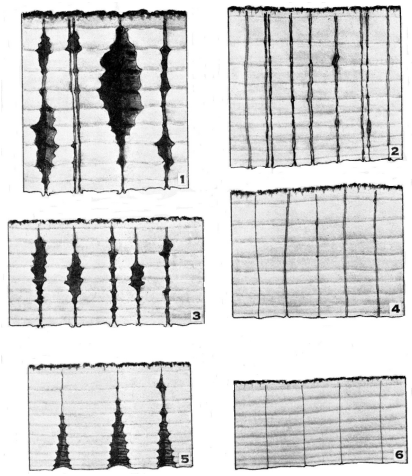


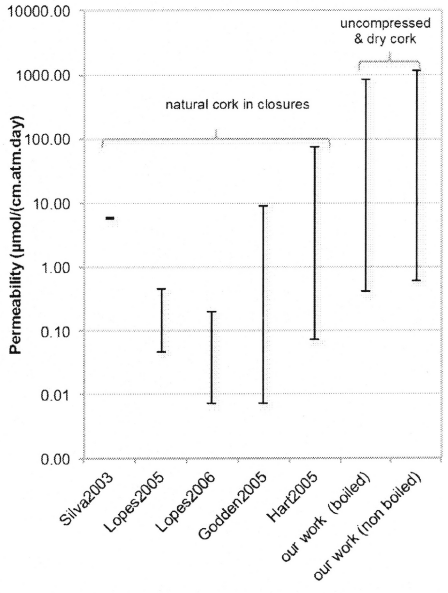



## Negative attributes of cork

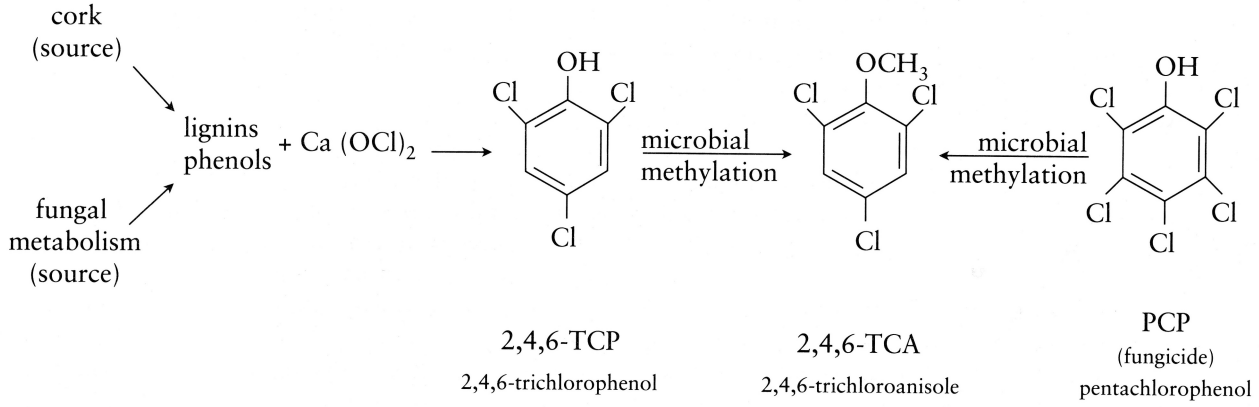
- unpredictabile permeability to gases and fat-soluble compounds (variable porosity)
- potential source of off-odors
- need for a cork screw or other device for extraction
- difficulty in reinsertion(unless chamfered)
- need to lay the bottle on its side to retain cork's elasticity
- slowly degrades with long contact with wine acidity (crumbles on removal)



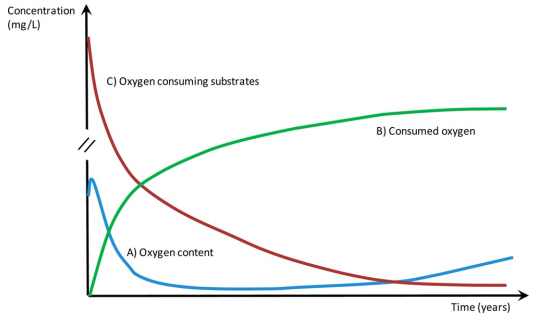
## Issues re closure selection: Taints

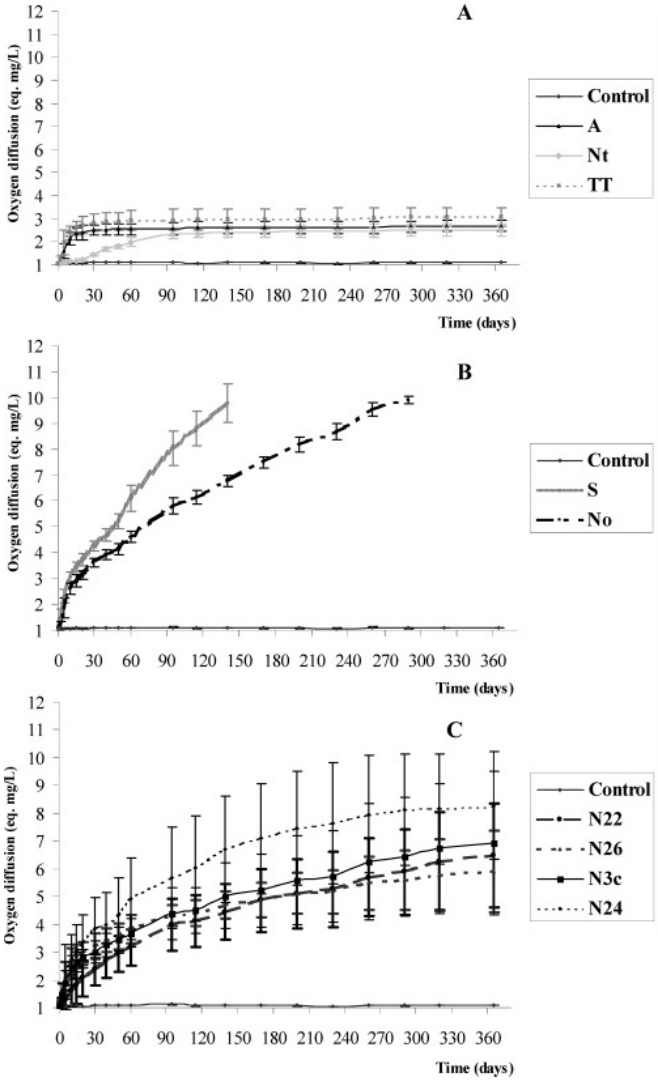
- the prime issue recently has been the ‘corked’ off-odor, due to 2,4,6-trichloroanisole (TCA)
- although associated with cork, it and related taints can be absorbed from cooperage, taints being absorbed by oak or alternative closures from the winery environment
- indications suggest TCA contamination is less common today, the source (PCP) being no longer used in cork forests
- however, subthreshold TCA can selectively suppress the odor perception (notably fruity flavors)



# Issues re closure selection: Oxidation

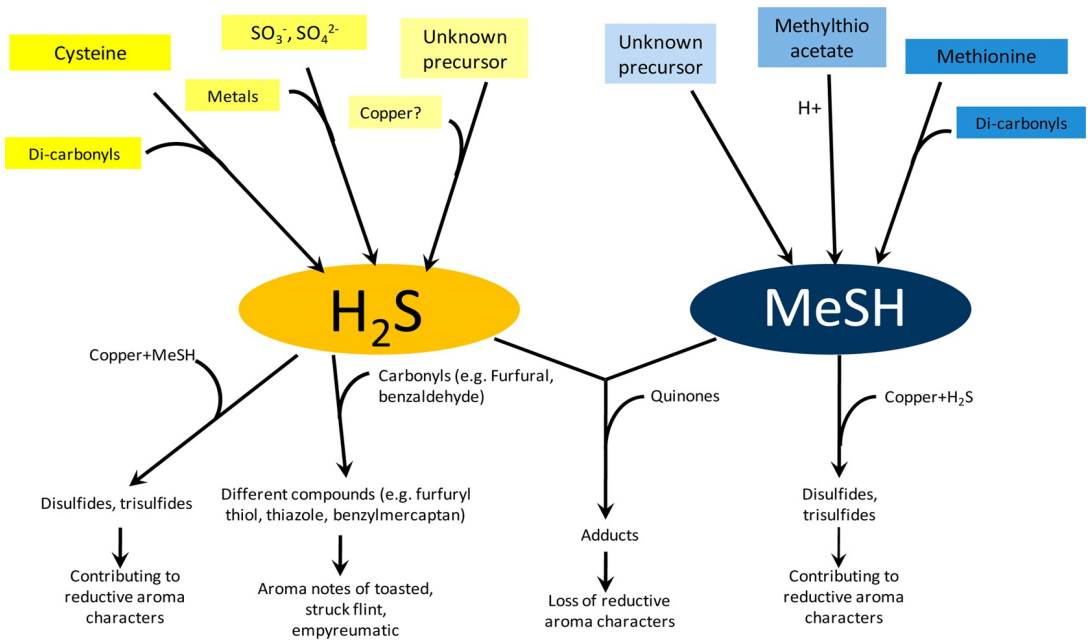
- most concern related to premature browning (white wine) and rancio (oxidized) odors in red wines
- the origin(s) of excessive $O_2$ uptake is contentious: porosity, cavities, residual bleaching agents, from cork cells, issues with poor insertion
- concern rests on the belief that such changes are relevant to consumer choice



## Issues re closure selection: Reduced odors

- concern about low $O_2$ uptake on production of reduced sulfur odors
- usually ascribed to $H_2S$, disulfides, mercaptans (e.g., MeSH)
- most associated with Sauvignon blanc wine, but also in others
- significance to consumers questionable



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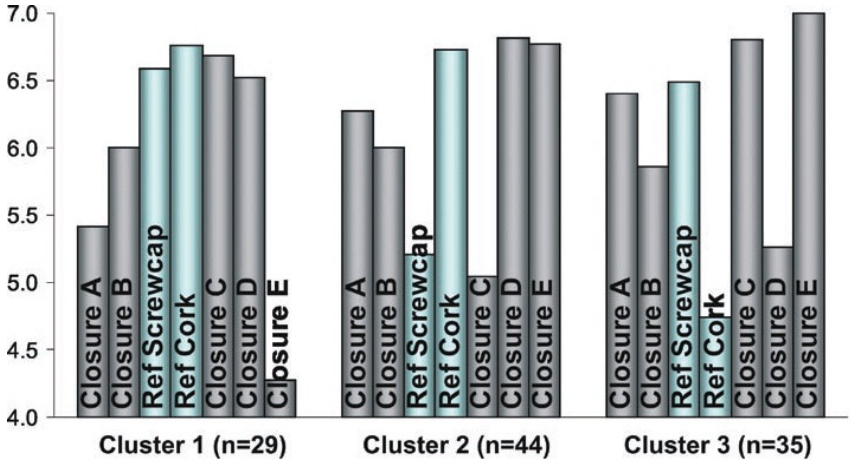
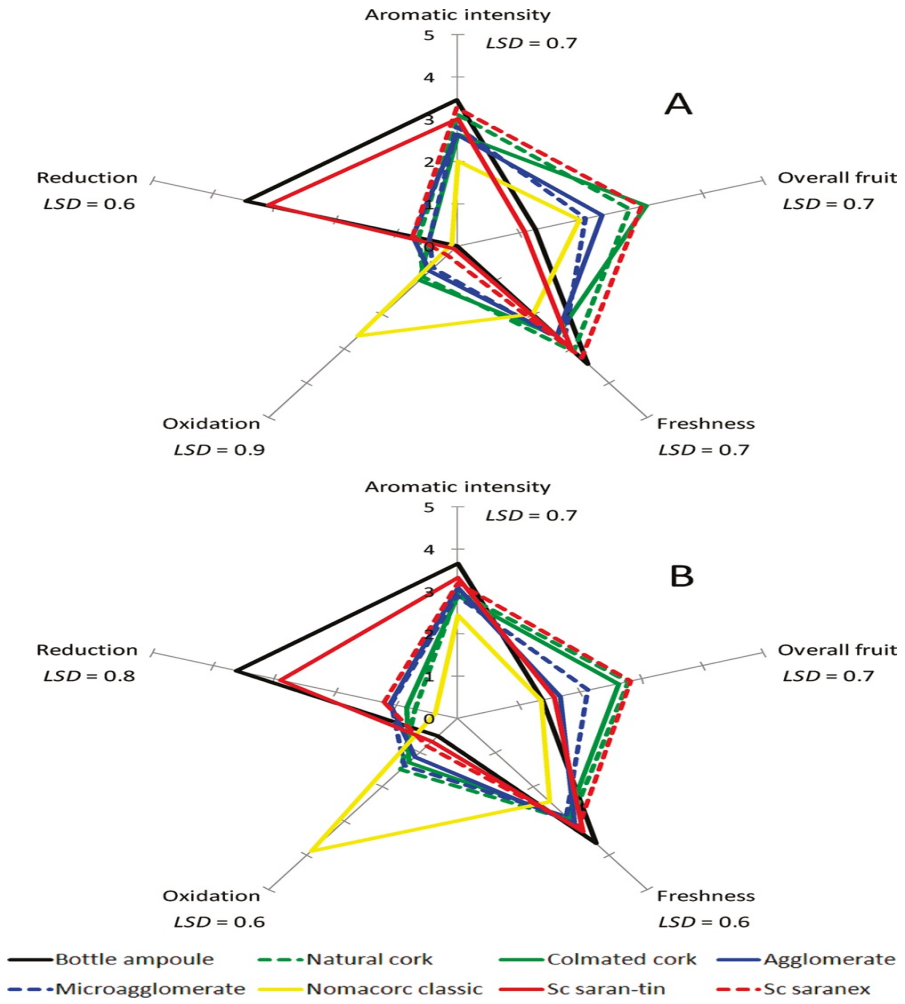


## Summary

- it's clear that the choice of closure can, and likely will, affect the characteristics of the wine as it ages

- there is no 'best' closure under all circumstances, even various versions of each type usually have different sealing properties

- the cultivar and style of wine, legal constraints, the aging-potential desires of the winemaker and intended consumer are important factors needing to be taken into consideration

- ideally the producer should do his/her own studies on the effects of those choices that initially seems the most appropriate

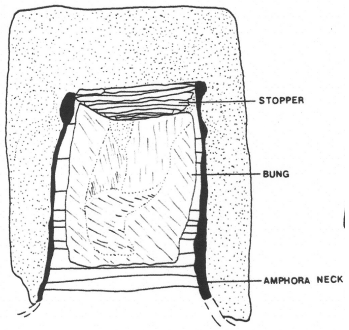
Or

“You pays your money and you takes your choice”

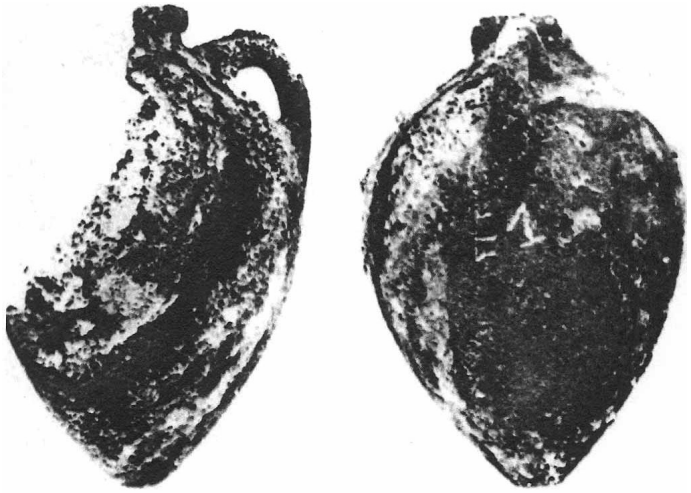
The closure show

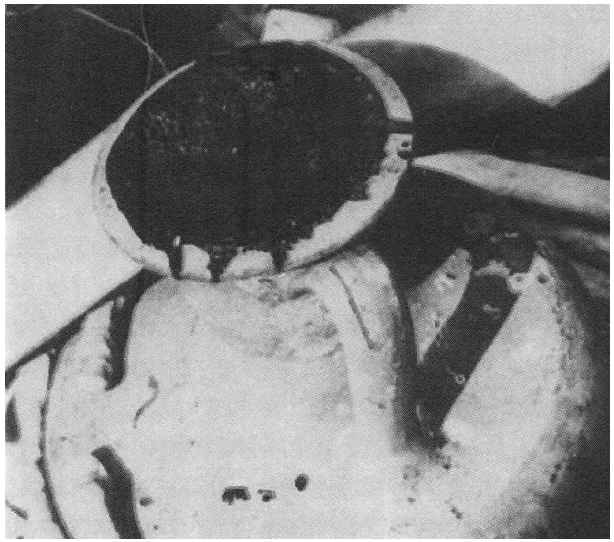
# Historical origins of closure usage

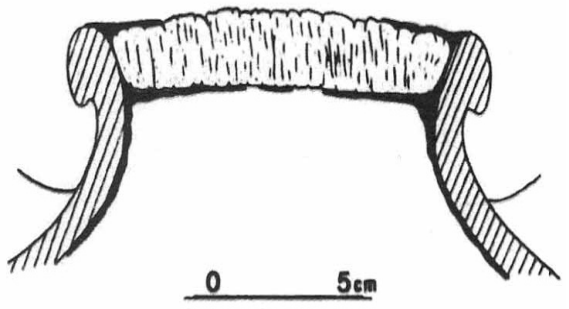
Egyptian



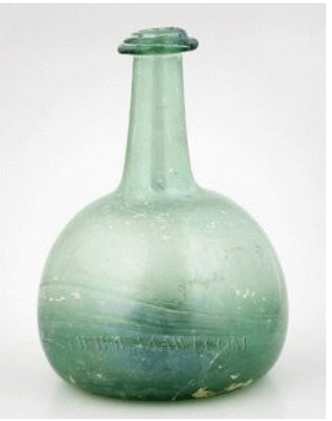

Etruscan, Greek, Roman



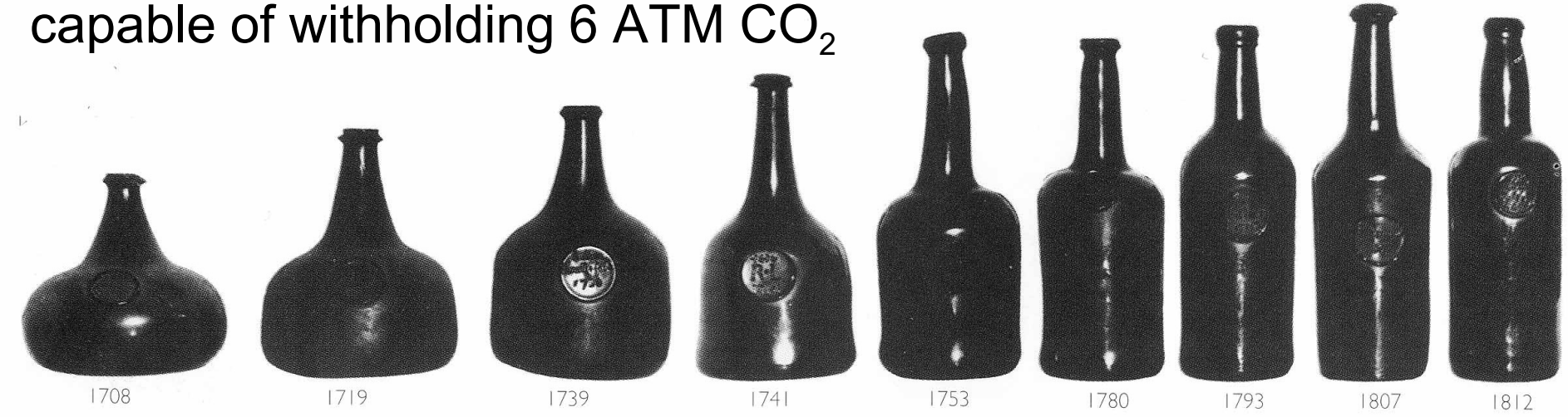




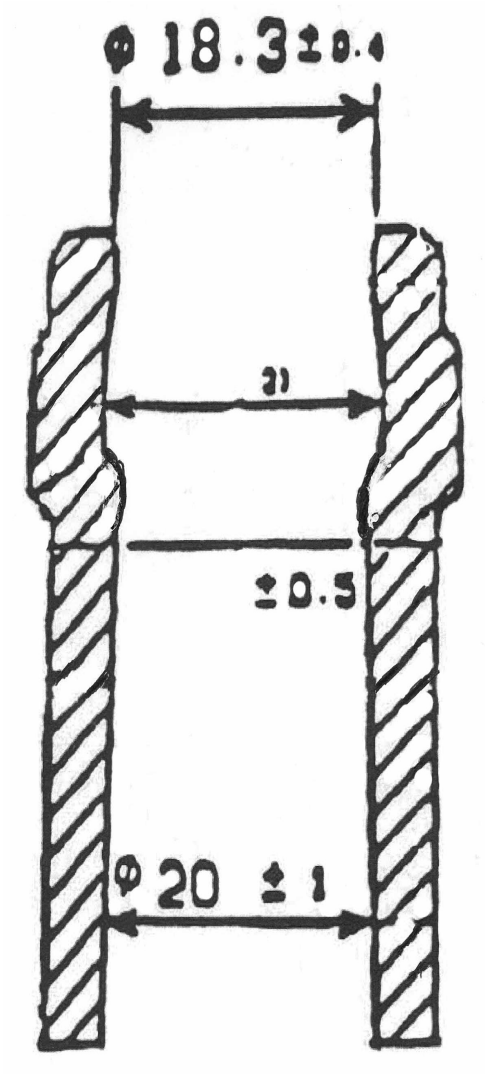
## Influence of rediscovery of cork circa 1600



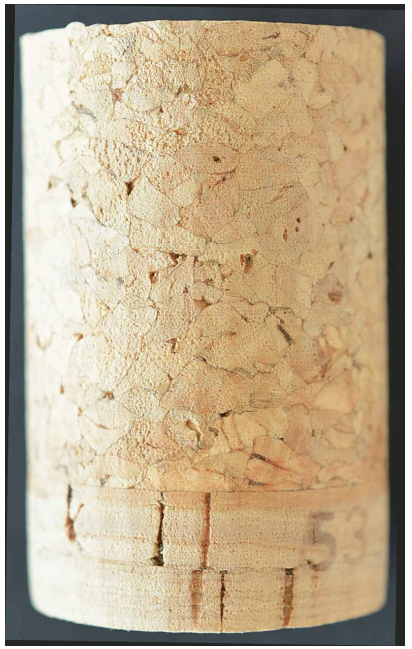
-with a switch from wood to coal for melting, glass absorbed sufficient sulfur to become much stronger, permitting the insertion of a tight-fitting cork closure (and color)
- this lead to an evolution in bottle shape - generation one that could laid horizontal, and capable of withholding 6 ATM $CO_2$

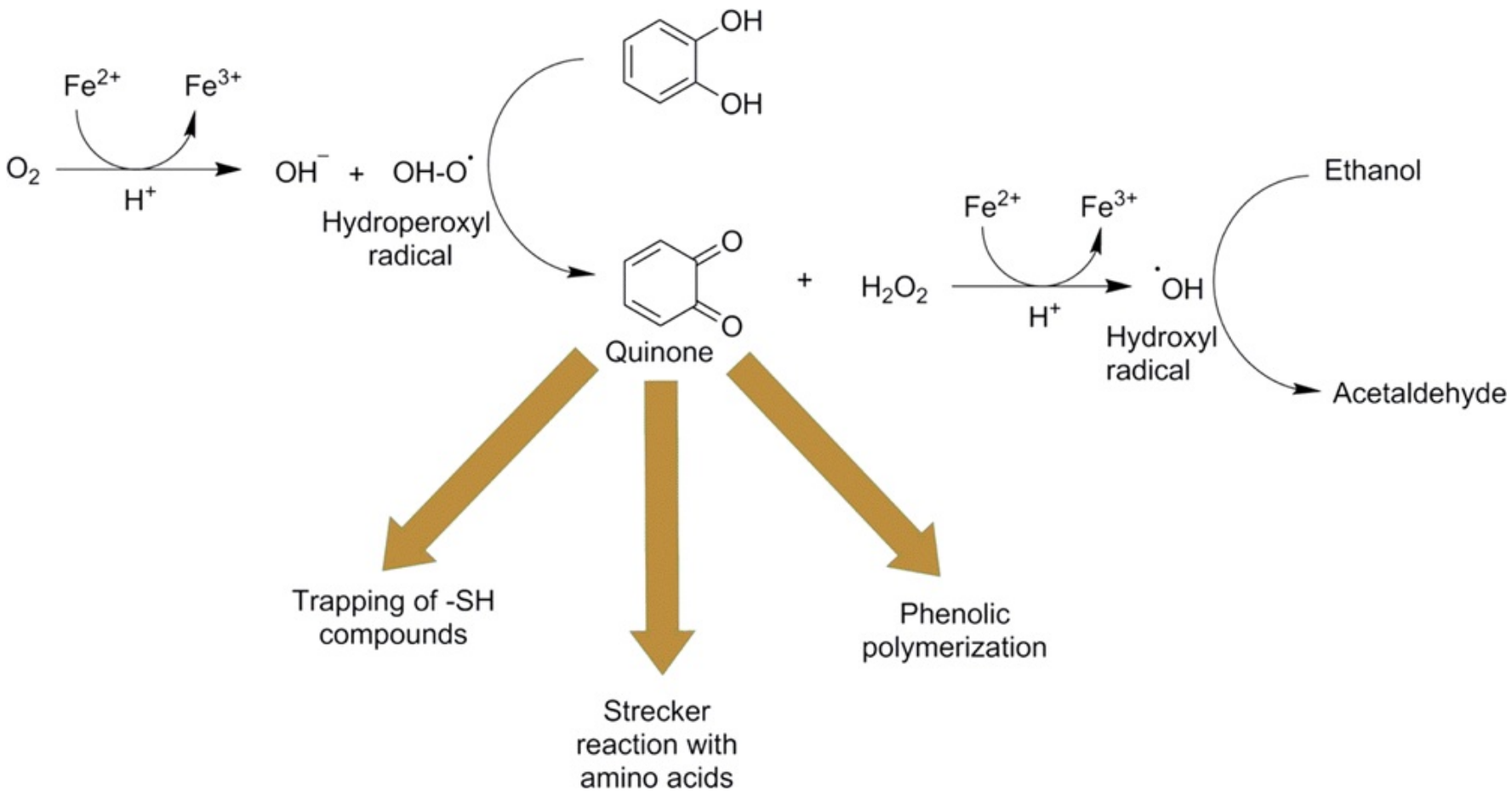


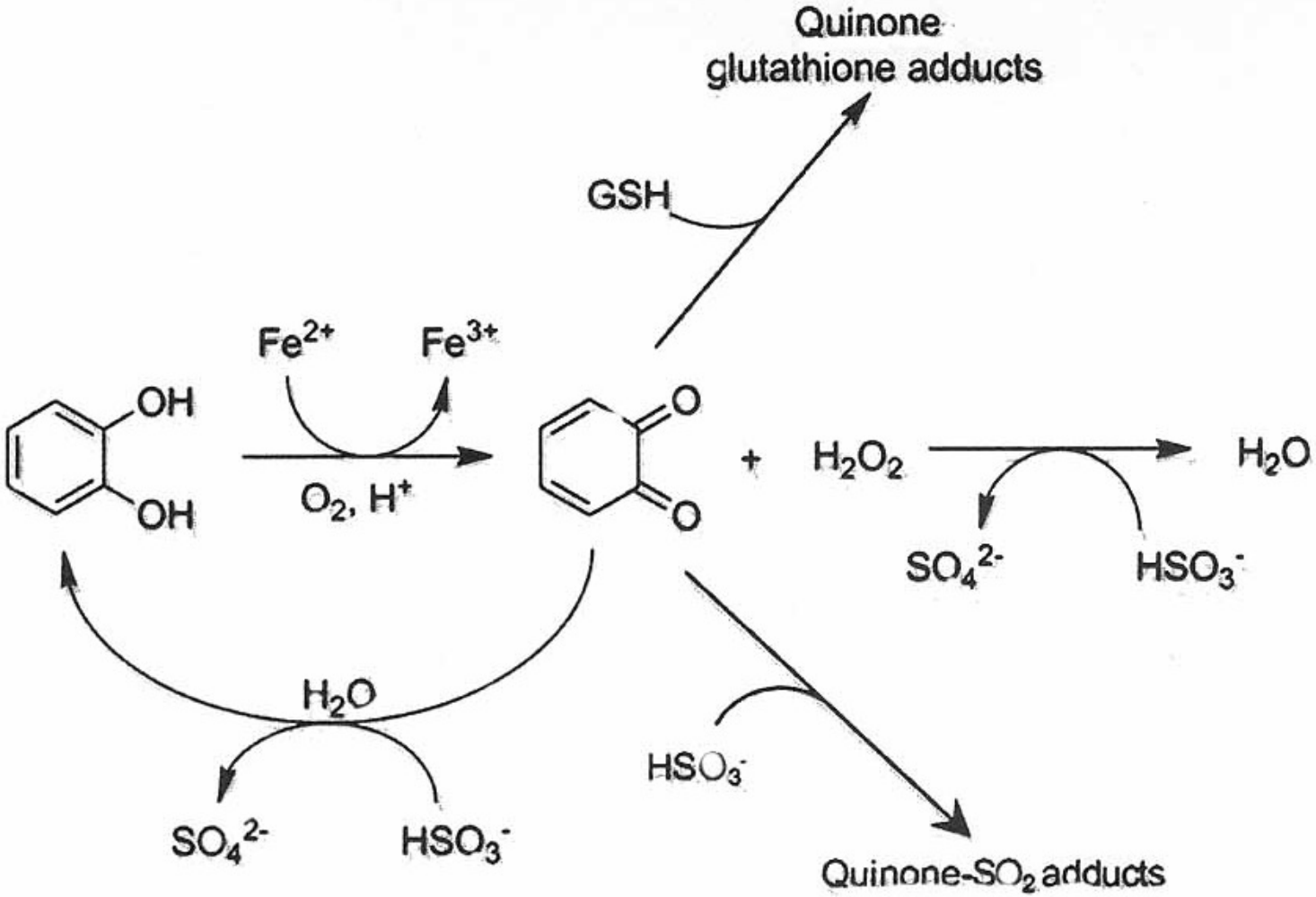
# A few asides re closures






Fe2+
Fe3+
O2
H+
OH−
+
OH-O•
Hydroperoxyl radical
OH
OH
O
O
Quinone
+
H2O2
Fe2+
Fe3+
H+
•OH
Hydroxyl radical
Ethanol
Acetaldehyde
Trapping of -SH compounds
Strecker reaction with amino acids
Phenolic polymerization


Quinone
glutathione adducts
GSH
Fe2+
Fe3+
OH
OH
O2, H+
O
O
+
H2O2
H2O
SO4 2-
HSO3-
H2O
SO4 2-
HSO3-
HSO3-
Quinone-SO2 adducts