

MATTIA IVALDI



WINE AND SCIENCE
A LOVE STORY

DENOMINAZIONE DI ORIGINE
CONTROLLATA E GARANTITA

IMBOTTIGLIATO ALL'ORIGINE DA
MATTIA IVALDI
UNIVERSITA' DEGLI STUDI DI TORINO - ITALIA

CONTIENE SULFITI - CONTAINS SULPHITES - ITALIA L12LCH

Net. Cont. 750 ML E PRODUCT OF ITALY Alc. 13,5 % by Vol.

Outline

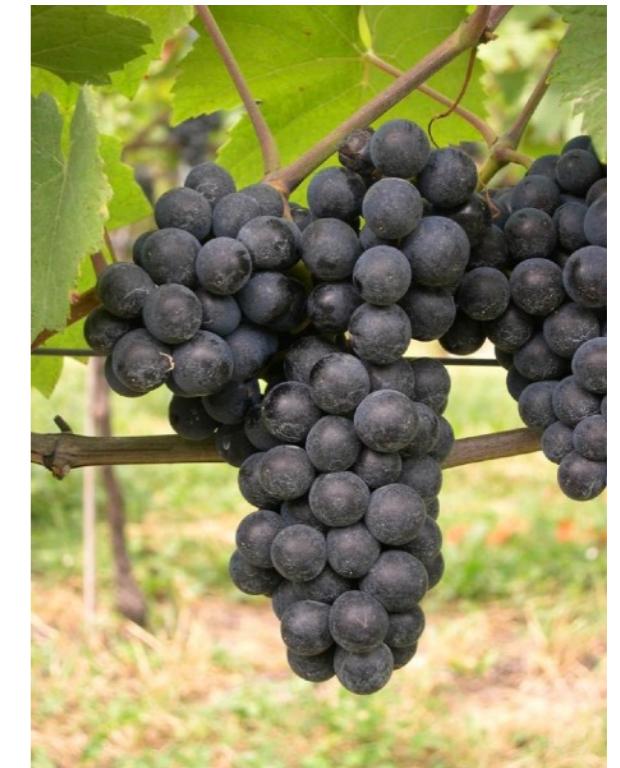
1. Back in the '800

2. Message in a bottle

3. An help from Physics



Vigna Rionda, Serralunga D'Alba (CN), Italy – one of the finest Italian MeGA (cru)



Pinot Noir

Where does the wine come from?

France

Egypt

Georgia

Italy

Where does the wine come from?

France

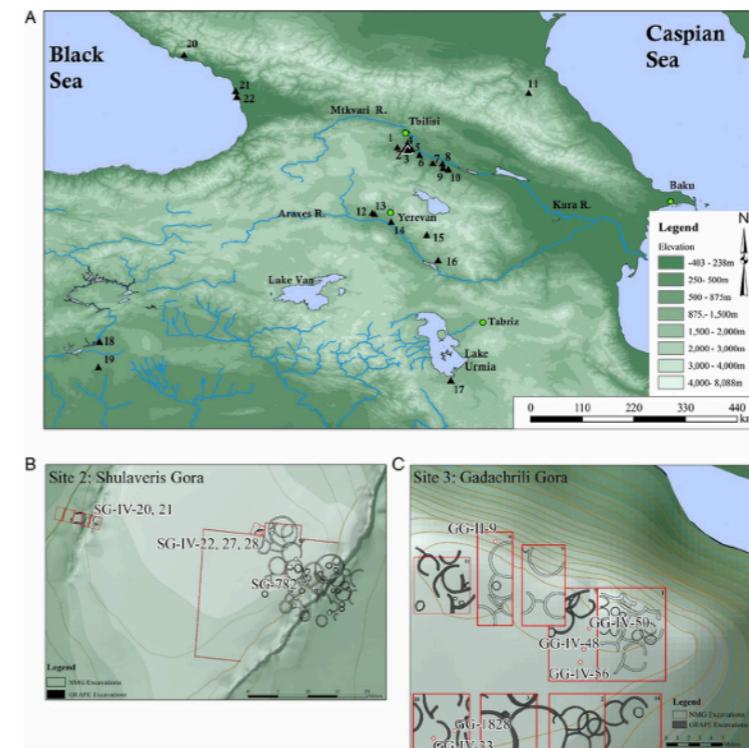
Egypt

Georgia

Italy



McGovern P. et al, Early Neolithic wine of Georgia in the South Caucasus, PNAS November 28, 2017 114 (48) E10309-E10318



Back in the '800

THE
LONDON, EDINBURGH, AND DUBLIN
PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE.

CONDUCTED BY

SIR DAVID BREWSTER, K.H. LL.D. F.R.S.L. & E. &c.
RICHARD TAYLOR, F.L.S. G.S. Astr. S. Nat. H. Mosc. &c.
SIR ROBERT KANE, M.D. M.R.I.A.
WILLIAM FRANCIS, Ph.D. F.L.S. F.R.A.S. F.C.S.
JOHN TYNDALL, Ph.D. F.R.S. &c.

"Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec noster
villor quia ex alienis libamus ut apes." JUST. LIPS. Polit. lib. i. cap. 1. Not.

VOL. X.—FOURTH SERIES.
JULY—DECEMBER, 1855.

L O N D O N .

TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET,
Printers and Publishers to the University of London;
SOLD BY LONGMAN, BROWN, GREEN, AND LONGMANS; SIMPKIN, MARSHALL
AND CO.; WHITTAKER AND CO.; AND PIPER AND CO., LONDON:
—BY ADAM AND CHARLES BLACK, AND THOMAS CLARK,
EDINBURGH; SMITH AND SON, GLASGOW; HODGES
AND SMITH, DUBLIN; AND PUTNAM,
NEW YORK.

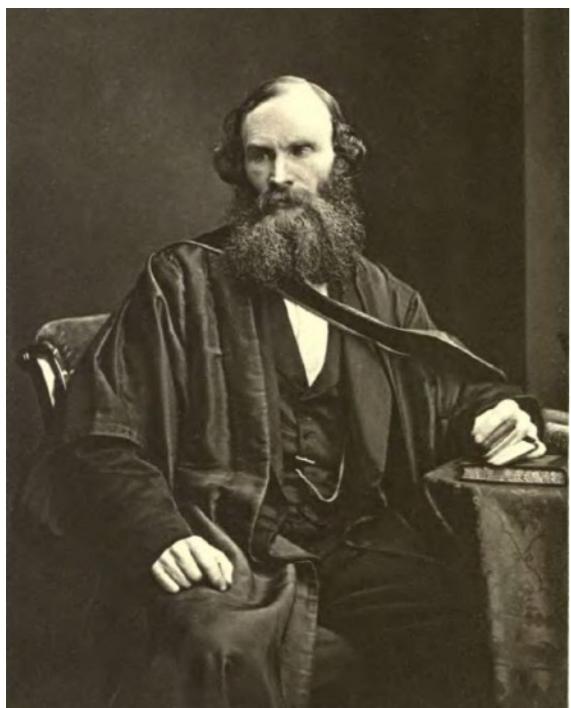
XLII. *On certain curious Motions observable at the Surfaces of
Wine and other Alcoholic Liquors.* By JAMES THOMSON,
A.M., C.E., Belfast*.



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Back in the '800

THE phænomena of capillary attraction in liquids are accounted for, according to the generally received theory of Dr. Young, by the existence of forces equivalent to a tension of the surface of the liquid, uniform in all directions, and independent of the form of the surface. The tensile force is not the same in different liquids. Thus it is found to be much less in alcohol than in water. This fact affords an explanation of several very curious motions observable, under various circumstances, at the surfaces of alcoholic liquors.



James Thomson FRS FRSE LLD

Belfast, 16/02/1822–Glasgow, 08/05/1892

Physicist, engineer, inventor, polymathic scientist.

Fun fact: proposed the triple-point concept.

VIDEO

<https://tinyurl.com/y3wjb6fr>

Back in the '800



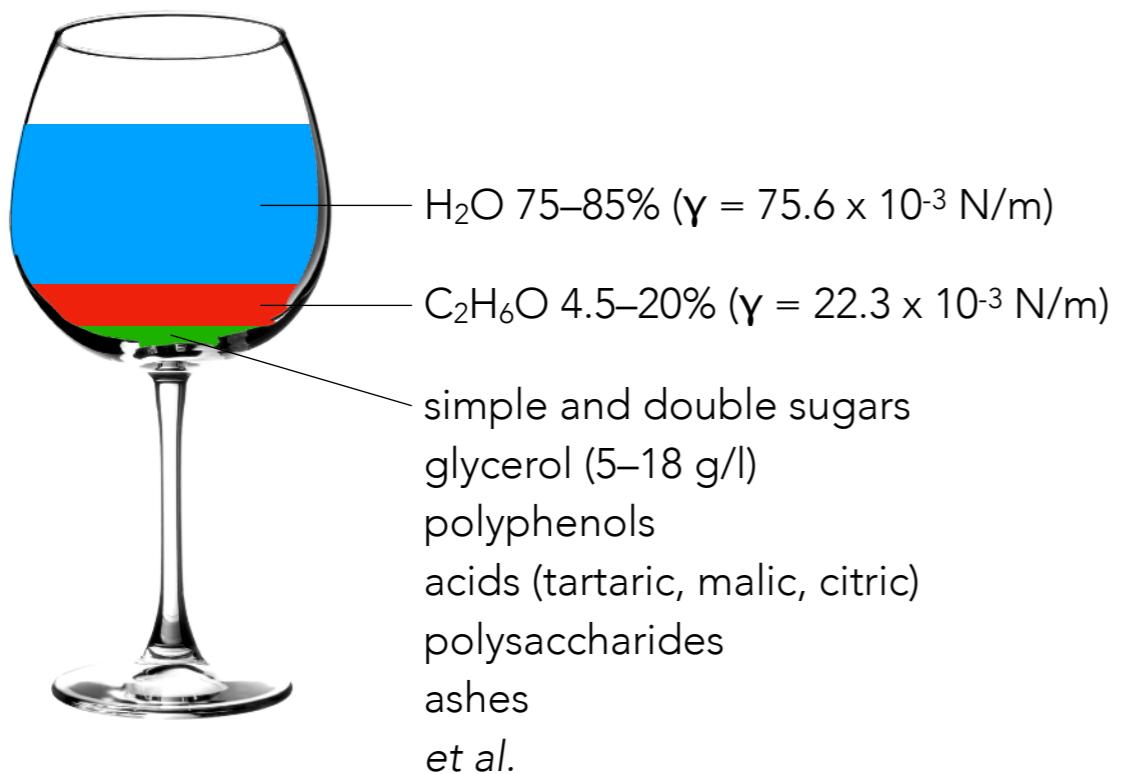
Carlo Marangoni

Pavia, 29/04/1840–Firenze, 14/04/1925

Physicist.

Fun fact: invented a Nefoscopio to observe clouds.

Back in the '800



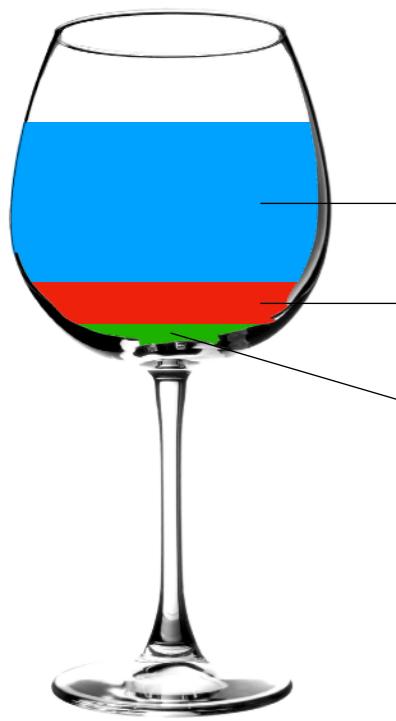
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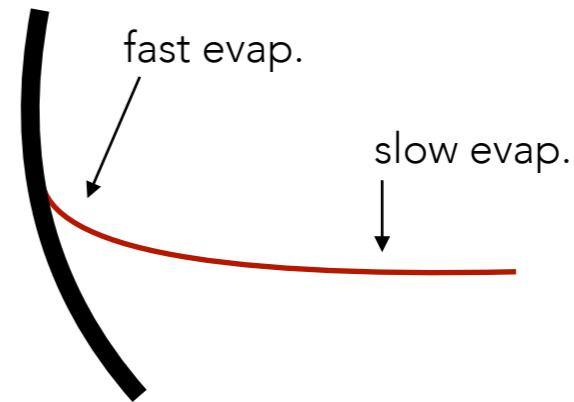
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H_2O 75–85% ($\gamma = 75.6 \times 10^{-3} \text{ N/m}$)
 C_2H_6O 4.5–20% ($\gamma = 22.3 \times 10^{-3} \text{ N/m}$)
simple and double sugars
glycerol (5–18 g/l)
polyphenols
acids (tartaric, malic, citric)
polysaccharides
ashes
et al.



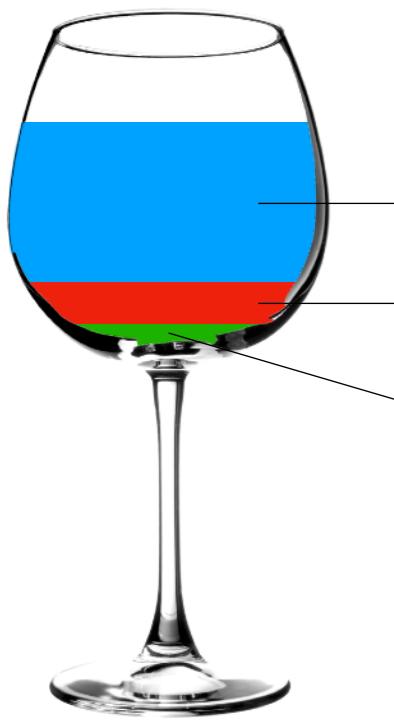
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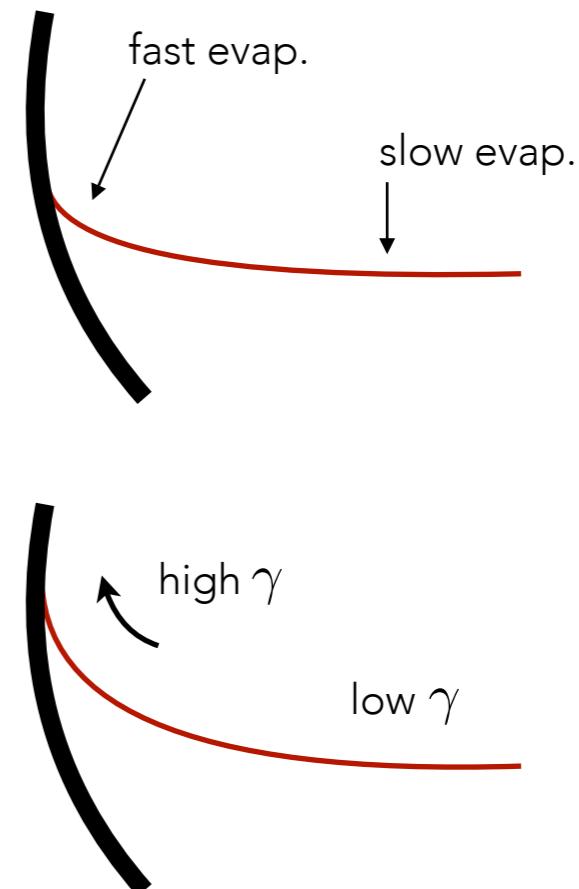
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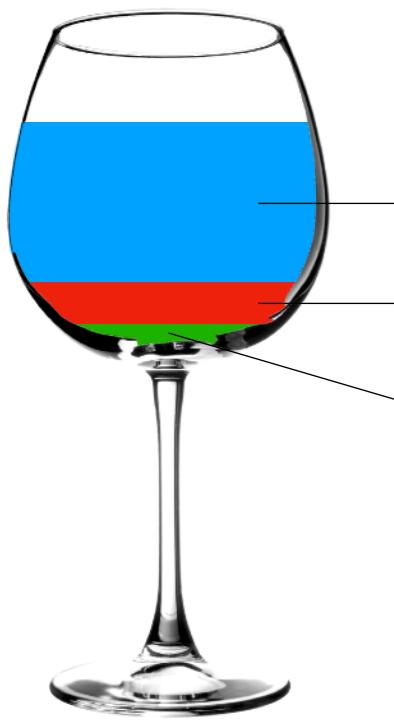
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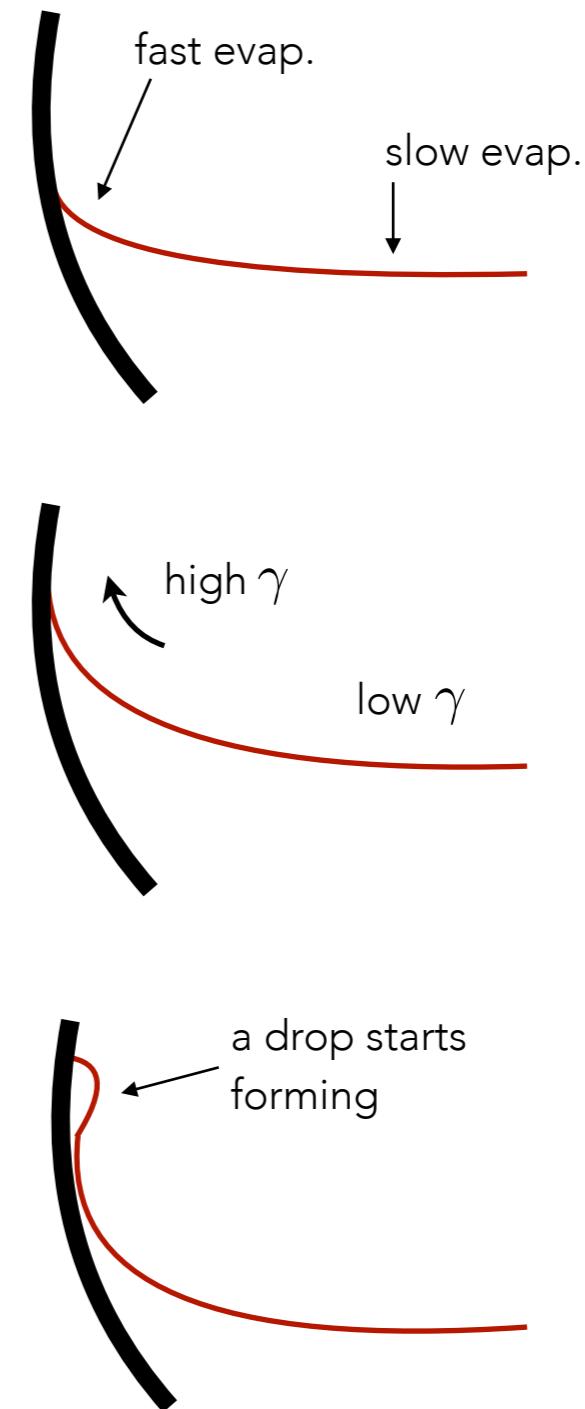


Carlo Marangoni

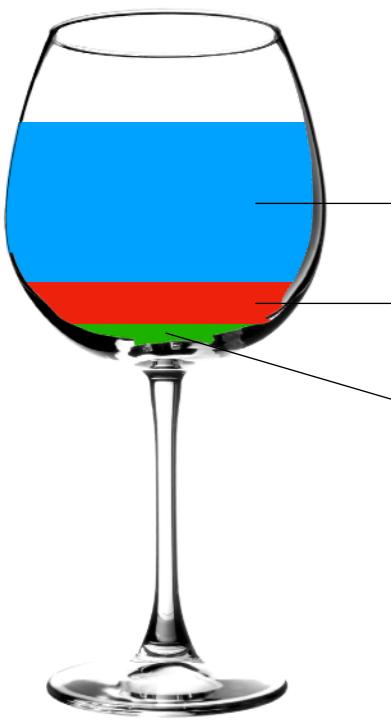
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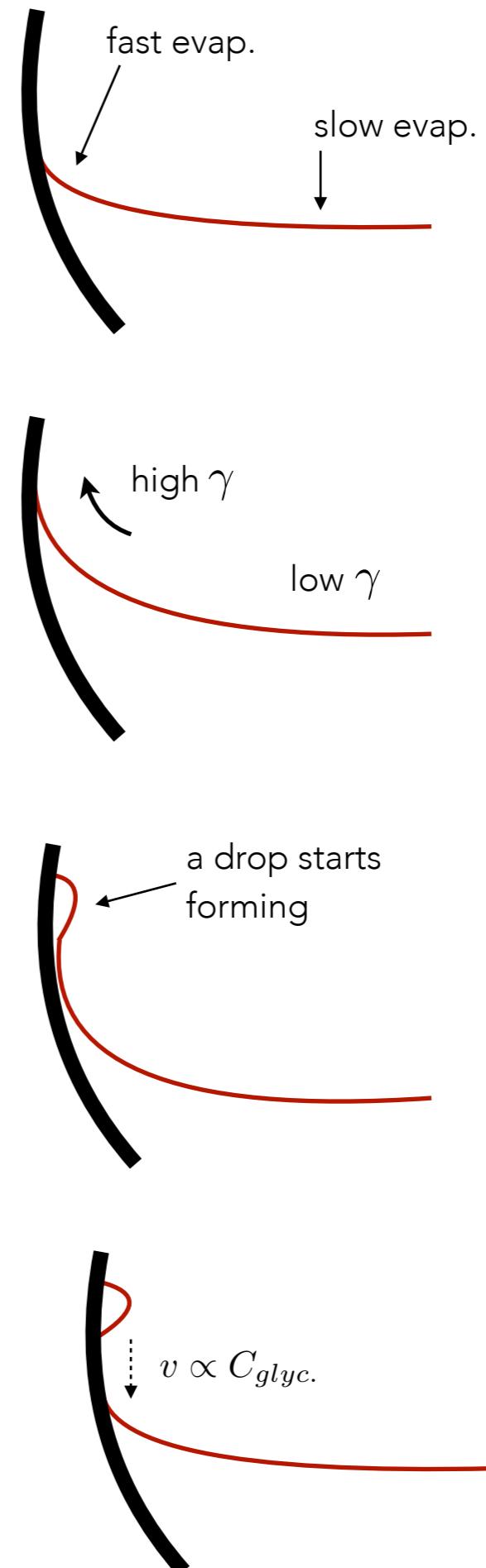


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How old is the oldest still-drinkable Champagne?

179 y

194 y

113 y

54 y

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179 y

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"heavily oxidised, with a sherry-like character, notes of truffles, caramel and mushrooms, complex flavour of figs and even a slight nose of sea"



Message in a bottle



Landskapet Åland (Island of perch)

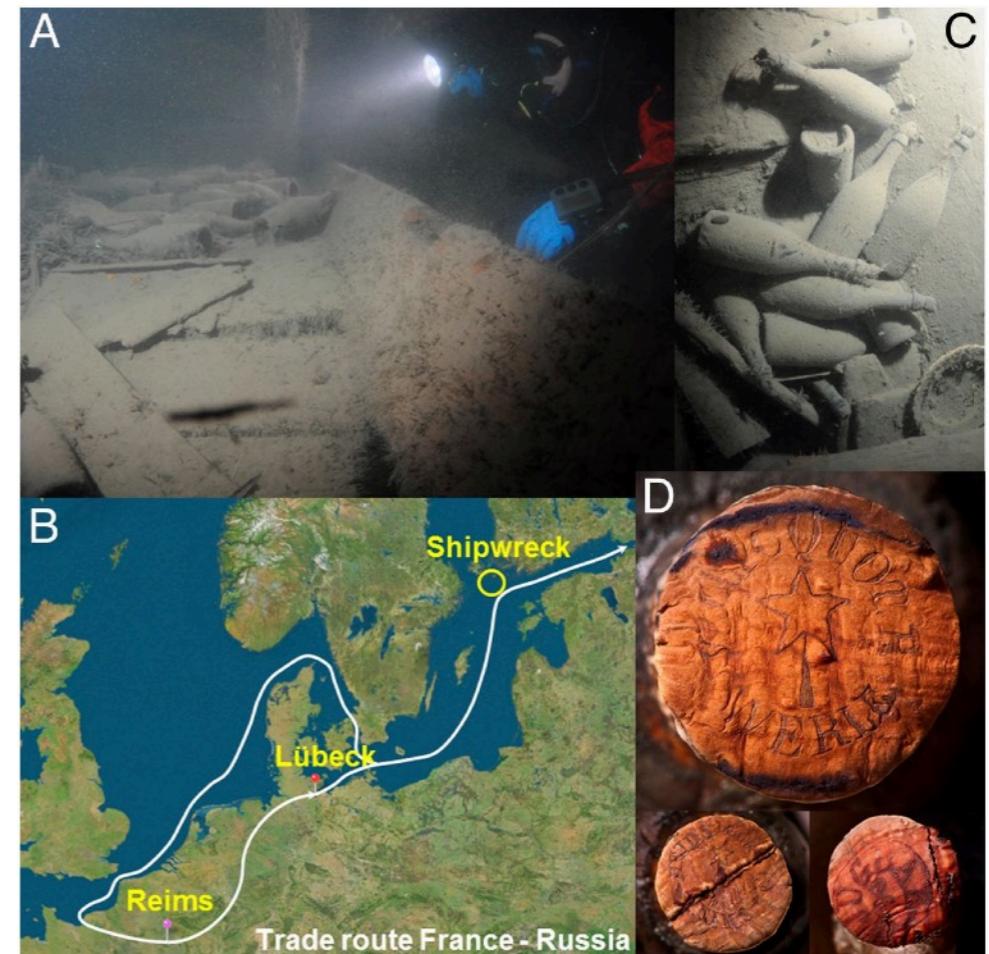
6500+ islands and cliffs

Population 29489 (2017)

Message in a bottle



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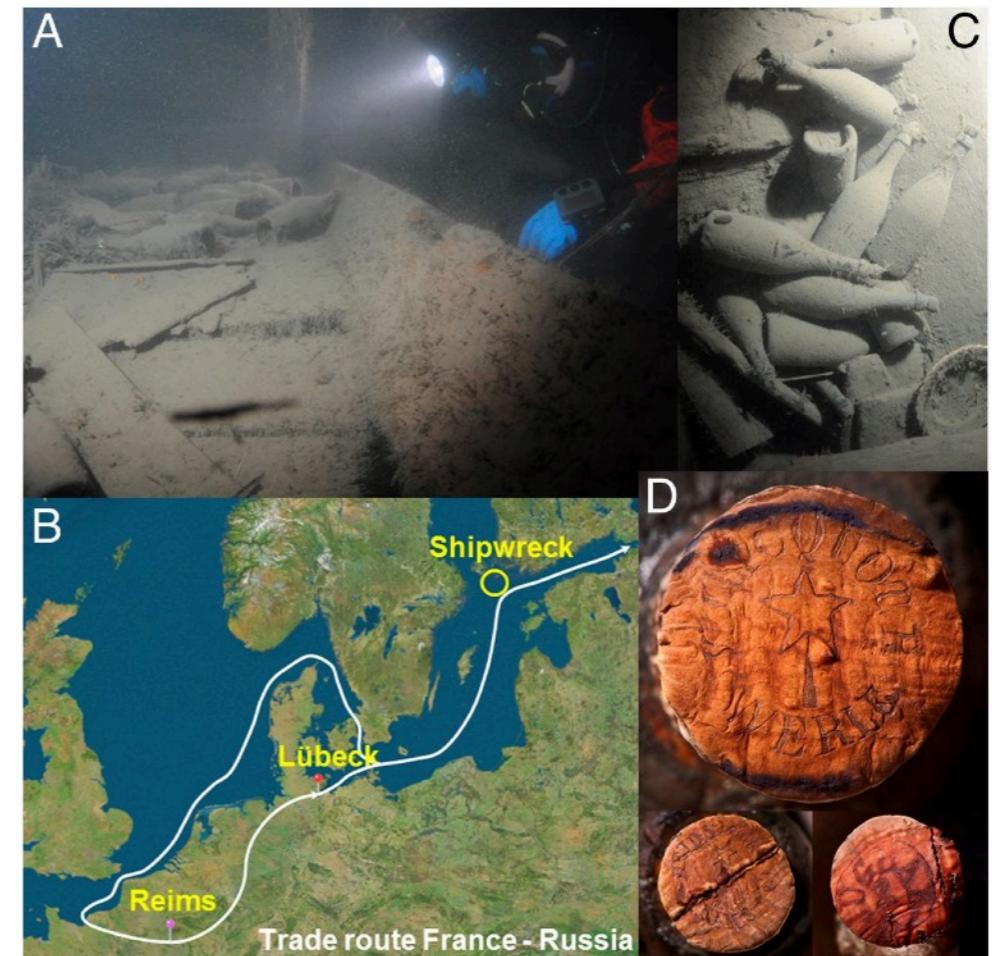


Jeandet P. et al, Chemical messages in 170-year-old champagne bottles from the Baltic Sea: Revealing tastes from the past, PNAS May 12, 2015 112 (19) 5893-5898

Message in a bottle



Landskapet Åland (Island of perch)
6500+ islands and cliffs
Population 29489 (2017)



Close-to-perfect slow-aging conditions:

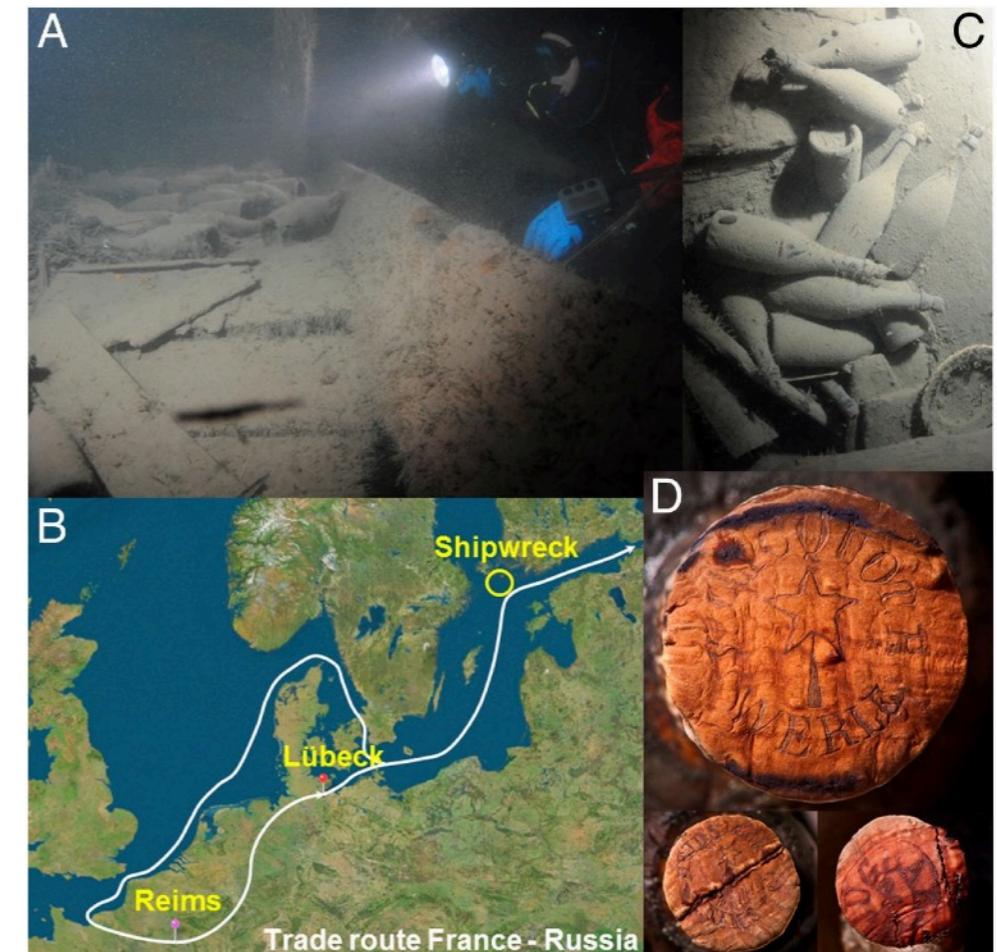
- ▶ total darkness;
- ▶ fairly constant temperature (2–4 °C);
- ▶ low salinity (<10 g/kg NaCl).

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Close-to-perfect slow-aging conditions:

- ▶ total darkness;
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- ▶ low salinity (<10 g/kg NaCl).

- ★ When were these wines produced?
- ★ What winemaking processes were in use at the time?
- ★ Were they traveling on a regular trade route?
- ★ What was their final destination?

Jeandet P. et al, Chemical messages in 170-year-old champagne bottles from the Baltic Sea: Revealing tastes from the past, PNAS May 12, 2015 112 (19) 5893-5898

Message in a bottle



3x

3x

Jeandet P. et al, Chemical messages in 170-year-old champagne bottles from the Baltic Sea: Revealing tastes from the past, PNAS May 12, 2015 112 (19) 5893-5898

Message in a bottle



What was the final destination?

- ▶ extraordinary high sugar content ($> 140 \text{ g/l}$) wrt current liqueur d'expédition dosage (0–50 g/l)

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Message in a bottle



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3x



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Message in a bottle



vs



3x

3x



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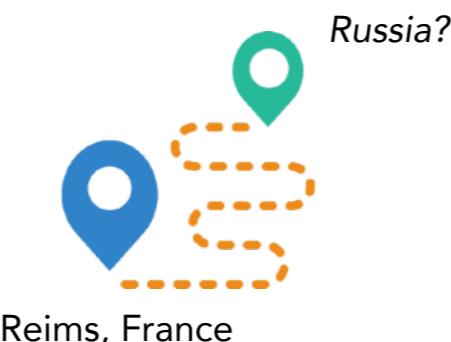
The *Champagne à la Russe* had a sugar dosage of 300 g/l!

Here they always have some sugar on any table close to their wine glass, for they add sugar not only to red wine but also to champagne.

Veuve Clicquot Archives (1810–1840) Correspondence exchanged by Madame Clicquot with Louis Bohne and Louis Boissonnet, 1810s–1840s (Veuve Clicquot Archives, Reims, France)

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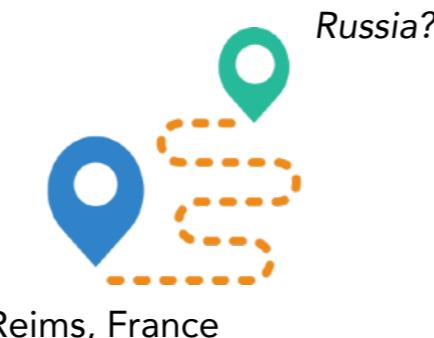
Levels of 150 g/l were desired by the French and German markets—the bottles might have been intended for the Germanic Confederation.

What winemaking processes were in use at that time?

- ▶ unusually high metallic cation concentration (Fe 13–118 mg/l, Cu 100–1400 µg/l) wrt to modern Champagne (Fe 1–4.6 mg/l, Cu 27–78 µg/l): higher use of the taille, Cu sulfate already used despite the first traces of buillie bordelaise (1880s);
- ▶ high malic acid contents (malic/lactic acid ratio 0.46–0.81): malolactic fermentation was left uncontrolled, and was occurring either in barrels at the beginning of spring or in the bottle;
- ▶ et al.

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Message in a bottle



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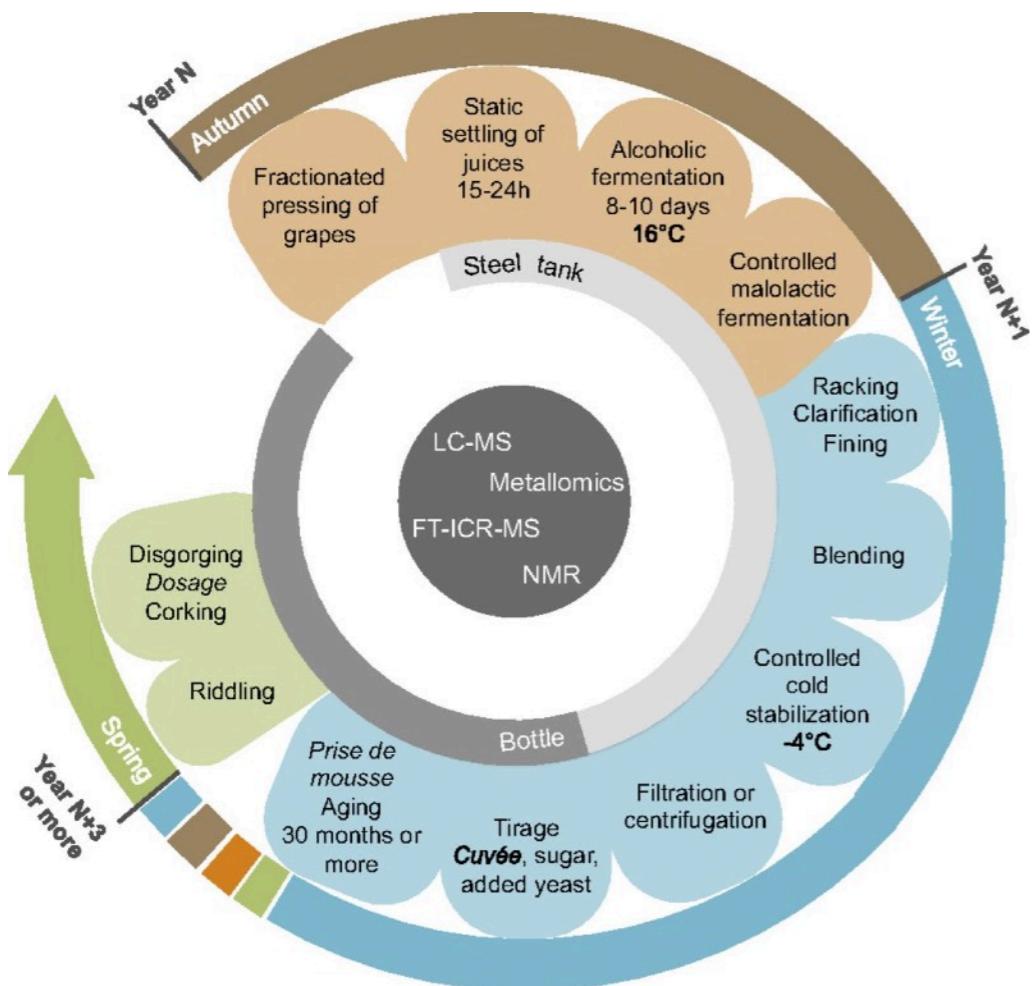
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What is the flavour of the Baltic Champagne?

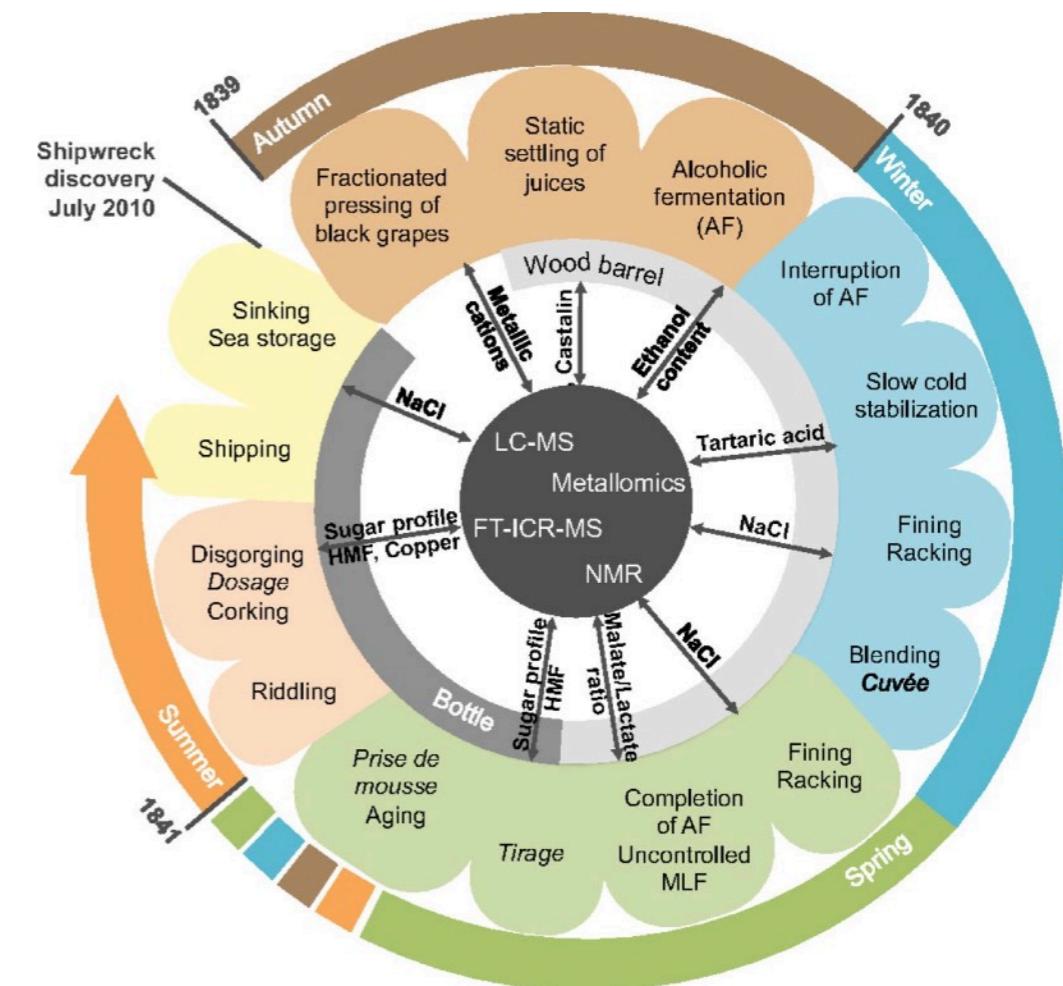
- ▶ animal and empyreumatic notes from volatile phenols, *Brettanomyces*, and *Saccharomyces cerevisiae*;
- ▶ reduction and wet hair from light sulfurous compounds;
- ▶ cheesy from butanoic and octanoic acids;
- ▶ upon swirling: grilled, spicy, smoky, leathery, fruity and floral notes

Jeandet P. et al, Chemical messages in 170-year-old champagne bottles from the Baltic Sea: Revealing tastes from the past, PNAS May 12, 2015 112 (19) 5893-5898

Message in a bottle



Modern Champagne-making process



Putative Champagne-making process at the beginning of the 19th century.

Jeandet P. et al, Chemical messages in 170-year-old champagne bottles from the Baltic Sea: Revealing tastes from the past, PNAS May 12, 2015 112 (19) 5893-5898

How much does the most expensive wine cost?

368 k\$

558 k\$

250 k\$

2.1 M\$

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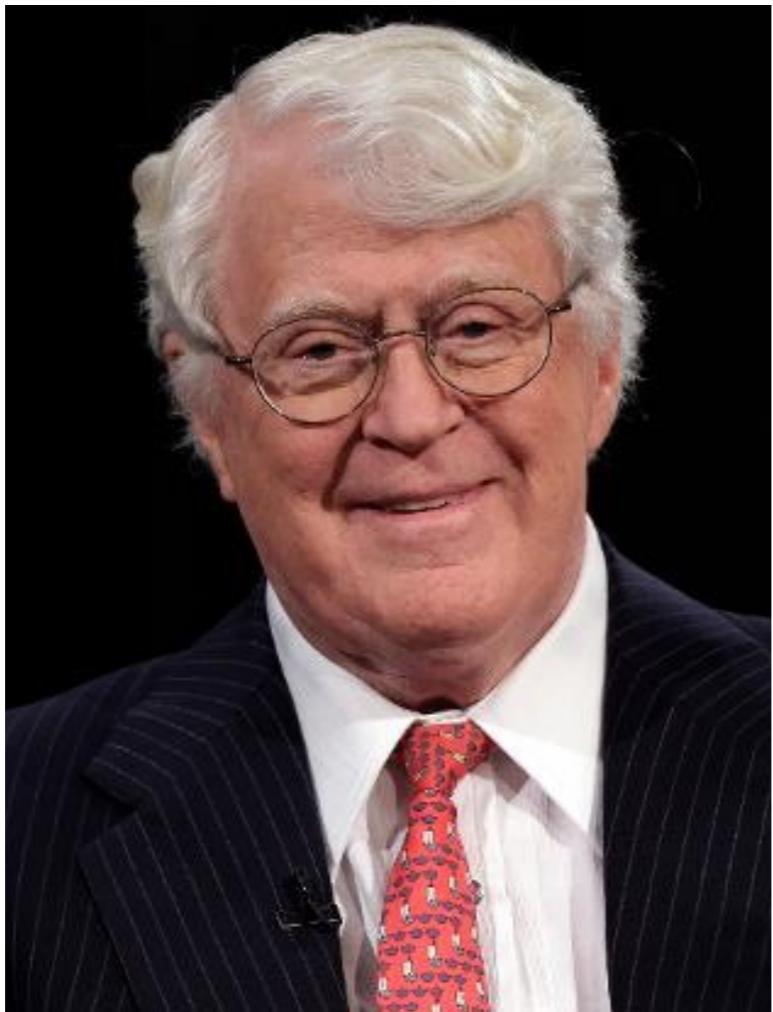
Romanée Conti Vigne Originelle Française Non Reconstituée 1945
Domaine de la Romanée-Conti

An help from Physics

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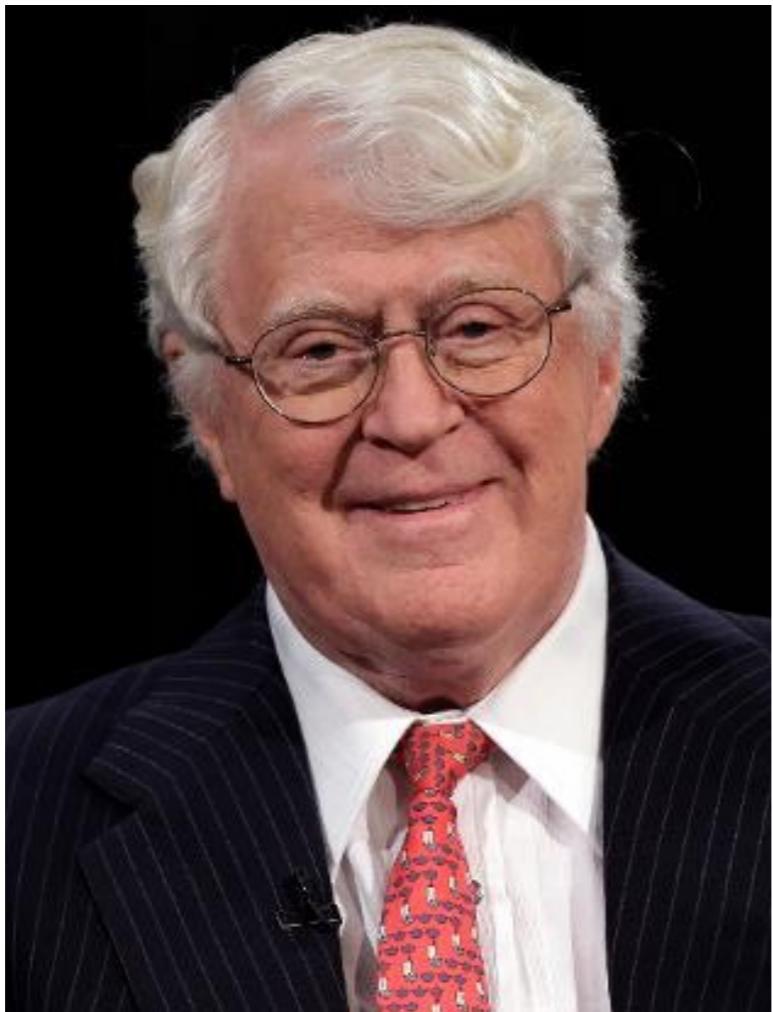
An help from Physics



William (Bill) Koch
Businessman, sailor, collector.
1.8 G\$ net worth



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500 k\$

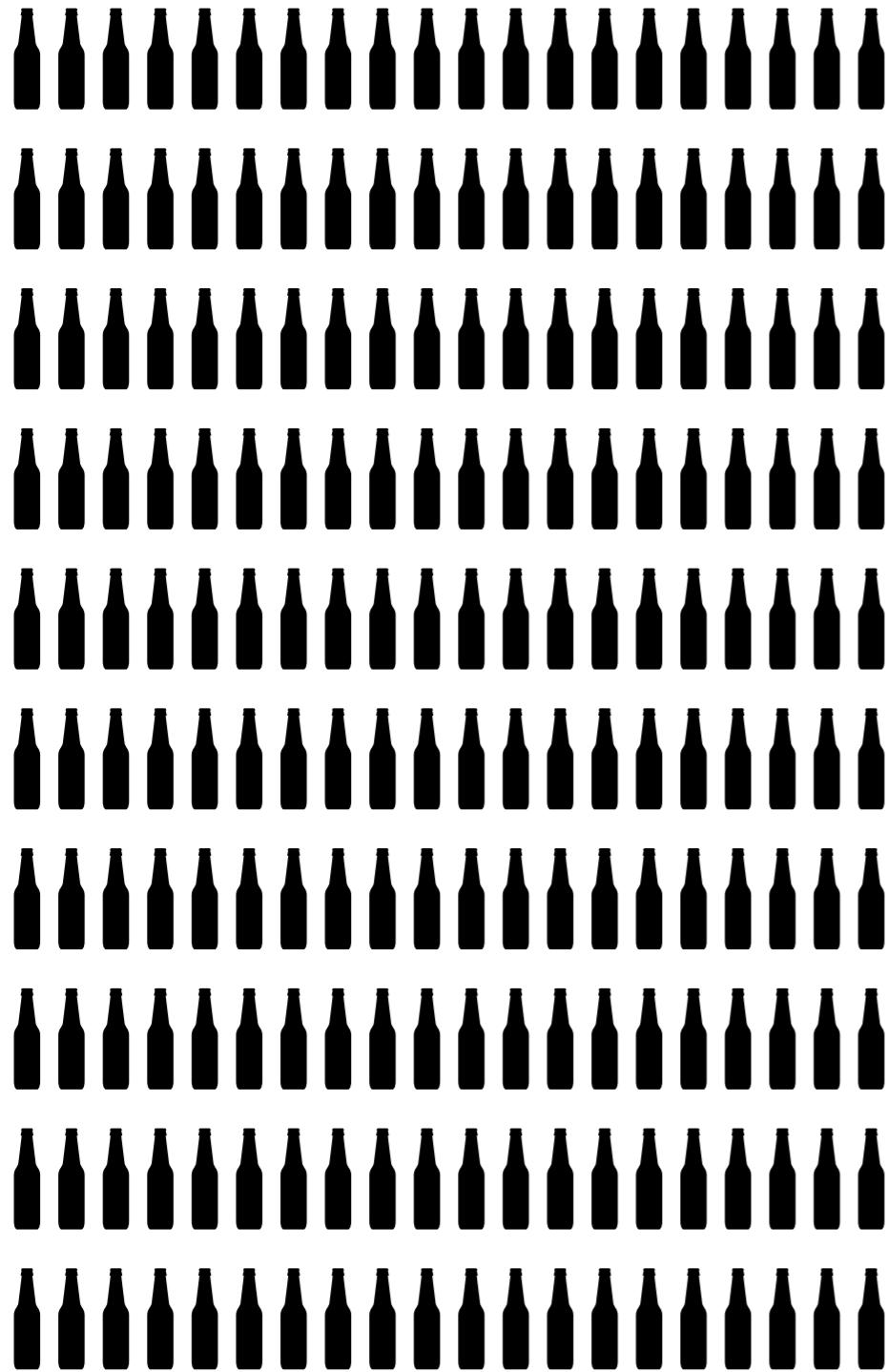
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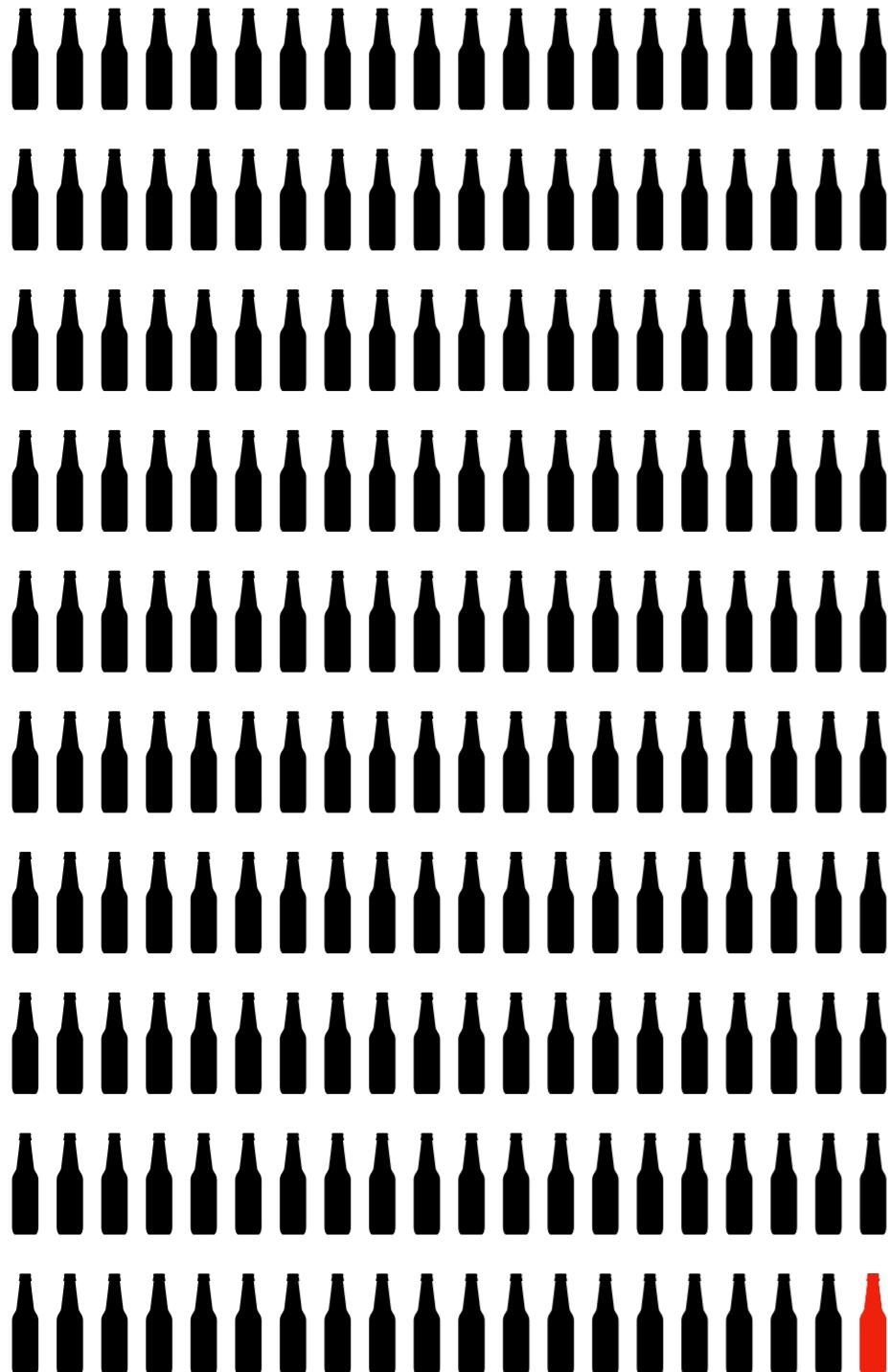
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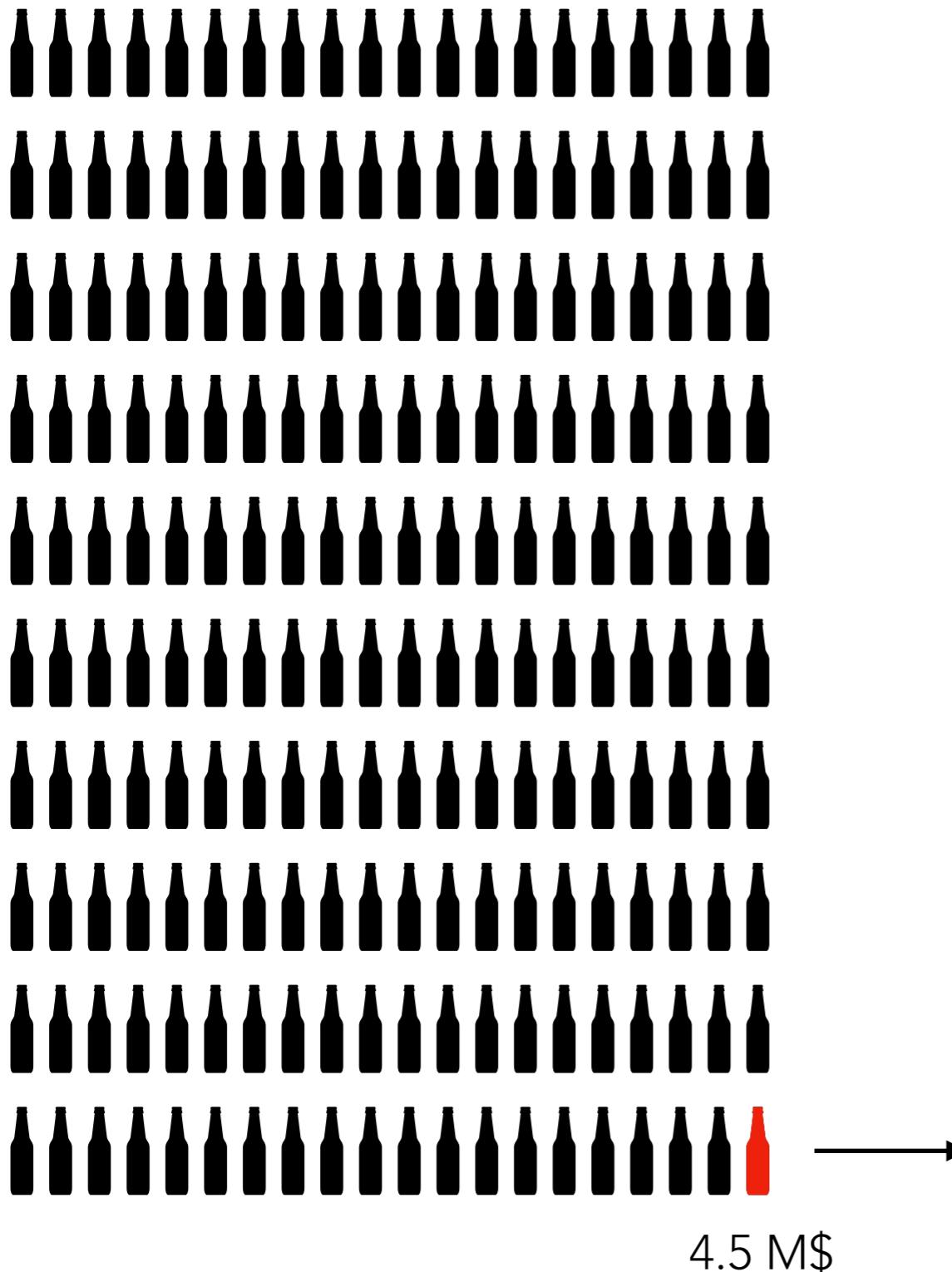
400/43000



4.5 M\$

An help from Physics

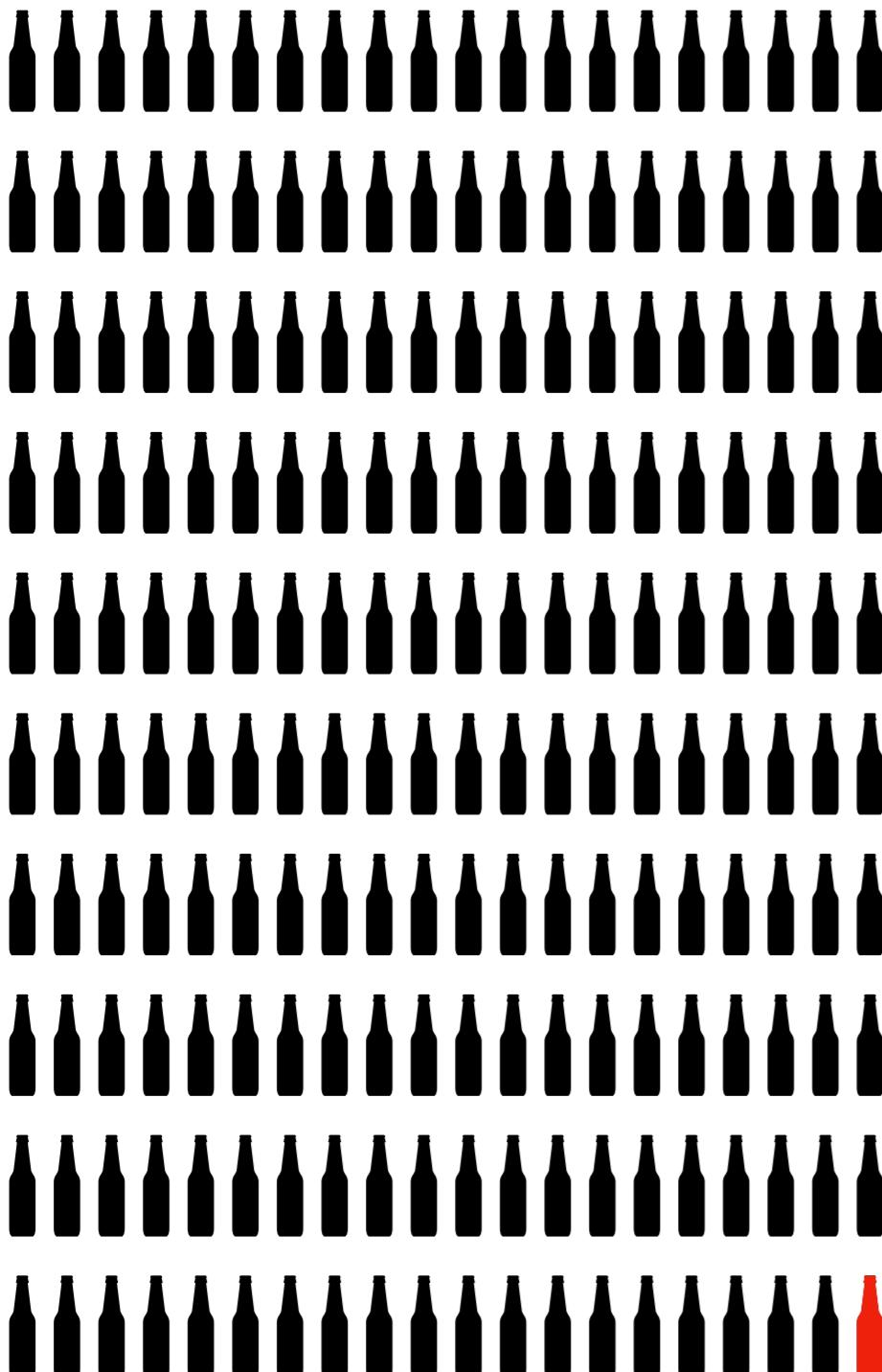
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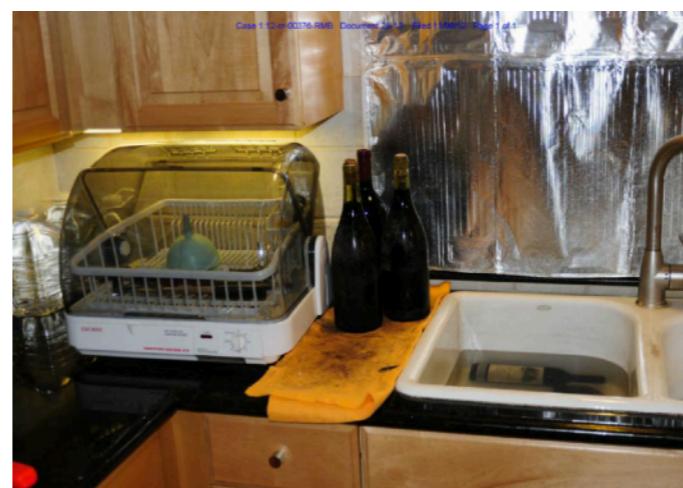
Rudy Kurniawan (Zhen Wang Huang)
Wine collector, crook.
Earliest possible release date 09/01/2021

An help from Physics

400/43000

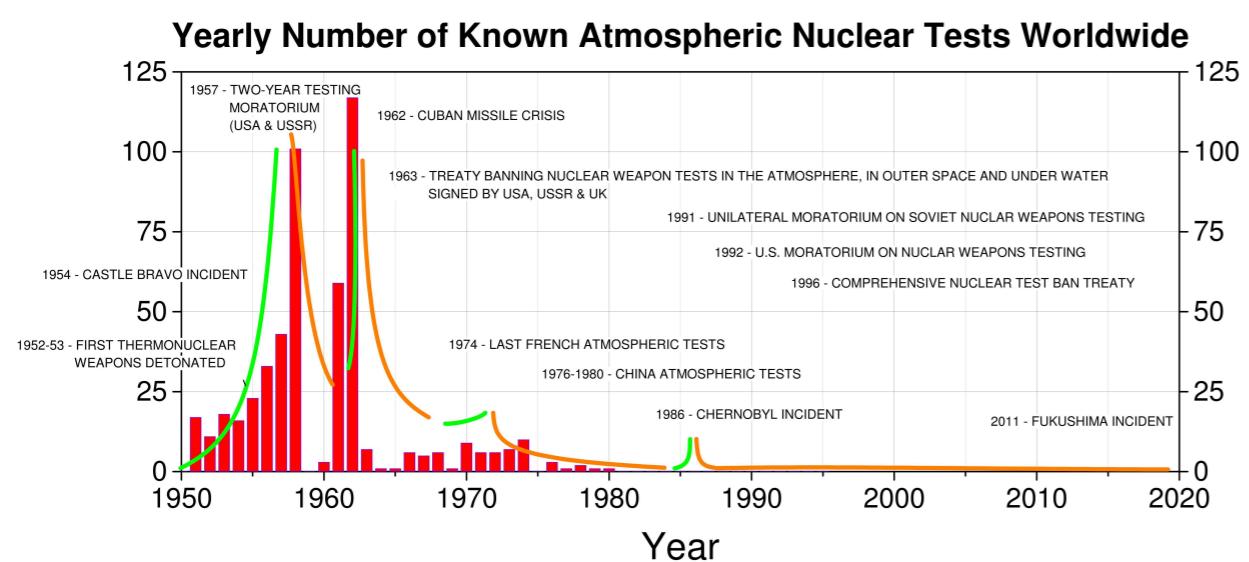


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S. Pravikoff, Michael & Marquet, Christine & Hubert, Philippe.
(2018). Dating of wines with cesium-137: Fukushima's imprint.

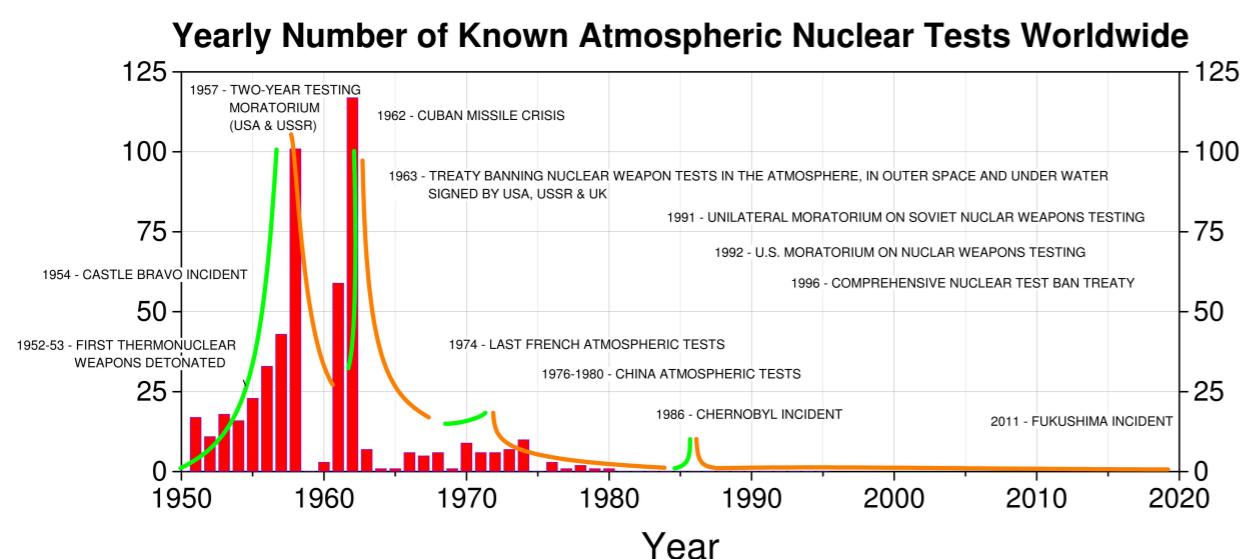
P. Hubert, F. Hubert, V. Raffestin-Tort. La datation des vins; une application des mesures des très faibles radioactivités. Bulletin de l'Union des Physiciens 862 (2004) p. 381.

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1954 W. F. Libby proposes the radiometric dating of wine using ^{3}H

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2001 P. Hubert et al. develop the ^{137}Cs dating



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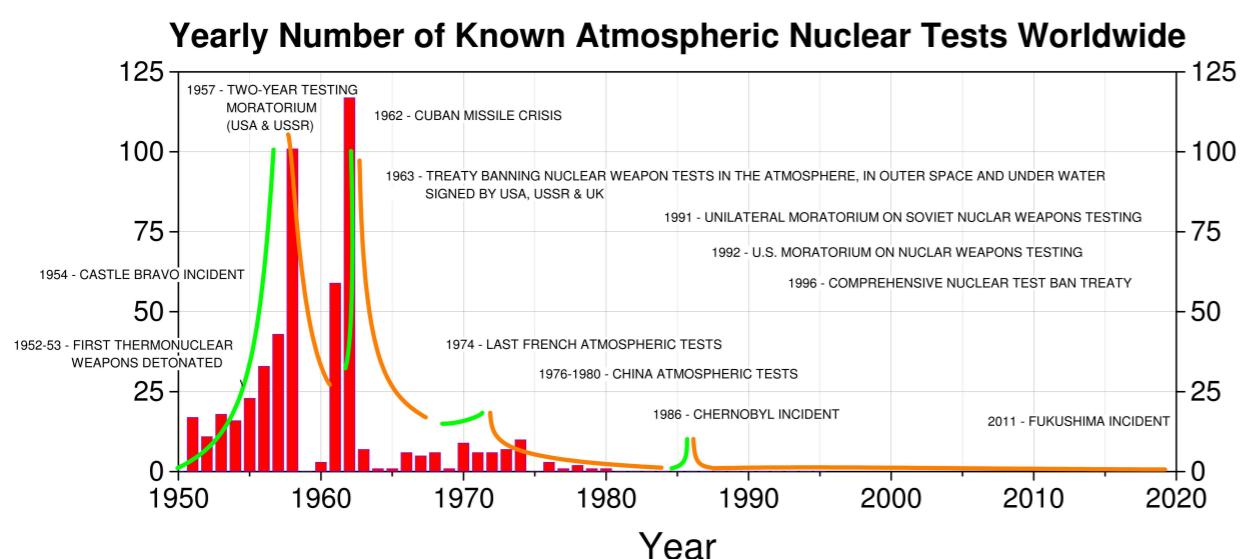
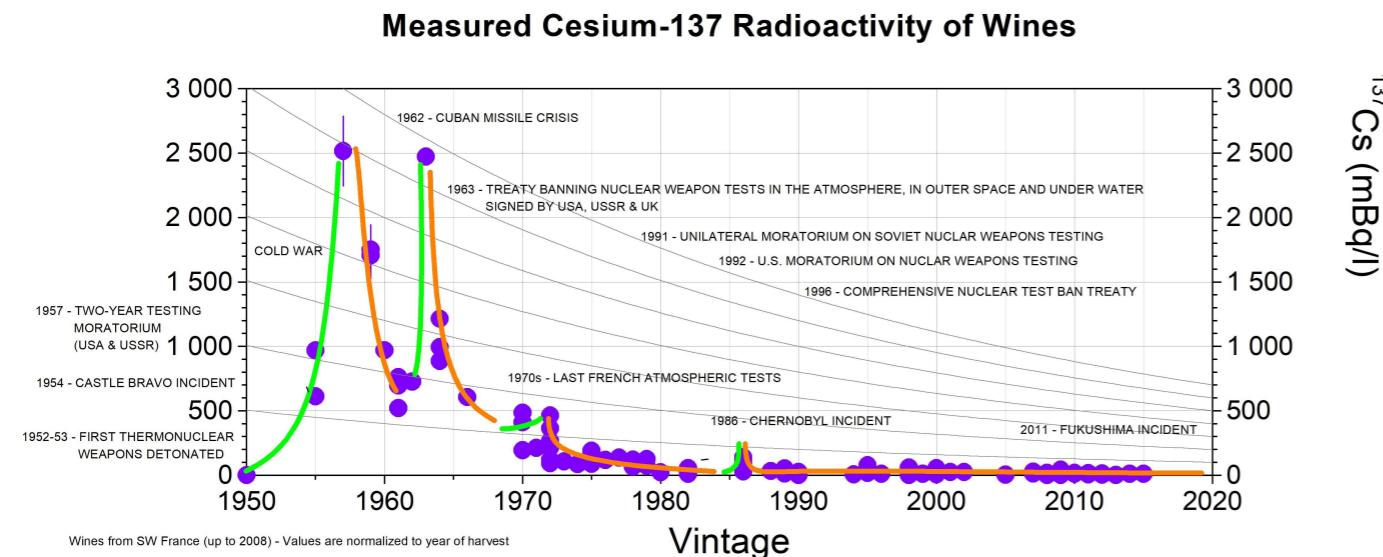
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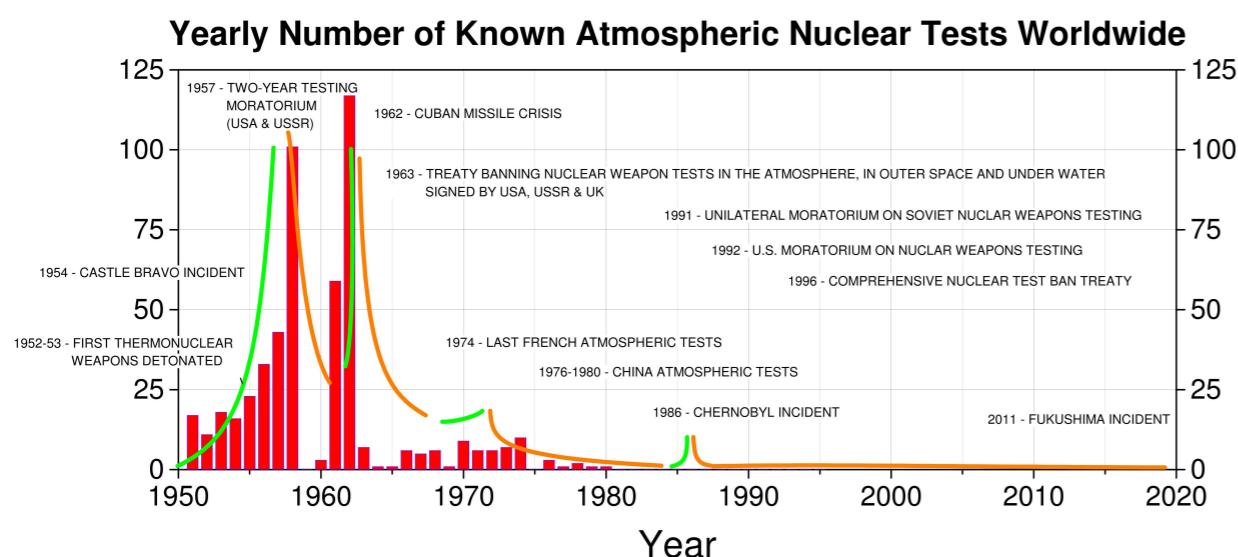
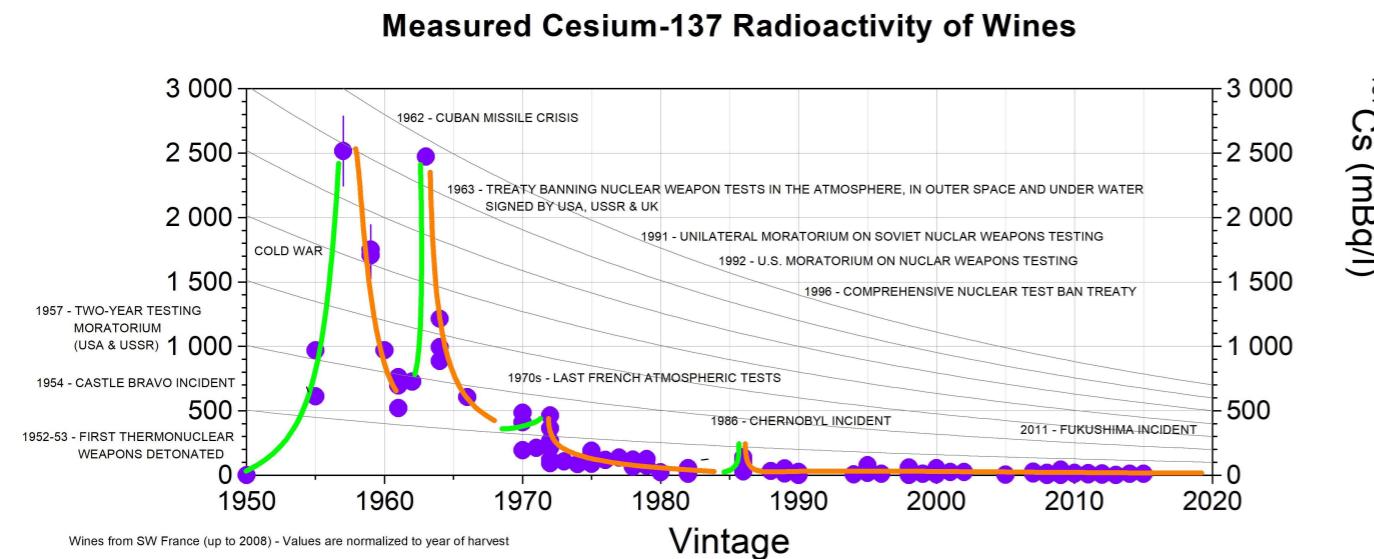
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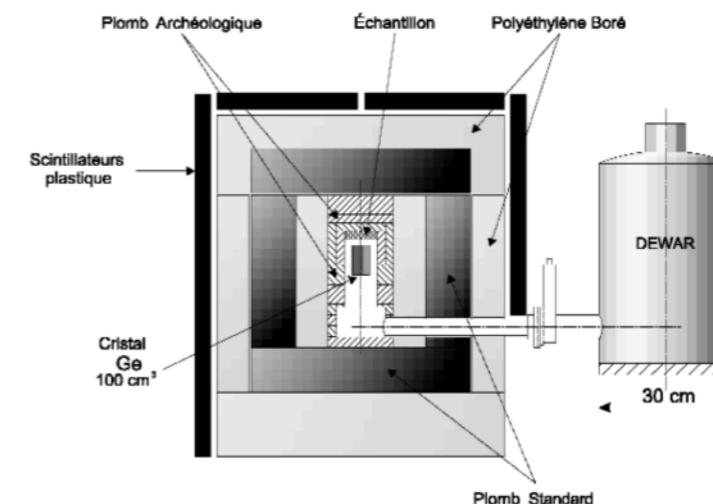
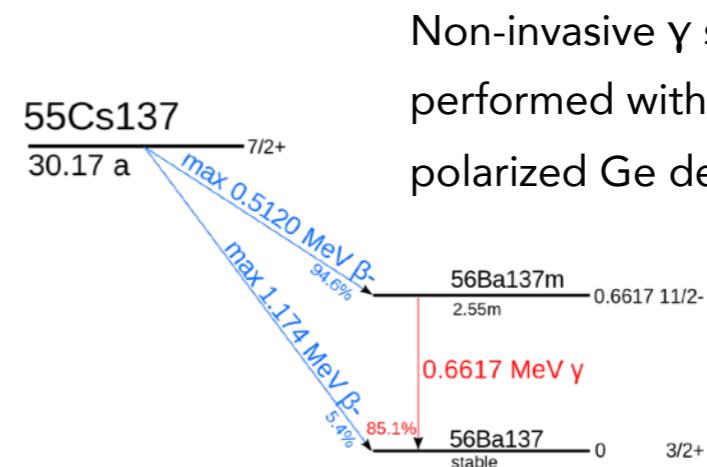
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Sensitivity down to 0.01 Bq/l!

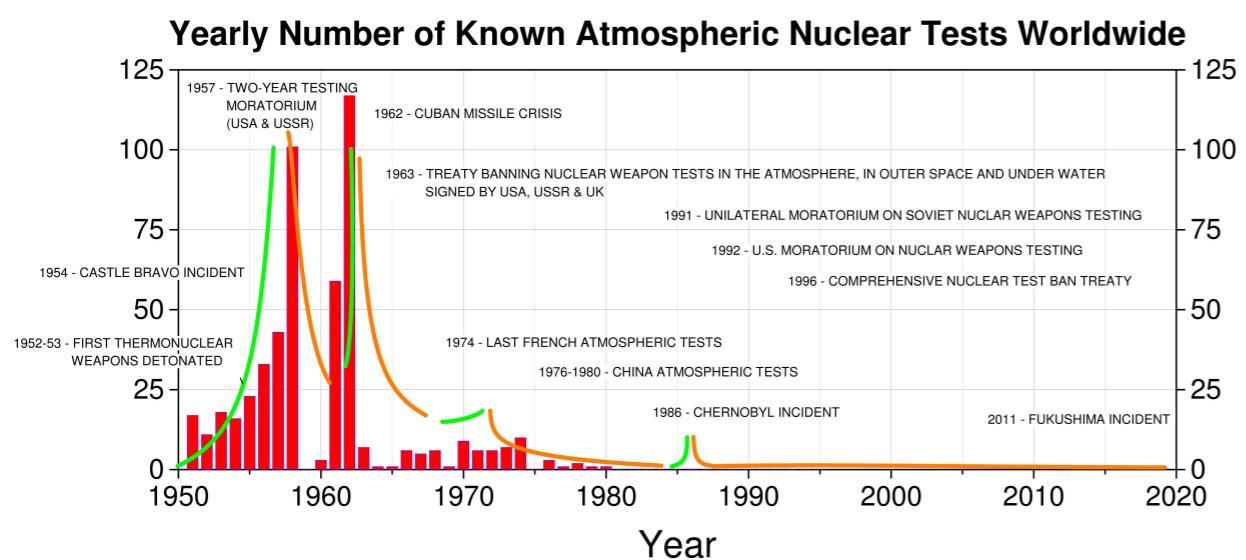
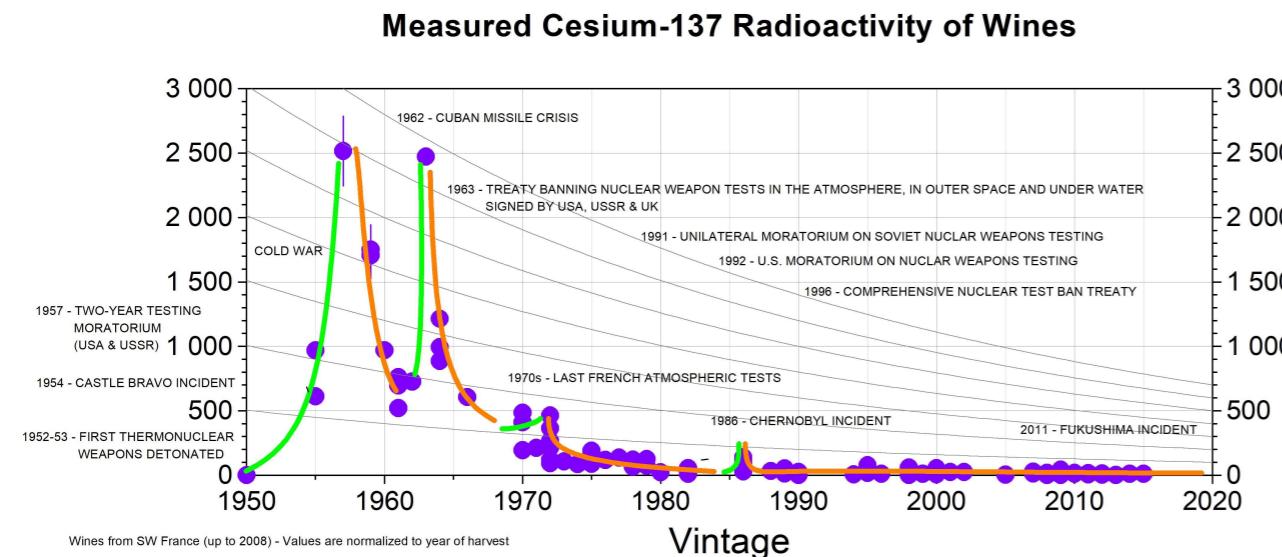
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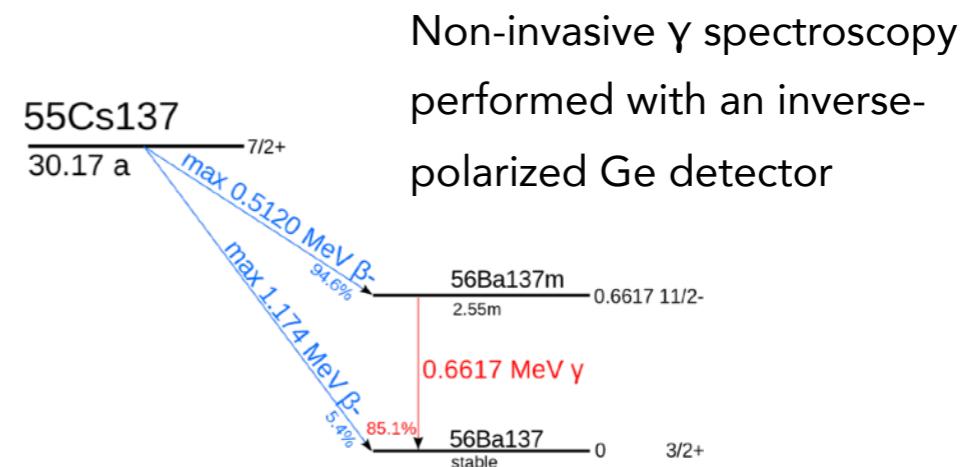
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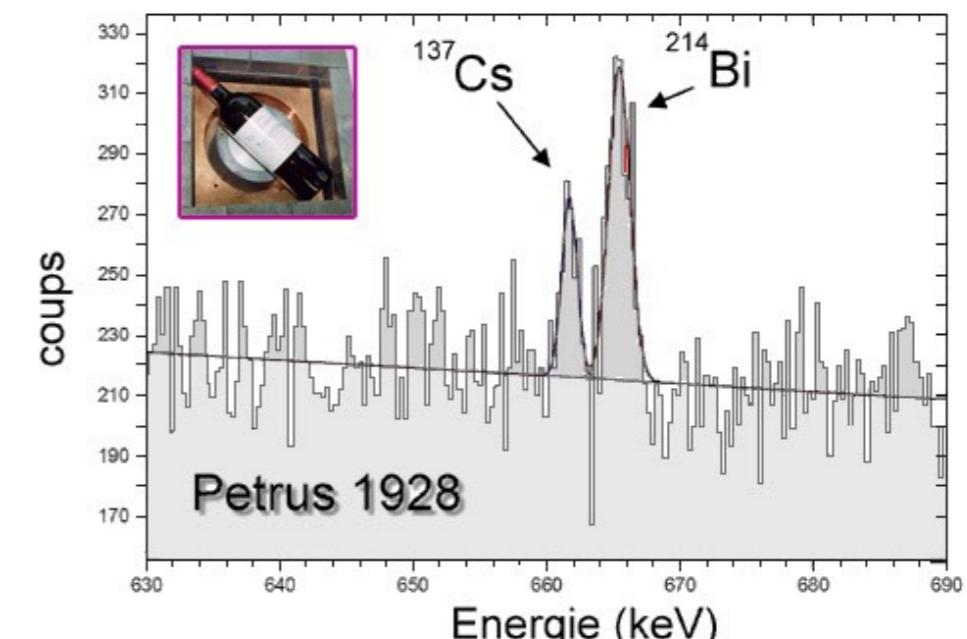


S. Pravikoff, Michael & Marquet, Christine & Hubert, Philippe.

(2018). Dating of wines with cesium-137: Fukushima's imprint.



Sensitivity down to 0.01 Bq/l!



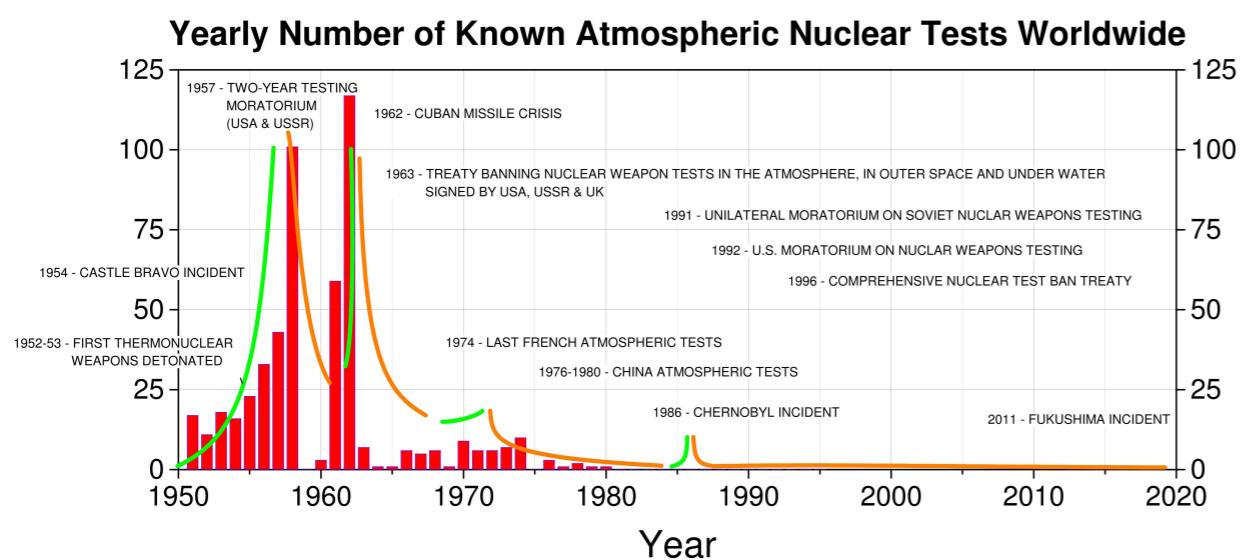
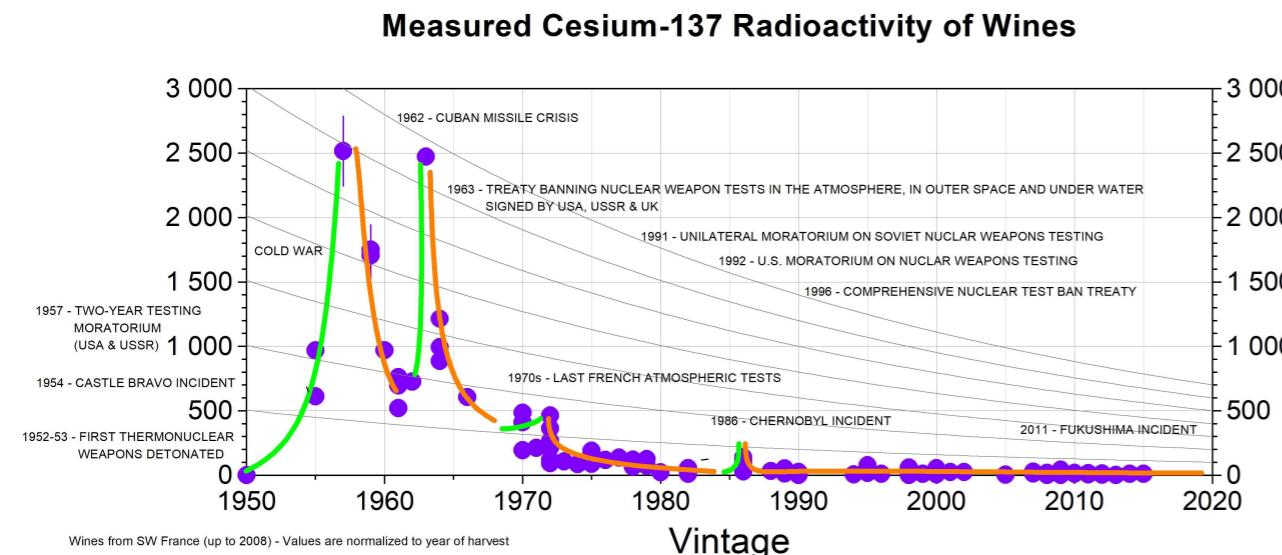
P. Hubert, F. Hubert, V. Raffestin-Tort. La datation des vins; une application des mesures des très faibles radioactivités. Bulletin de l'Union des Physiciens 862 (2004) p. 381.

An help from Physics

1954 W. F. Libby proposes the radiometric dating of wine using ^{3}H

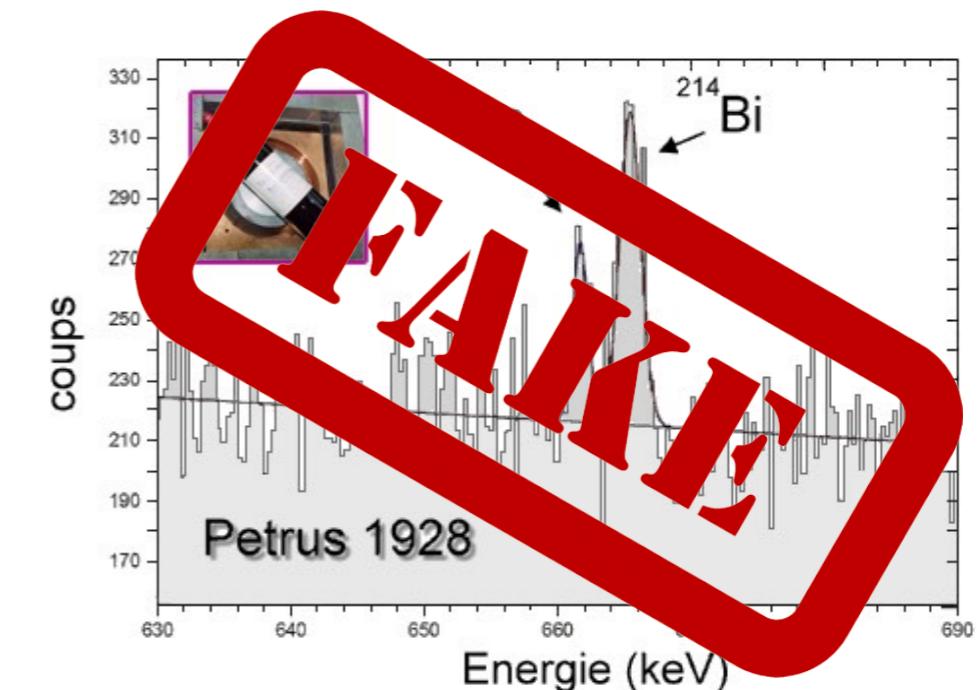
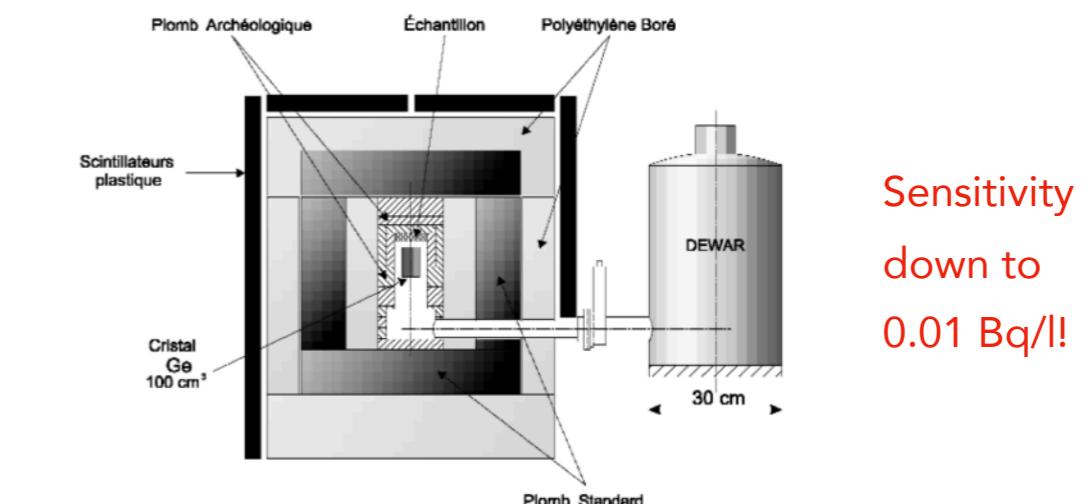
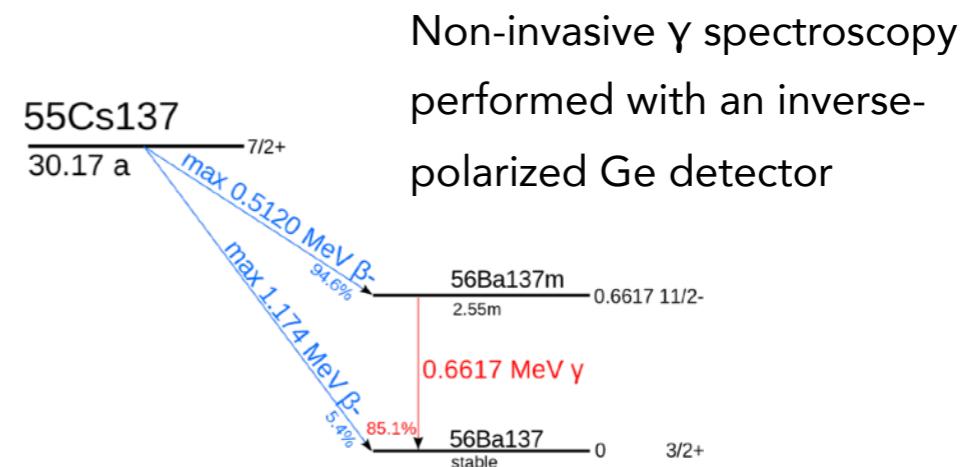
1970 P. Martinière et al. perform first Bordeaux dating with ^{14}C

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Fukushima plant, 2011



Opus One vineyard

An help from Physics

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Fukushima plant, 2011

Destructive analysis:

- ▶ wine is poured into a crystallizer which is placed in an oven;
- ▶ the temperature gradually rises to 100° C, stay at this value for 1 hour, then rise again to 500° C, and stay at this value for 8 hours–then it turns down (from a 750 ml bottle 2–4 g of wine hash);
- ▶ the Ge γ spectroscopy is performed.



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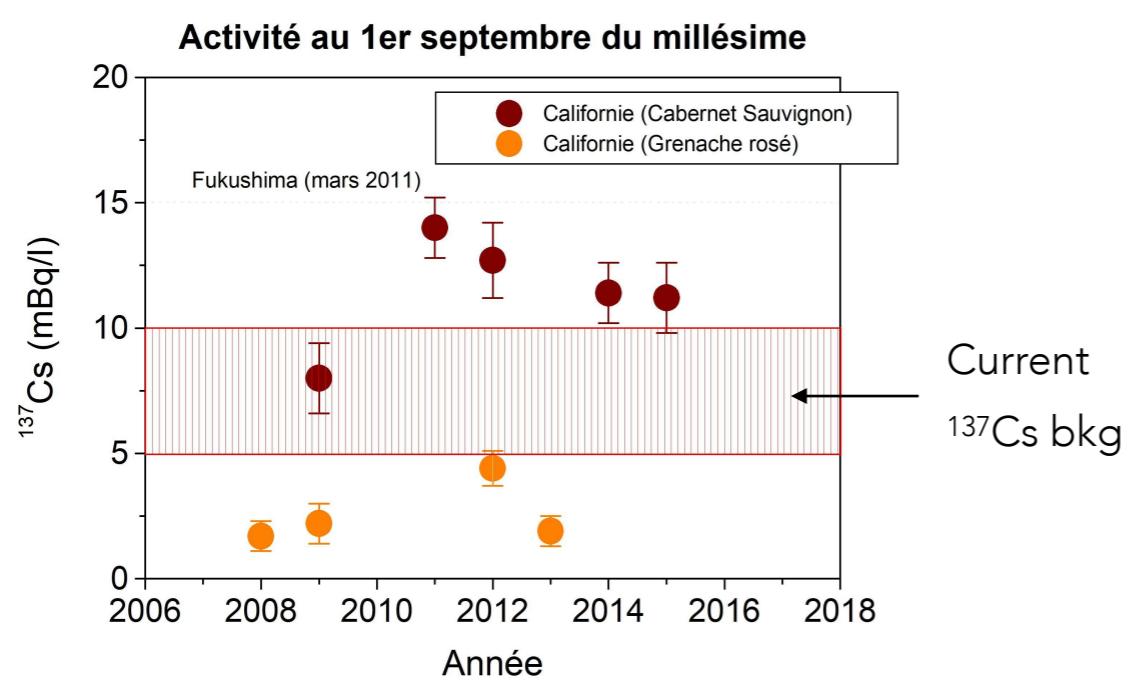
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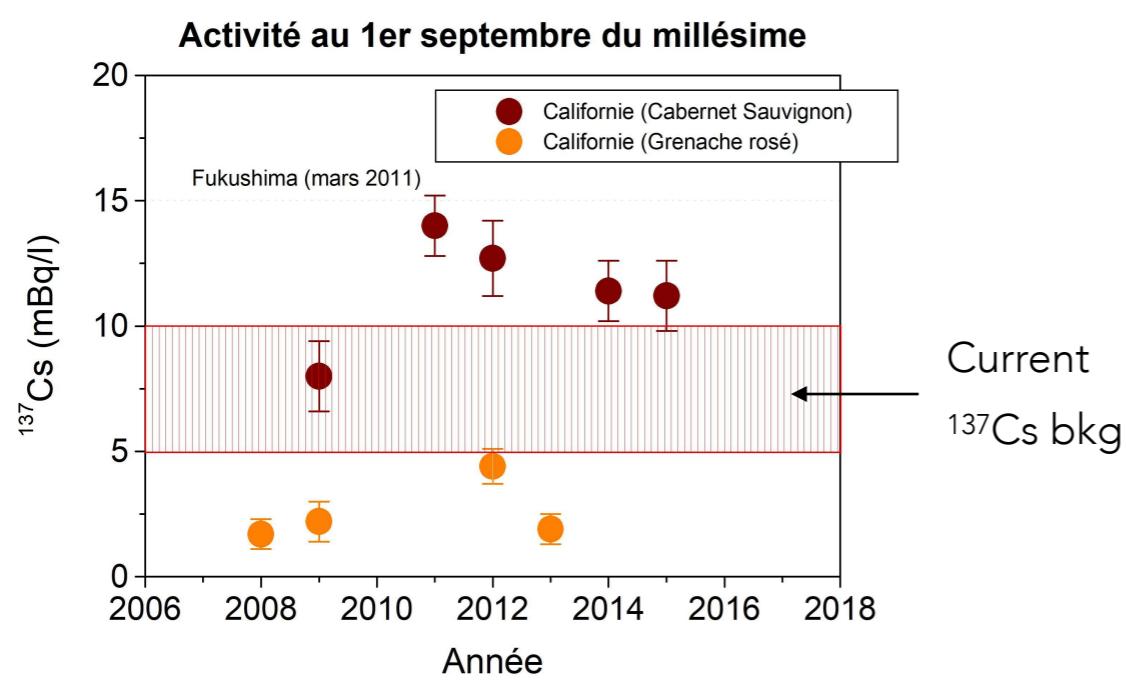
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Opus One vineyard



- ▶ activity increased by a factor of 2
- ▶ white and rosé wines have significantly lower values than red wines

Cheers!



All info and material: <https://tinyurl.com/y2ozafzq>