

WHY GENIUS ? WHAT'S GENIUS ?

DMITRII MENDELEEV: THE TABLE AND BEYOND

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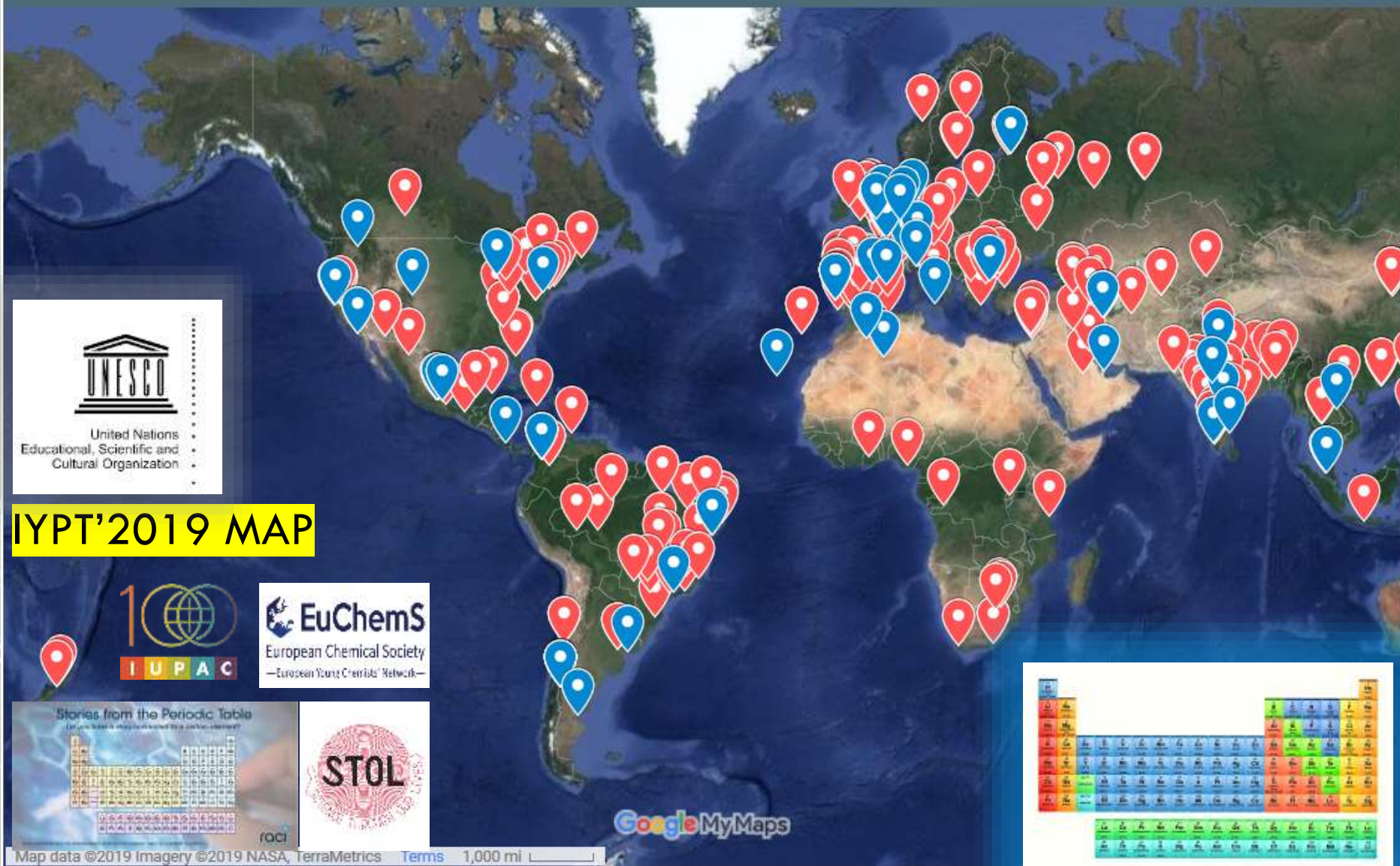
EUROPEAN PHYSICAL SOCIETY

AMERICAN PHYSICAL SOCIETY

[HTTPS://WWW.IYPT2019.ORG/](https://www.iypt2019.org/)

IYPT2019

UNESCO INT'L YEAR OF PERIODIC TABLE



How a warm "Blob" ate
Pacific ecosystems p. 442

Membrane proteases diffuse
superfast pp. 453 & 497

Overturning ideas about
ocean circulation pp. 456 & 516

Science

\$15
1 FEBRUARY 2019
sciencemag.org

AAAS



SPECIAL ISSUE
PERIODIC
TABLE TURNS
150

nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE



Directed evolution
of microbial enzyme
opens fresh route to
carbon-carbon bond
formation PAGE 67

COLLECTION | 05 FEBRUARY 2019

The International Year of the Periodic Table

2019 is the International Year of the Periodic Table of Chemical Elements, marking 150 years since Dimitri Mendeleev ordered the elements into a table. Of course, the table and our understanding of chemical periodicity has evolved in the intervening time, and this... show more

IN YOUR ELEMENT
24 JAN 2019
Nature Chemistry

Life and death with nitrogen

Although first known among chemists for its curious or whimsical character, nitrogen was later revealed to be involved in many life, and death, processes. **Michael Yarnell** ponders on this enigmatic characteristic.

Michael C. Yarnell



IN YOUR ELEMENT
15 DEC 2018
Nature Chemistry

Oxygen origins

Oxygen has contributed to our understanding of the evolution of life on Earth by providing irrefutable clues to geological processes — yet it still holds the key to some unresolved mysteries, as **Mark H. Thiemens** explains.

Mark H. Thiemens



IN YOUR ELEMENT
19 DEC 2018
Nature Chemistry

The allure of aluminium

David Baldwin outlines the history, properties and uses of aluminium — one of the most versatile, pervasive and ubiquitous metals today, yet it was considered a rare and costly element only 150 years ago.

David Baldwin



IN YOUR ELEMENT
1 JAN 2019
Nature Chemistry

Silicon beyond the valley

Markus Jurek reflects on how silicon, whether bonded with other elements in a variety of materials, is high priority for electronic devices, or in its native "black silicon" form, continues to be invaluable in many aspects of our lives.

Markus Jurek



IN YOUR ELEMENT
18 DEC 2018
Nature Chemistry

The two faces of phosphorus

Jonathan B. Mitchell considers how the story of phosphorus, an element that glows without fire, truly illustrates the pursuit of scientific knowledge — including how such knowledge goes on to serve many purposes, for better or for worse.

Jonathan B. Mitchell



FERMILAB (CHICAGO) – MAY 2019



Saint Petersburg, Russia
9–13 September, 2019



MENDELEEV CONGRESS
on general and applied chemistry



**EUROPEAN PHYSICAL SOCIETY — EPS HISTORIC SITE
THE MENDELEEV MUSEUM AND ARCHIVES —
ST. PETERSBURG STATE UNIVERSITY**

Dmitry Ivanovich Mendeleev (1834-1907) — great Russian scientist, inventor of the periodic system of elements, Professor of St. Petersburg Imperial University — studied, worked and lived here from 1860 to 1890. On March 6, 1869 (old style) during the Russian Chemical Society meeting at St. Petersburg Imperial University Mendeleev's Periodic Law, one of the fundamental laws of the universe, was reported for the first time. Being one of the most brilliant scientists of the 19th century, Mendeleev also had made numerous studies of physical constants such as the specific volumes and expansion coefficients of various compounds, investigated the phenomenon of ionization, discovered the "absolute boiling point of liquids" (critical temperature, 1890), developed the hydrate theory of solutions, had written his classic textbook "Principles of Chemistry" (1869-1871), formulated the ideal gas state equation, to its most general form (Savaryon-Mendeleev equation, 1874) and conducted a series of basic experiments in chemistry, physics, meteorology, mineralogy, economics, aeronautics, agriculture and chemical technology.

The 101st chemical element of the Periodic Table, mendelevium (101), is named after Mendeleev. To celebrate the 160th anniversary of Mendeleev's discovery, the year of 2019 has been declared by the United Nations General Assembly and UNESCO as the International Year of the Periodic Table of Chemical Elements.

ST. PETERSBURG — SEPTEMBER 12, 2019

**ЕВРОПЕЙСКОЕ ФИЗИЧЕСКОЕ ОБЩЕСТВО —
ИСТОРИЧЕСКОЕ МЕСТО МУЗЕЙ-АРХИВ Д. И. МЕНДЕЛЕЕВА, СПБГУ**

Здесь учился, работал и жил в 1860-1890 годах великий русский учёный, создатель Периодической системы элементов, профессор Императорского Санкт-Петербургского университета Дмитрий Иванович Менделеев (1834-1907). 6 марта (по ст. ст.) 1869 года на заседании Русского химического общества при Императорском Санкт-Петербургском университете Дмитрий Иванович впервые сообщил о Периодическом законе Менделеева — одном из фундаментальных законов мироздания.

Будучи одним из самых гениальных учёных XIX века, Менделеев проводил многочисленные эксперименты, исследовал свойства различных веществ, открыл в 1890 году температуру абсолютного кипения жидкостей (критическую температуру), разработал гидратную теорию растворов, написал классический учебник «Основы химии» (1869-1871), написал общее уравнение состояния идеального газа (уравнение Клапейрона — Менделеева, 1874) и провел ряд фундаментальных исследований по химии, физике, метеорологии, минерологии, экономике, воздухоплаванию, сельскому хозяйству и химической технологии.

Элемент Менделеева (номер 101 в классификации элементов Периодической таблицы — мendelevий (Mc)) и часть 180-летия открытия Менделеева 2019 год объявлен (Генеральной Ассамблеей ООН и ЮНЕСКО) Международным годом Периодической таблицы химических элементов.

САНКТ-ПЕТЕРБУРГ — 12 СЕНТЯБРЯ 2019 ГОДА.



Calcium

PASSION FOR SCIENCE

NEW ELEMENTS AND NEW MATERIALS



Società Italiana di Fisica



Società Chimica Italiana

ACCADEMIA DELLE SCIENZE
DELL'ISTITUTO DI BOLOGNA



6-7 November 2019

Sala Ulisse

Accademia delle Scienze dell'Istituto di Bologna

International Symposium on the occasion of the International Year of the Periodic Table of Chemical Elements IYPT2019

Organised by the Italian Physical Society – SIF

in collaboration with the Italian Chemical Society – SCI

Vittorio Pellegrini (IIT, Genova, Italy)
From carbon nanotubes to graphene

Emanuela Zaccarelli (Istituto dei Sistemi Complessi del CNR, Roma)
Smart materials

Lucio Rossi (CERN, Geneva, Switzerland)
Superconducting materials

Petra Rudolf (University of Groningen, Netherlands)
Materials and surfaces

Ulrich Schubert (Vienna University, Austria)
New materials: where chemistry and materials sciences meet

Vladimir Shiltsev (Fermilab, Chicago, USA)
From Lomonosov to Mendeleev at the Bologna Academy of Sciences

Diederik Wiersma (INRIM–Istituto Nazionale di Ricerca Metrologica, Italy)
The new system of units

Antonino Zichichi (Università di Bologna, Italy)
Elements and antielements



Festival della Scienza

Genova, 24 ottobre _ 2 novembre 2014 | www.festivalscienza.it

Tempo





DMITRII IVANOVICH MENDELEEV

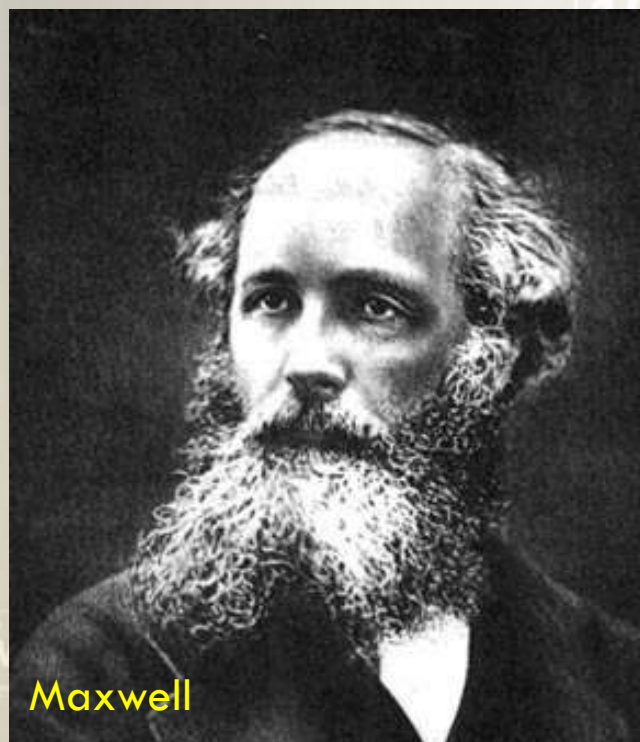
(DIM)

GENIUS

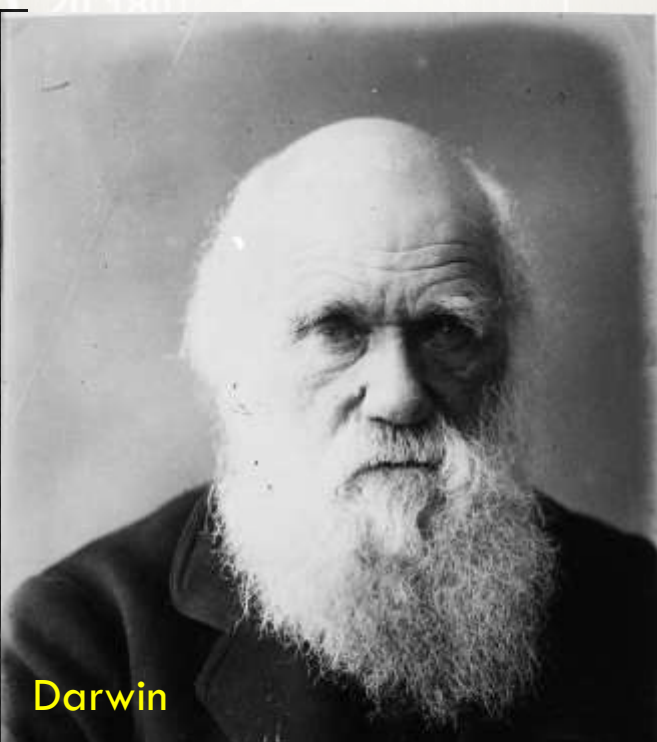
“THE TABLE” AND BEYOND

VLADIMIR SHILTSEV

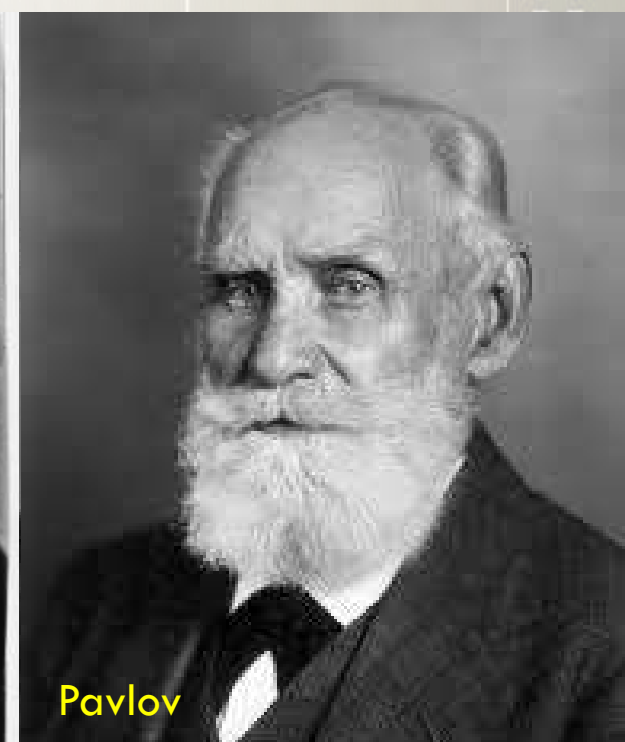
CERN 2019



Maxwell



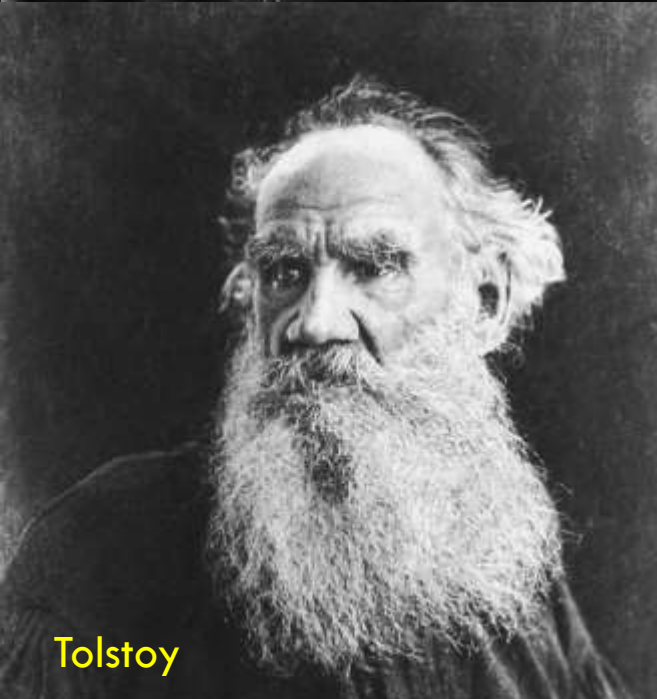
Darwin



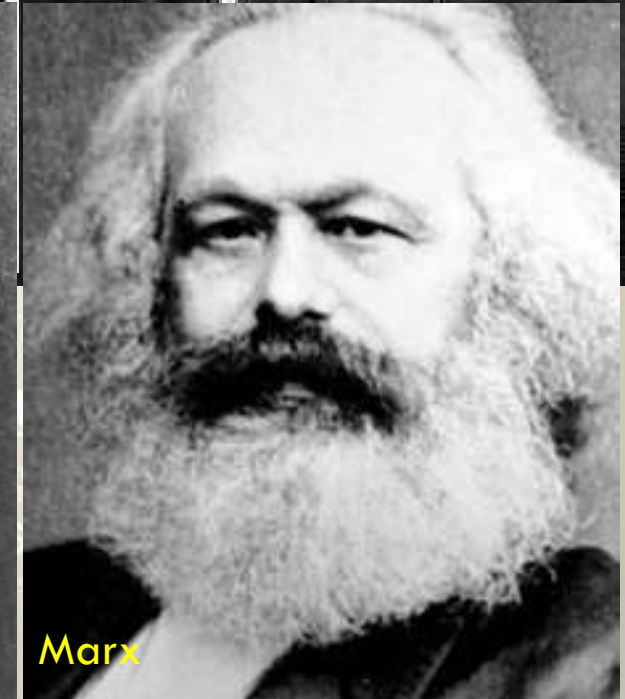
Pavlov



Garibaldi



Tolstoy



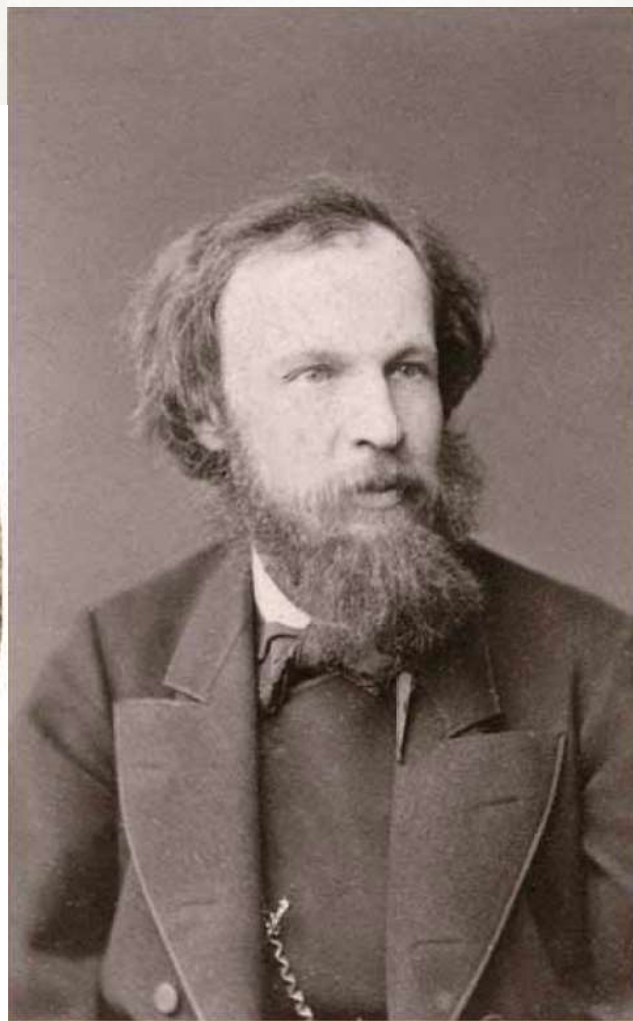
Marx

DIM : b. 1834 (Tobolsk), d. 1907 (StPetersburg)

1850



1869



1900



DIM'S ORIGINAL TABLE FEB. 17, 1869

Менделѣевъ
1869. II. 17

H=1.	?=8	?=22	Cu=63,4	Ag=108	Hg=200.
He	Li=7	Be=9,4	B=11	Si=28	Al=27,4
	C=12	N=14	O=16	F=19	Na=23
	Si=28	P=31	S=32	Cl=35,5	K=39
	Ca=40	Sc=45	Ti=50	V=51	Cr=52
	Fe=56	Mn=55	Co=59	Ni=58,7	Cu=63,4
	Zn=65,2	As=75	Se=79,4	Br=80	Kr=83,8
	Rb=85,4	Sr=87,6	Y=90	Zr=90	Nb=94
	Mo=96	Rh=104,4	Pd=106,6	Ag=108	Hg=200.
	Pt=197,4	Au=197,2			

Essai d'une
d'après leurs poids atomiques et
fonctions chimiques par D. Mendeleeff

18 II 69.

Менделѣевъ
1869. II. 17
Система
д'après leurs poids atomiques et
fonctions chimiques par D. Mendeleeff
18 II 69.

но въ ней, мнѣ кажется, уже ясно выражается примѣнимость въ
ставляемаго мною начала ко всей совокупности элементовъ, пай
которыхъ извѣстенъ съ достовѣрностію. На этотъ разъ я и желалъ
преимущественно найти общую систему элементовъ. Вотъ этотъ
опытъ:

H=1	Be=9,4	Mg=24	Zn=65,2	Ag=108	Hg=200.
	B=11	Al=27,4	?=68	Ur=116	Au=197?
	C=12	Si=28	?=70	Su=118	
	N=14	P=31	As=75	Sb=122	Bi=210
	O=16	S=32	Se=79,4	Te=128?	
	F=19	Cl=35,5	Br=80	I=127	
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204
		Ca=40	Sr=87,6	Ba=137	Pb=207.
		?=45	Ce=92		
		?Er=56	La=94		
		?Yt=60	Di=95		
		?In=75,6	Th=118?		

IMPORTANT SUBTLETY: **MAJOR DISCOVERY IS PERIODIC LAW**, THE TABLE IS JUST ITS PRESENTATION

- **PERIODIC LAW: PERIODIC DEPENDENCE OF CHEMICAL PROPERTIES OF ELEMENTS ON THEIR ATOMIC WEIGHT**

- **PRESENTED: 6 MARCH 1869**
- **INITIALLY: ONLY 63 ELEMENTS**
- **PREDICTED AND DISCOVERED:**

GA (1875), Sc (1879), GE (1885)

DISCOVERY OF GALLIUM

1875 - **Paul-Émile Lecoq de Boisbaudran** – original density measured 4.7 g/cm^3 ,
Mendeleev advised to re-measure – the correct value found was 5.9 g/cm^3

Property	Mendeleev's predictions 1871	Actual properties 1875
Atomic weight	~68	69.723
Density	5.9 g/cm^3	5.904 g/cm^3
Melting point	Low	$29.767 \text{ }^\circ\text{C}$
Formula of oxide	M_2O_3	Ga_2O_3
Density of oxide	5.5 g/cm^3	5.88 g/cm^3
Nature of hydroxide	amphoteric	amphoteric

ability to act either as an acid or a base.

- **DISCOVERY OF ELECTRON (1897), PROTON (1913) AND NEUTRON (1932)**
- **CHEMICAL PROPERTIES EXPLAINED BY QUANTUM MECHANICS**
- **COMPOSITION OF NUCLEI – BY QUANTUM CHROMODYNAMICS**

Niels Bohr's Table (1922)

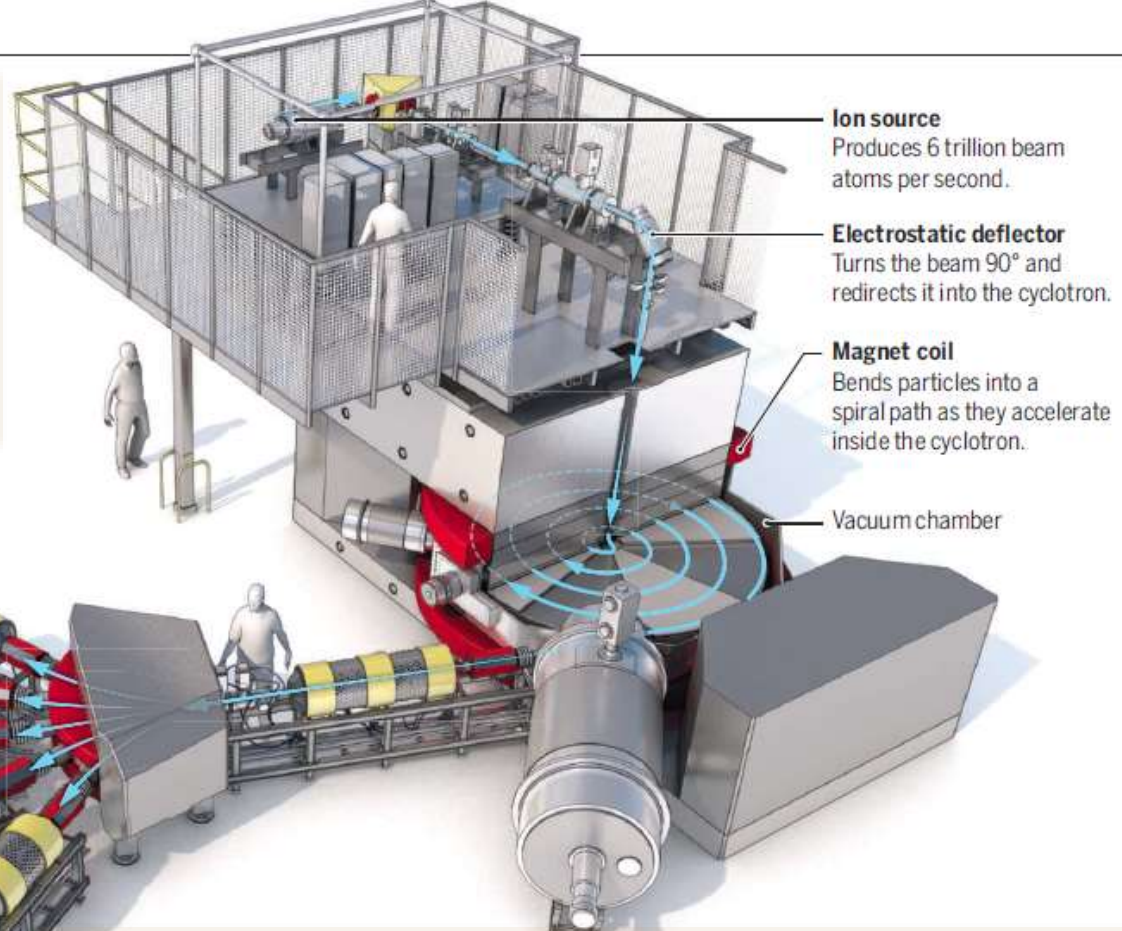
29 Man-Made Synthetic Elements

Element	Symbol	At. No.
Technetium	Tc	43
Promethium	Pm	61
	At	85
Neptunium	Np	93
Plutonium	Pu	94
Americium	Am	95
Curium	Cm	96
Berkelium	Bk	97
Californium	Cf	98
Einsteinium	Es	99
Fermium	Fm	100
Mendelevium	Md	101
Nobelium	No	102
	Lr	103
Rutherfordium	Rf	104

Element	Symbol	At. No.
Dubnium	Db	105
Seaborgium	Sg	106
Bohrium	Bh	107
	Hs	108
Meitnerium	Mt	109
Darmstadtium	Ds	110
Roentgenium	Rg	111
Copernicium	Cn	112
	Nh	113
Flerovium	Fl	114
Moscovium	Mc	115
	Lv	116
Tennessine	Ts	117
Oganesson	Og	118

26 in red – accelerator bombardment
3 – in blue – irradiation/bomb products

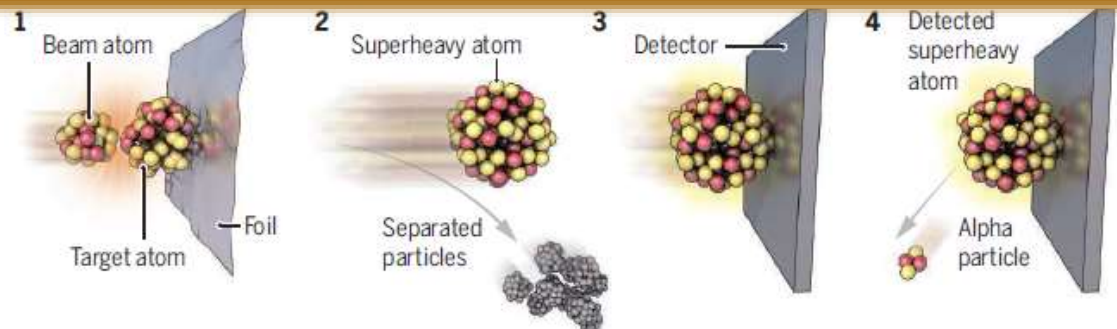
HOW NEW ELEMENTS GET DISCOVERED NOW (E.G. IN DUBNA)



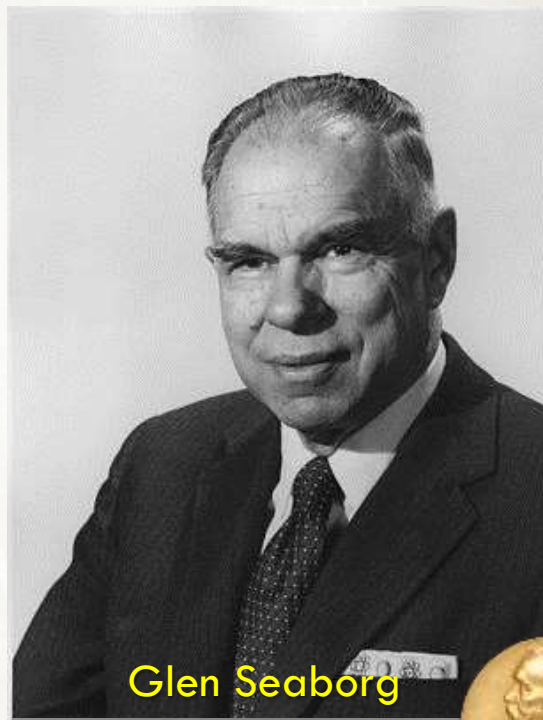
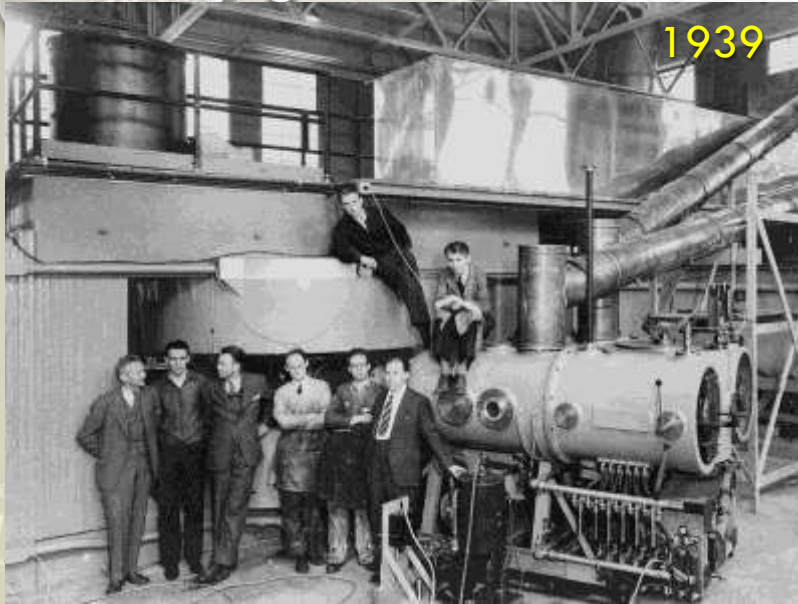
**Neon (10) → Uranium (92) = Nobelium (102)...or
Calcium (20) → Californium (98) = Oganesson (118)**

Creation, separation, and detection

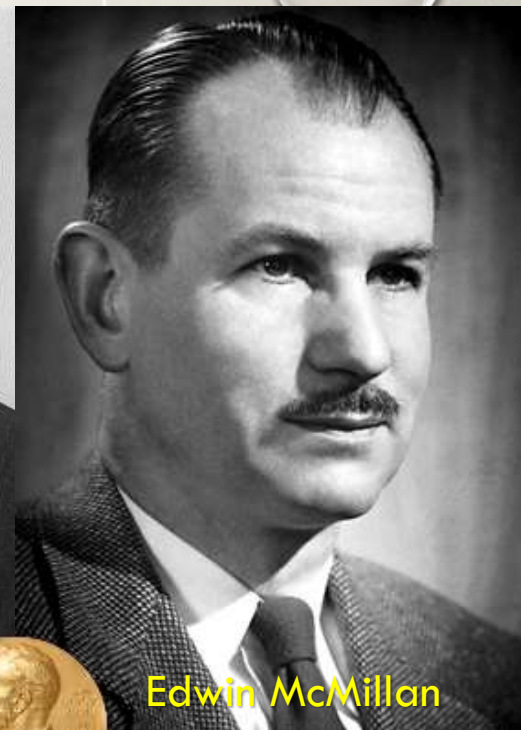
The beam is split and redirected toward the target, separator, and detector in another room (right).



THE TABLE & ACCELERATORS

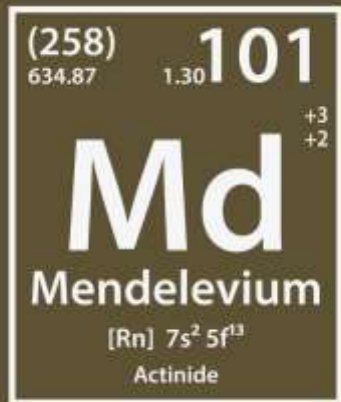


Glen Seaborg



Edwin McMillan

1951 Nobel Prize for discovery of transuranic elements (Seaborg, McMillan)



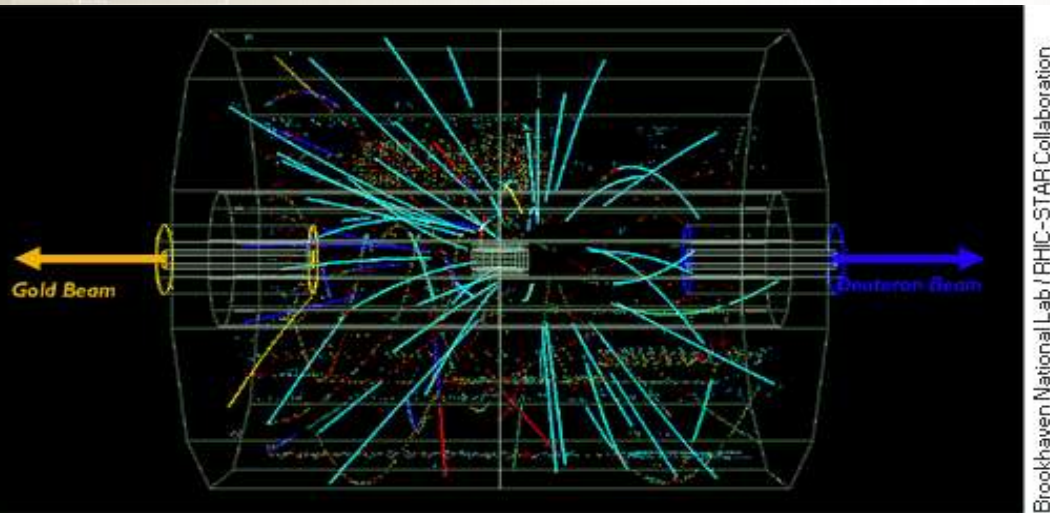
Ernest Lawrence



Emilio Segre

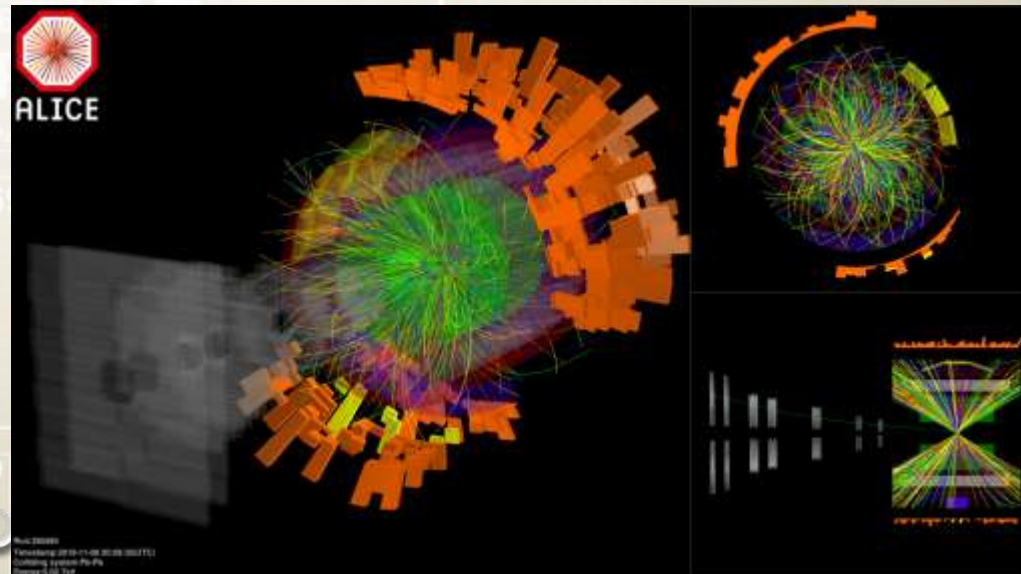
ALSO AT ACCELERATORS: ELEMENTS TO THE HIGHEST ENERGIES

At RHIC upto 0.1 TeV/ n
Variety of accelerated
and collider ions: H , Al ,
 Cu , Au , U ...



Brookhaven National Lab / RHIC-STAR Collaboration

At the LHC upto 2.76 TeV/ n
Providing the world's highest
energy collisions of elements
from the periodic table :
 H , Xe , Pb , soon O ...



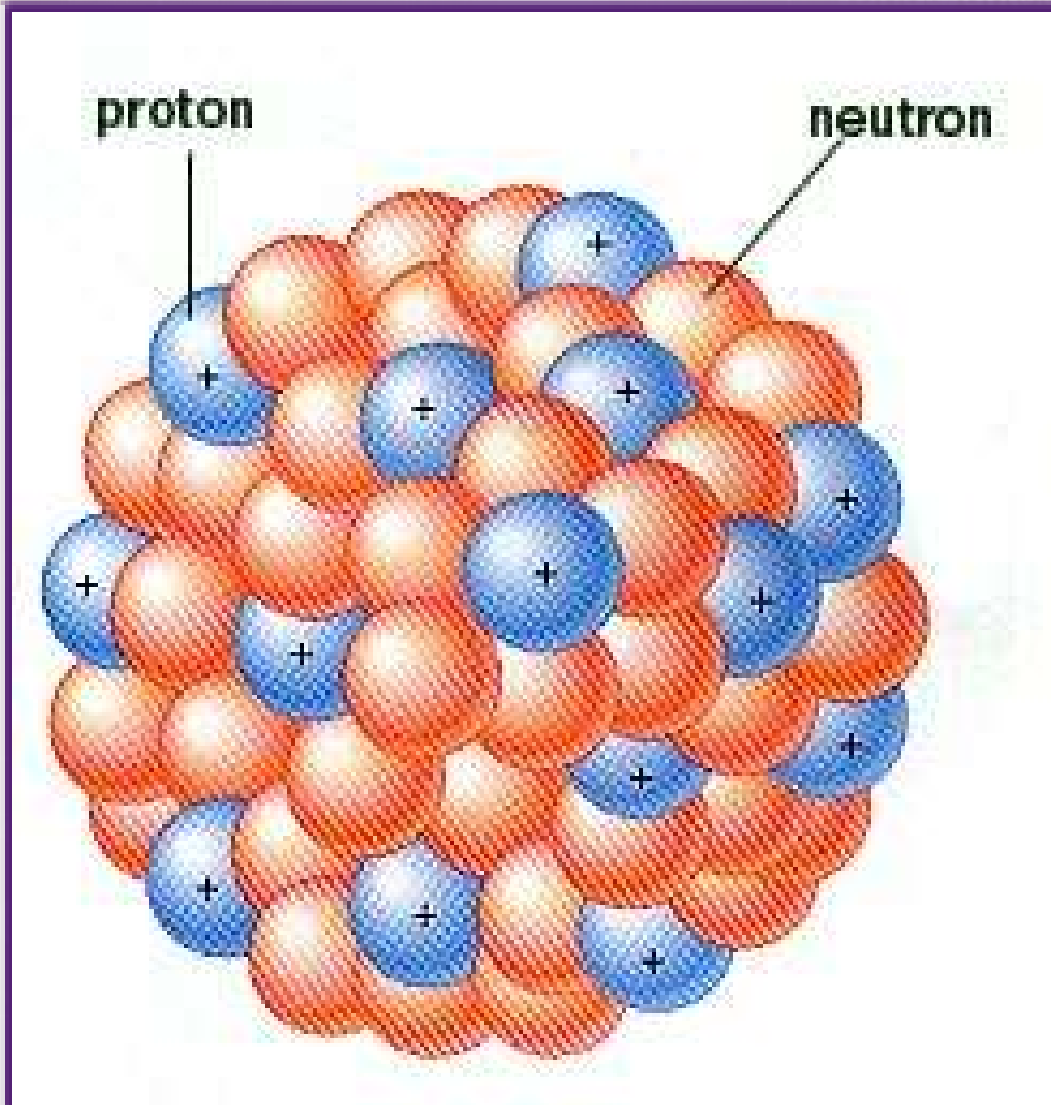
ANOTHER TABLE :

STANDARD MODEL OF PARTICLE PHYSICS

QUARKS	mass →	$\approx 2.3 \text{ MeV}/c^2$	$\approx 1.275 \text{ GeV}/c^2$	$\approx 173.07 \text{ GeV}/c^2$	0	$\approx 126 \text{ GeV}/c^2$
	charge →	$2/3$	$2/3$	$2/3$	0	0
	spin →	$1/2$	$1/2$	$1/2$	1	0
		u up	c charm	t top	g gluon	H Higgs boson
LEPTONS		$\approx 4.8 \text{ MeV}/c^2$	$\approx 95 \text{ MeV}/c^2$	$\approx 4.18 \text{ GeV}/c^2$	0	
		$-1/3$	$-1/3$	$-1/3$	0	
		$1/2$	$1/2$	$1/2$	1	
		d down	s strange	b bottom	γ photon	
LEPTONS		$0.511 \text{ MeV}/c^2$	$105.7 \text{ MeV}/c^2$	$1.777 \text{ GeV}/c^2$	$91.2 \text{ GeV}/c^2$	
		-1	-1	-1	0	
		$1/2$	$1/2$	$1/2$	1	
		e electron	μ muon	τ tau	Z Z boson	
LEPTONS		$< 2.2 \text{ eV}/c^2$	$< 0.17 \text{ MeV}/c^2$	$< 15.5 \text{ MeV}/c^2$	$80.4 \text{ GeV}/c^2$	
		0	0	0	± 1	
		$1/2$	$1/2$	$1/2$	1	
		ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	W W boson	
		GAUGE BOSONS				

TWO PROBLEMS FOR TOO MANY PROTONS

#1: too many protons → electrons get closer and enter the inner nucleus → protons and electrons fuse into neutrons → can NOT get more than **172 protons** at once !



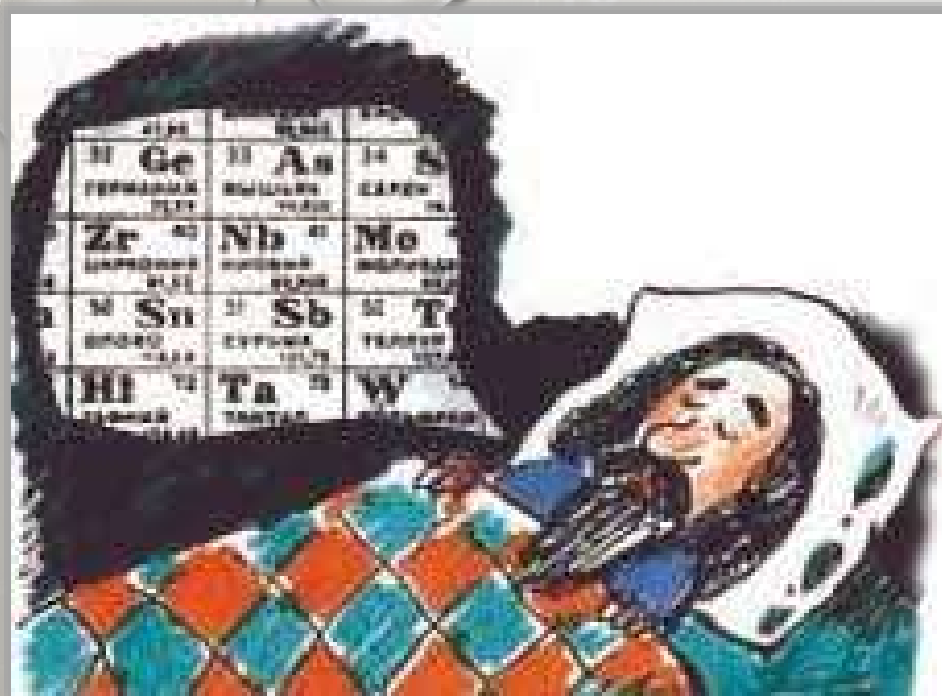
#2: too many protons → very strong repulsive forces → nucleus quickly breaks out → hard to survive even for **10^{-14} s !**

MENDELEEV IS AN ILLUSTRATIVE EXAMPLE OF GENIUS, ГЕНИЙ, GÉNIE, GENIO

- A GENIUS IS A PERSON WHO DISPLAYS EXCEPTIONAL INTELLECTUAL ABILITY, CREATIVE PRODUCTIVITY, UNIVERSALITY IN GENRES OR ORIGINALITY, TYPICALLY TO A DEGREE THAT IS ASSOCIATED WITH THE ACHIEVEMENT OF NEW ADVANCES IN A DOMAIN OF KNOWLEDGE
- THE NOUN IS RELATED TO THE LATIN VERB GENUI, GENITUS, "TO BRING INTO BEING, CREATE, PRODUCE".
- CLOSE: GENESIS AND GENE
- FROM PROTO-INDO-EUROPEAN *G^wÉN
- IN RUSSIAN, OF THE SAME ROOT – ЖЕНА (WIFE)



Figure 1 By playing “chemical solitaire” on long train rides, Mendeleev organized the elements according to their properties.



“MENDELEEV’S DREAM”

(INVENTION OF PERIODIC TABLE)

- In memoirs of Prof. A.Inostrantsev (1843-1919), geologist, friend
- Widely spread by media
- Very popular among students (*no study – go to bed!*)
- DIM himself never confirmed or denied...
 - commented that it took him 20 yrs of thinking



Opening “Mendeleev’s Dream” monument in St.Petersburg (2017)

ОСНОВЫ ХИМИИ

Д. Менделѣва.

ПРОФЕССОРА П. Свѣ. УНИВЕРСИТЕТА.

ЧАСТЬ ПЕРВАЯ,

съ 151-мъ полнотипажемъ.

С.-ПЕТЕРБУРГЪ.

1869.

67

ЕСТЕСТВЕННАЯ СИСТЕМА ЭЛЕМЕНТОВЪ Д. МЕНДЕЛѢЕВА.

Периодъ 1-й. Периодъ 2-й. Периодъ 3-й. Периодъ 4-й. Периодъ 5-й.															
Li Литій	Be Берилл	B Боръ	C Углеродъ	N Азотъ	O Кислородъ	F Фторъ	Na Натрій	Mg Магній	Al Алюминій	Si Кремній	P Фосфоръ	S Сѣра	Cl Хлоръ	Br Бромъ	I Йодъ
K Калий	Ca Кальцій	Sc Скандій	Ti Титанъ	V Ванадій	Cr Хромъ	Mn Марганецъ	Fe Железо	Co Кобальтъ	Ni Никель	Cu Медь	Zn Цинкъ	As Арсенъ	Se Селенъ	Br Бромъ	Te Теллуръ
Rb Рубидій	Sr Стронцій	Y Иттрий	Zr Цирконій	Nb Нибобій	Mo Молибденъ	—	Ru Рутеній	Rh Родій	Pd Палладій	Ag Серебро	Cd Кадмій	In Индій	Sb Свѣтъ	Te Теллуръ	I Йодъ
Cs Цезій	Ba Барій	La Лантанъ	Ce Церій	Pr Прометій	Th Торий	Pa Пакетъ	U Уранъ	Os Осмиумъ	Ir Иридий	Pt Платина	Au Золото	Hg Ртуть	Tl Талій	Pb Свинецъ	Bi Висмутъ
—	—	Er Ербий	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	Th Торий	—	—	—	—	—	—	—	—	—	—	—	—	—

Mendeleev's "System of Elements" in short form
Published in Part 2 of "Foundations of Chemistry" (1871)

Д. И. МЕНДЕЛЕЕВ

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Д. И. МЕНДЕЛЕЕВ

Volume I. Ph.D. and Master thesis (3 articles).

Volume II. Periodic law (7).

Volume III. The study of aqueous solutions by specific gravity (11).

Volume IV. Solutions (13).

Volume V. Fluids (16).

Volume VI. Gases (17).

Volume VII. Geophysics and hydrodynamics (25).

Volume VIII. Works in the field of organic chemistry (29).

Volume IX. Gunpowder (34).**Volume X. Oil (36).**

Volume XI. Fuel (40).

Volume XII. Works in the field of metallurgy (42).

Volume XIII. "Principles of Chemistry". Part One (50).

Volume XIV. "Principles of Chemistry". Part Two (55).

Volume XV. "Knowledge is theoretical", small notes (62).

Volume XVI. Agriculture and processing of agricultural products (68).

Volume XVII. Technology (70).

Volume XVIII. Economic work. Volume I (74).

Volume XIX. Economic work. Volume II (78).

Volume XX. Economic work. Volume III (82).

Volume XXI. Economic work. Volume IV (84).

Volume XXII. Metrological work (86).

Volume XXIII. Public education and higher education (93).

Volume XXIV. Articles and materials on general issues (96).

Volume XXV. Supplementary Materials (98).

MENDELEEV INTERESTS

II Organic chemistry

Periodic law,
pedagogy

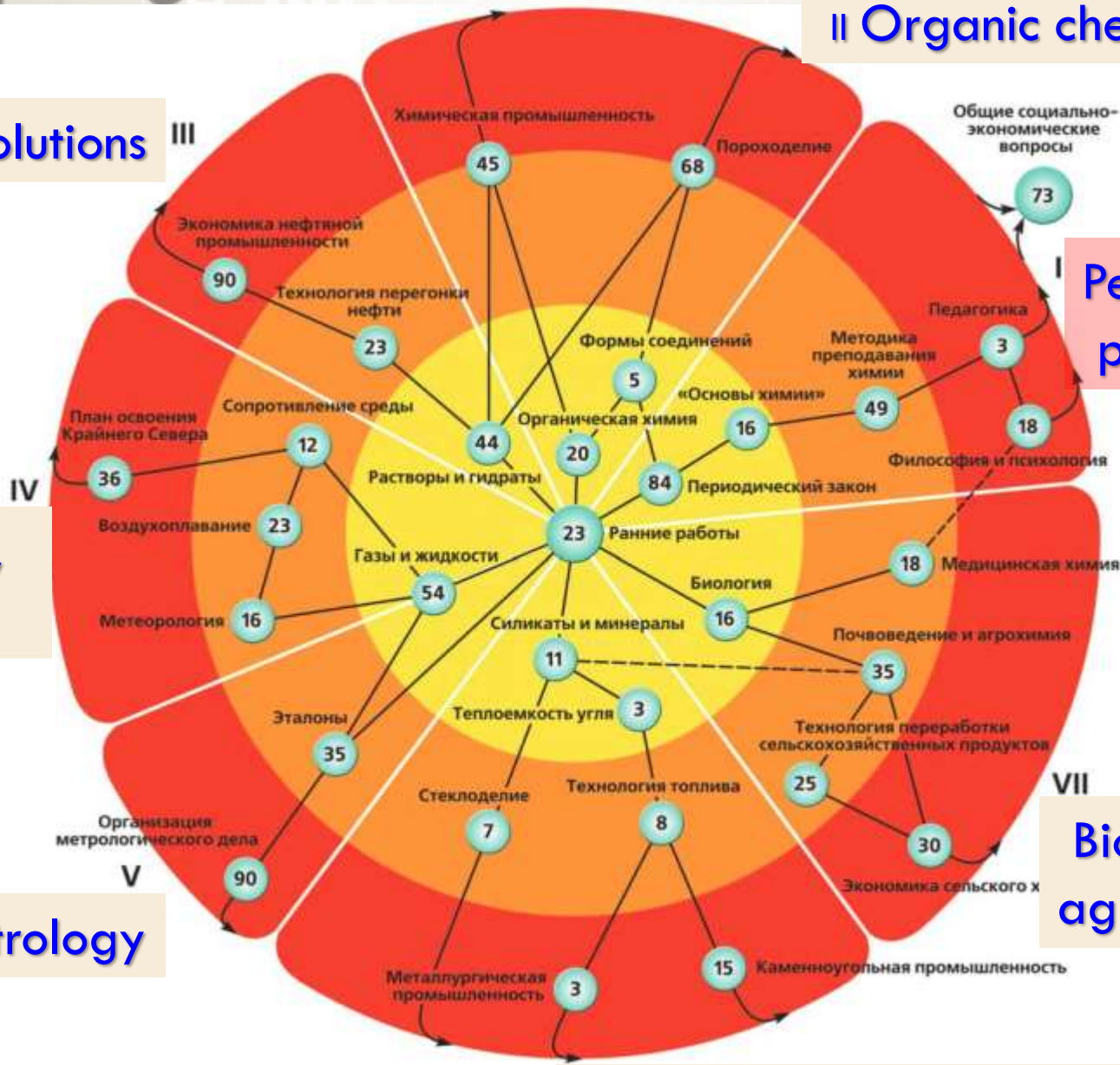
Bio-med,
agriculture

Solid state, glass, metallurgy

Solutions

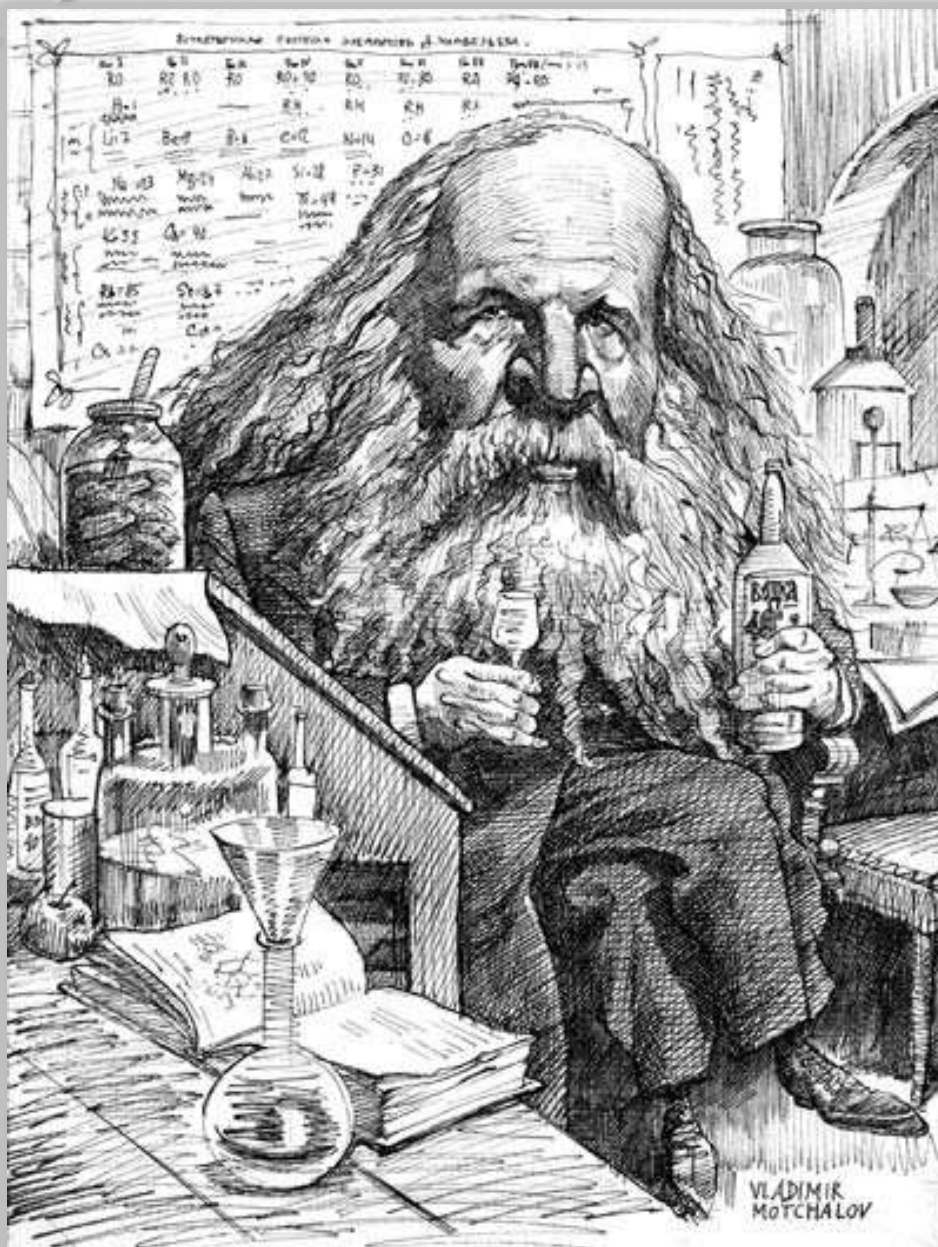
Gases,
liquids

Metrology



MENDELEEV'S STORIES

- **VODKA (PHYSICS AND CHEMISTRY OF SOLUTIONS)**
- **PERIODIC LAW AND TABLE**
- **SUPERCRITICAL LIQUID**
- RARIFIED GASES – SEARCH FOR ETHER
- CLAPEYRON-MENDELEEV EQUATION OF IDEAL GASES
- AERONAUTIC AND METEOROLOGY, SMOKELESS POWDER
- CHAMBER OF WEIGHTS AND MEASURES
- **PERSONAL LIFE**
- CRITICISM OF SPIRITISM AND TESTS/EXPOSURES OF MEDIUMS
- OIL IN BAKU – NOBEL BROTHERS, DONETSK COAL, ECONOMICS & TARIFFS
- JUDGMENTS ON LITERATURE AND POETRY
- MENDELEEV AND LOMONOSOV
- **“WHAT KIND OF ACADEMY WE NEED” – (NON-ELECTION AND FAME)**



POPULAR MYTHS ABOUT VODKA

- **“INVENTED BY DMITRII MENDELEEV”**
- **“IDEAL RECIPE ESTABLISHED BY MENDELEEV DUE MANY UNIQUE PROPERTIES OF 40 % ALCOHOL”:**
 - **BURSTS INTO FLAME**
 - **DOES NOT FREEZE**
 - **ULTRA PURE PRODUCT**
 - **FAT DROWNS IN VODKA**
 - **EVAPORATES BUT AS FAST AS WATER**
 - **FROM GRAIN ONLY**
 - **MINIMAL HANGOVER**

... AND MANY OTHER FASCINATING FEATURES ATTRIBUTED

"The solution is Jesiutic"

30

"Un-Real History" (TNT channel)



VODKA STANDARDS



Mendeleev is often cited as “father of Russian vodka”

- Interpretation of his 1865 PhD thesis
- DIM was on the State Commission on Tariffs in 1890-1900's (incl. alcohol standards and monopoly)
 - Initiated by Tzar Alexander III
 - Implem'd by S.Witte 1895-1904
 - Out of concerns of health and \$\$
 - **25-30% of budget income (!)**

*Others make vodka,
we make*

The vodka

RUSSIAN STANDARD

VODKA AS IT SHOULD BE

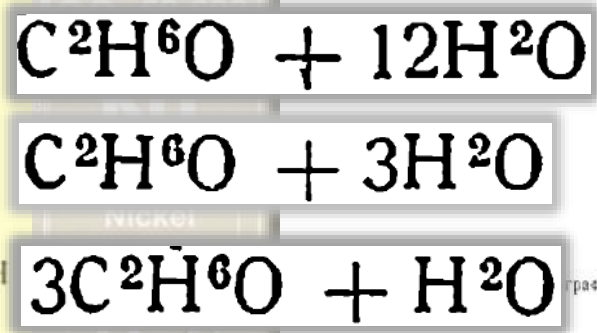
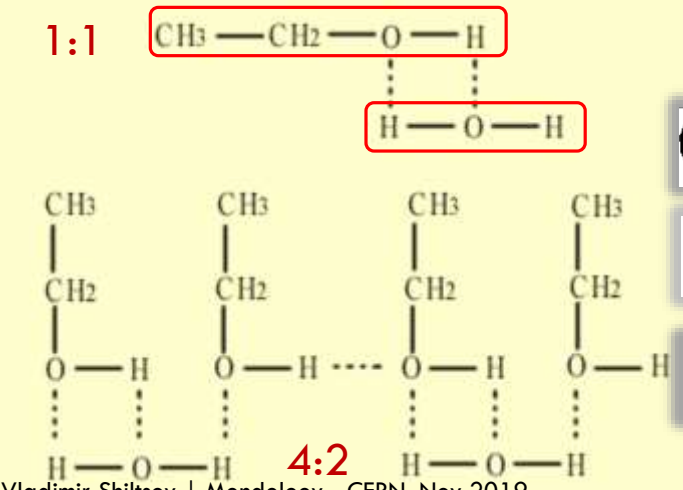
Our vodka is the only vodka that's made to Mendeleev's 1894 recipe, originally crafted for the Tsar. It's one of the things that makes Russian Standard the only 100% Russian premium vodka.

■ **Seminal scientific** study of solutions of alcohol C_2H_5OH in water:

- Temperature control $dT \sim 0.02^\circ C$, new method to get record pure **99.99% ethyl alcohol**, took into account air weight and air pressure, precise calibration of P and T , glass expansion, etc etc...
- VERY thorough error analysis
- Record accuracy **<0.01 %**
- Chi-squared and **Chebyshev** methods
- Cont'd analysis in 1887

■ **Concluded presence of “associations”**

■ What we now know as hydrogen bonds



PHD THESIS (1865)

On Compounds of Alcohol with Water

РАЗСУЖДЕНИЕ

О СОЕДИНЕНИИ СПИРТА СЪ ВОДОЮ,

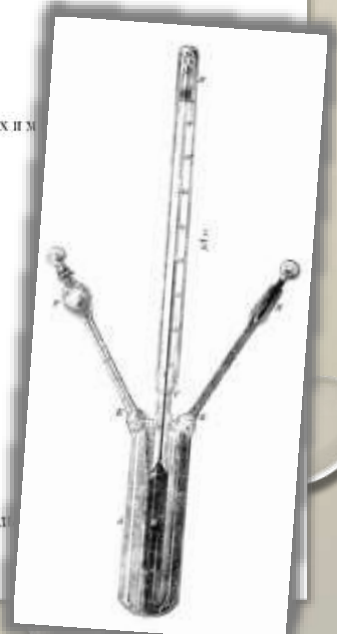
ПРЕДСТАВЛЕННОЕ ВЪ ФИЗИКОМАТЕМАТИЧЕСКІЙ ФАКУЛЬТЕТЪ

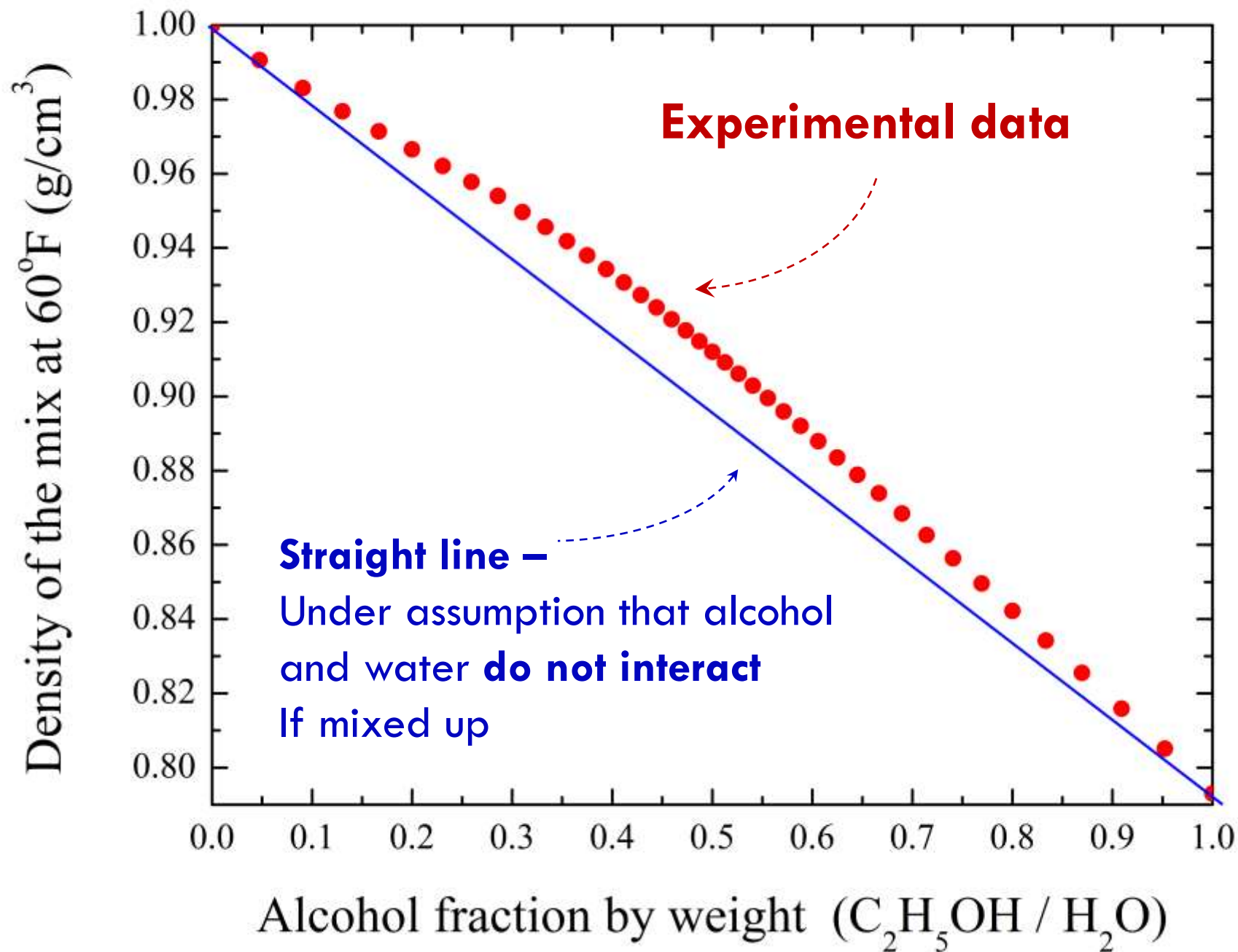
И. С.-ПЕТЕРБУРГСКАГО УНИВЕРСИТЕТА

Д. Менделѣевъ,

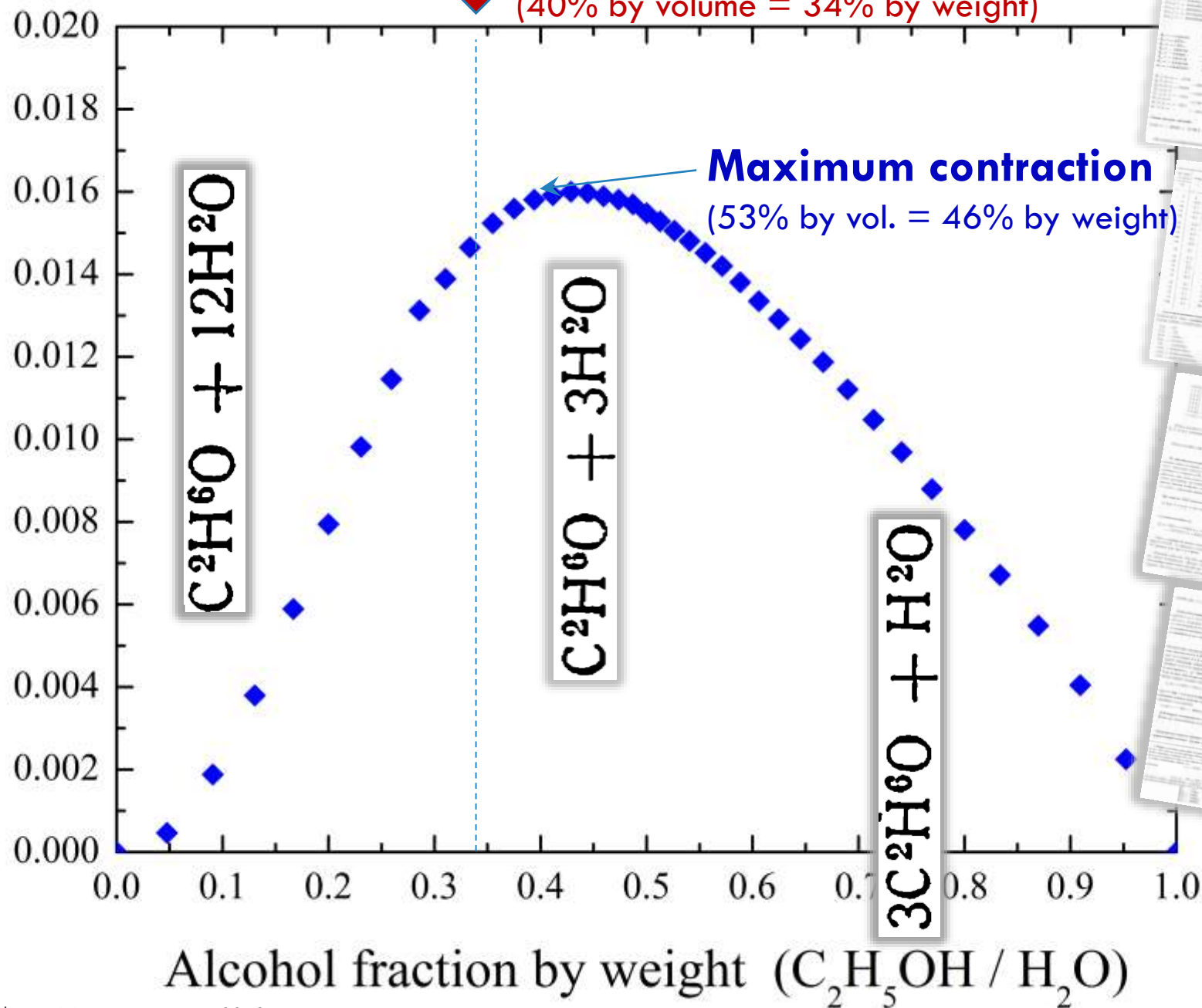
для получения степени доктора хим.

САНКТ-ПЕТЕРБУРГЪ.
Издано въ Типографіи Товарищества „Общественная Польза“
1865.





"Extra" density of the mix at 60°F (g/cm³)



WHY PEAK AT 46% ALCOHOL?



$$12 \times 2 + 5 + 16 + 1$$

46

$$3 \times (2 + 16)$$

54

OUT OF TOTAL OF 100

MODERN VIEW ON THE ISSUE

INT'L SCIENTIFIC SEMINAR, MOSCOW STATE UNIVERSITY, 2010

“145-TH ANNIVERSARY OF MENDELEEV'S THESIS”

Dr. V. Grigorieva (Moscow, author of “Vodka: Known and Unknown”, M., 2010)

- It's incorrect to cite **DM** as the creator of Russian vodka

Prof. D. Shaefer (U. Cincinnati)

- NMR and UV analysis shows just two clustering phenomena: at 1:5 (~20-25%) and 1:1 (~46%, as in **DM**'s work)
- due to hydrogen bonds, balanced by thermal motion

Prof. Masashi Hojo (Kochi University, Japan, author “Sake: Chemistry and Maturation”, “Alcohol Consumption and Health”)

- Hydrogen bond strength depends not only on ethanol concentration but also on impurities/foreign substances
- Consequently, the taste is strongly dependent on them, too

Dr. A. Kalinina (Moscow, Russian Narcology Center)

- Comparative analysis of health effects of vodka, gin, beer, whiskey

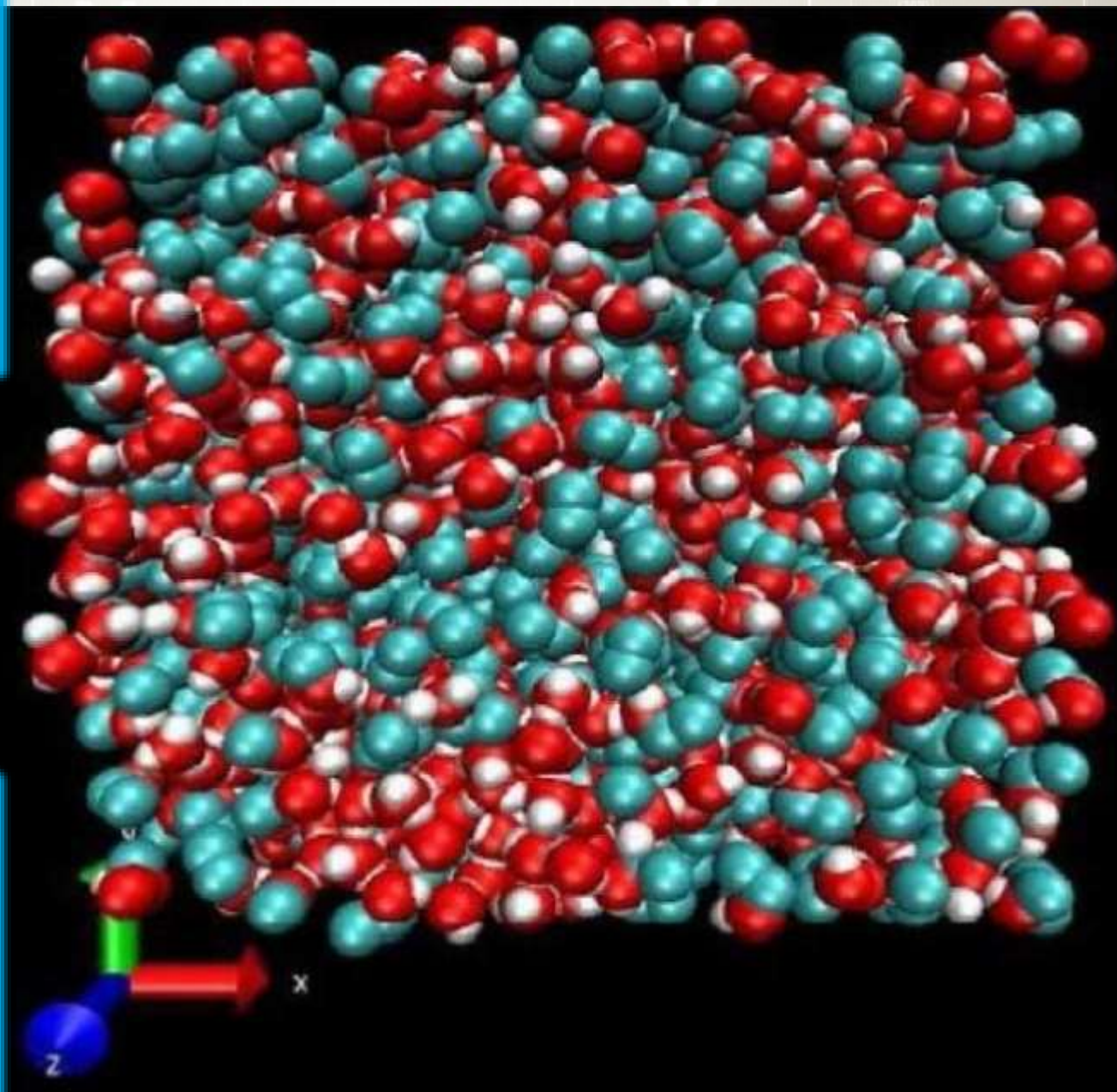
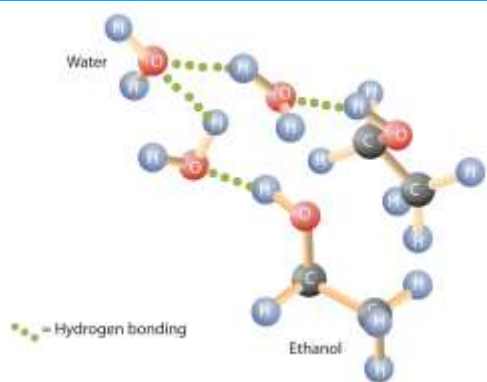
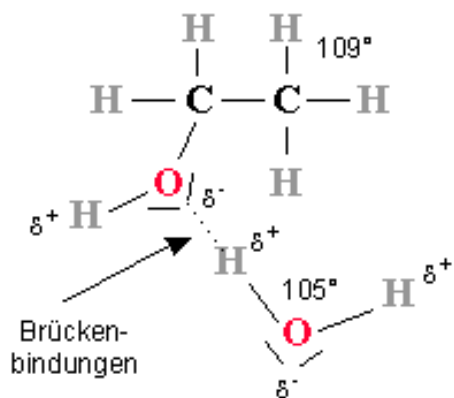
Drs. S. Patsaeva and T. Dolenko (Moscow State University)

- Successfully applied Raman scattering for precise determination of the ethanol concentration and detail analysis of impurities





EtOH



The Boston Globe

SUNDAY, APRIL 9, 2017

DEPORTATIONS TO BEGIN

President Trump calls for tripling of ICE force; riots continue

Curfews extended
in multiple cities

PRESIDENT TRUMP has set in motion one of his most controversial campaign promises, calling on Congress to fund a "massive deportation force" by tripling the number of federal Immigration and Customs Enforcement agents.

The president made the announcement in a nationally televised address last night from the Old Post Office building in Washington, D.C.

Trump International Hotel. I arrive here after the speech, I visited Attorney General Christie to stand right next to him at 9 am to field questions. "wow, a for Christie this time," tweeted News Channel reporter Meg who was covering the speech sports her near Rockefeller Center cause she has been placed on House blacklist.

Although Trump reiterates promise to eject some 11.3 million workers on a two-year time "no fact that your head will be



**Markets
sink as
trade war
looms**

ALL-OR-DAYTIME STOCKS

[HOME](#) / [BUSINESS](#) / [TECHNOLOGY](#)

ASK DR. KNOWLEDGE

Why is vodka 40 percent alcohol?

November 22, 2010

 [E-mail](#) |  [Print](#) |  [Reprints](#) |

Text size  

Why is vodka 40 percent alcohol? Is this arbitrary? No — and the reasons are linked to the specific properties of alcohol and water. All of them rather amazingly lead to the “40 percent alcohol by volume” label we know so well.

33 74.922

As

Arsenic

Mg

Magnesium

Hs

Hassium

(269)

Sg

Seaborgium

79 196.97

Au

Gold

72 150.4

Hf

45 102.91

Rh

Rhodium

48 112.41

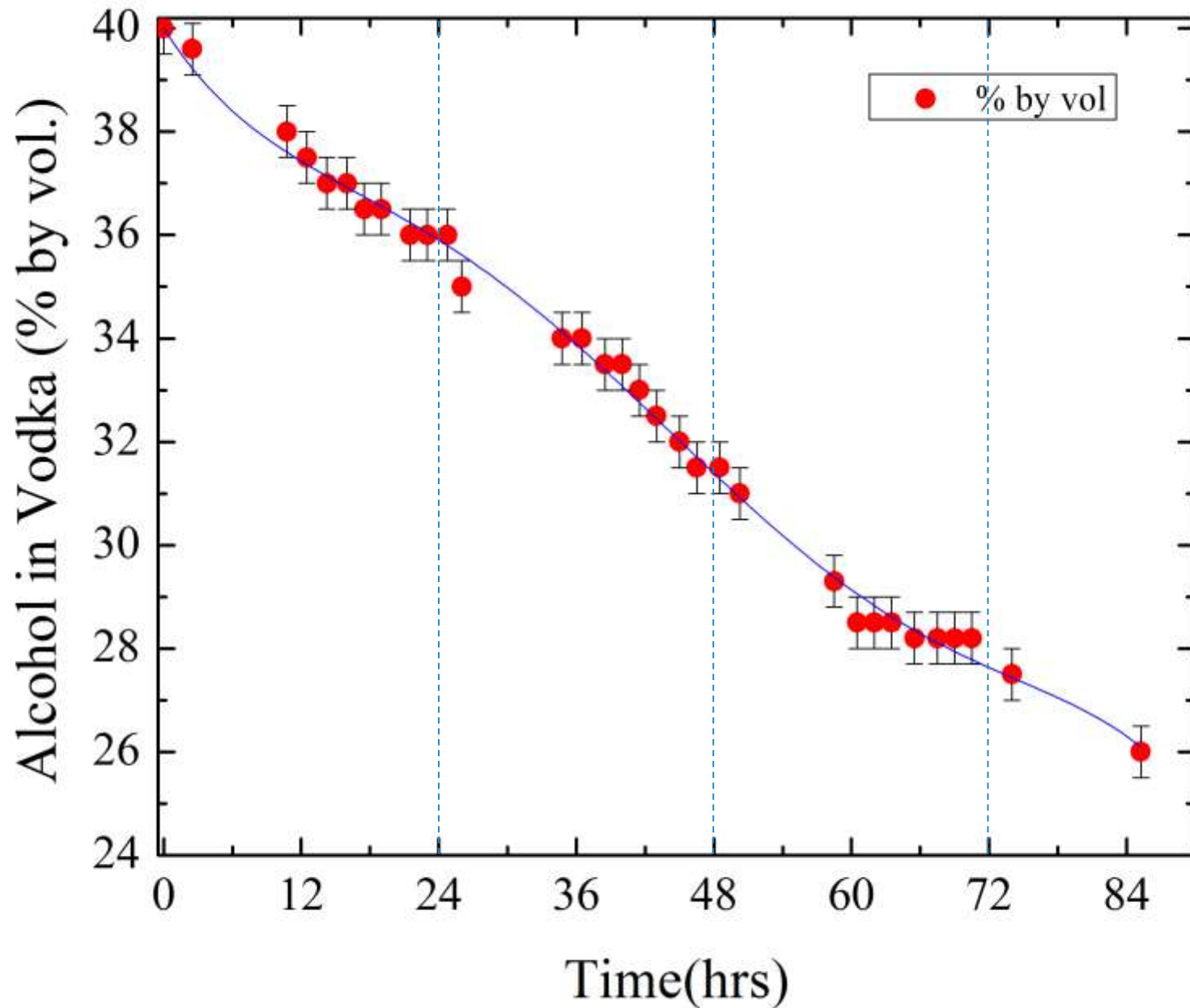
Cd

Br

Nullius in verba !



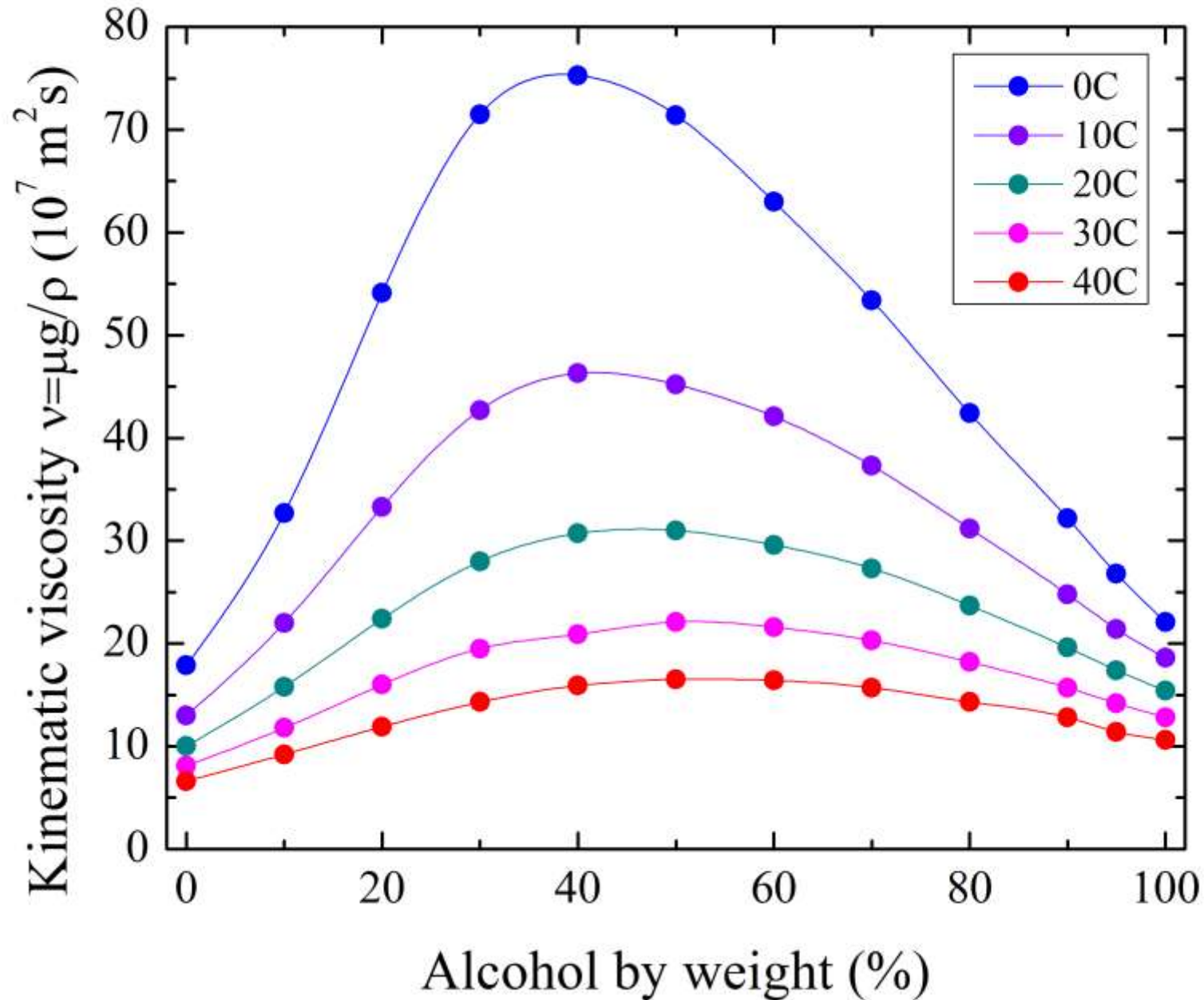
"STRENGTH LOSS IN TIME"



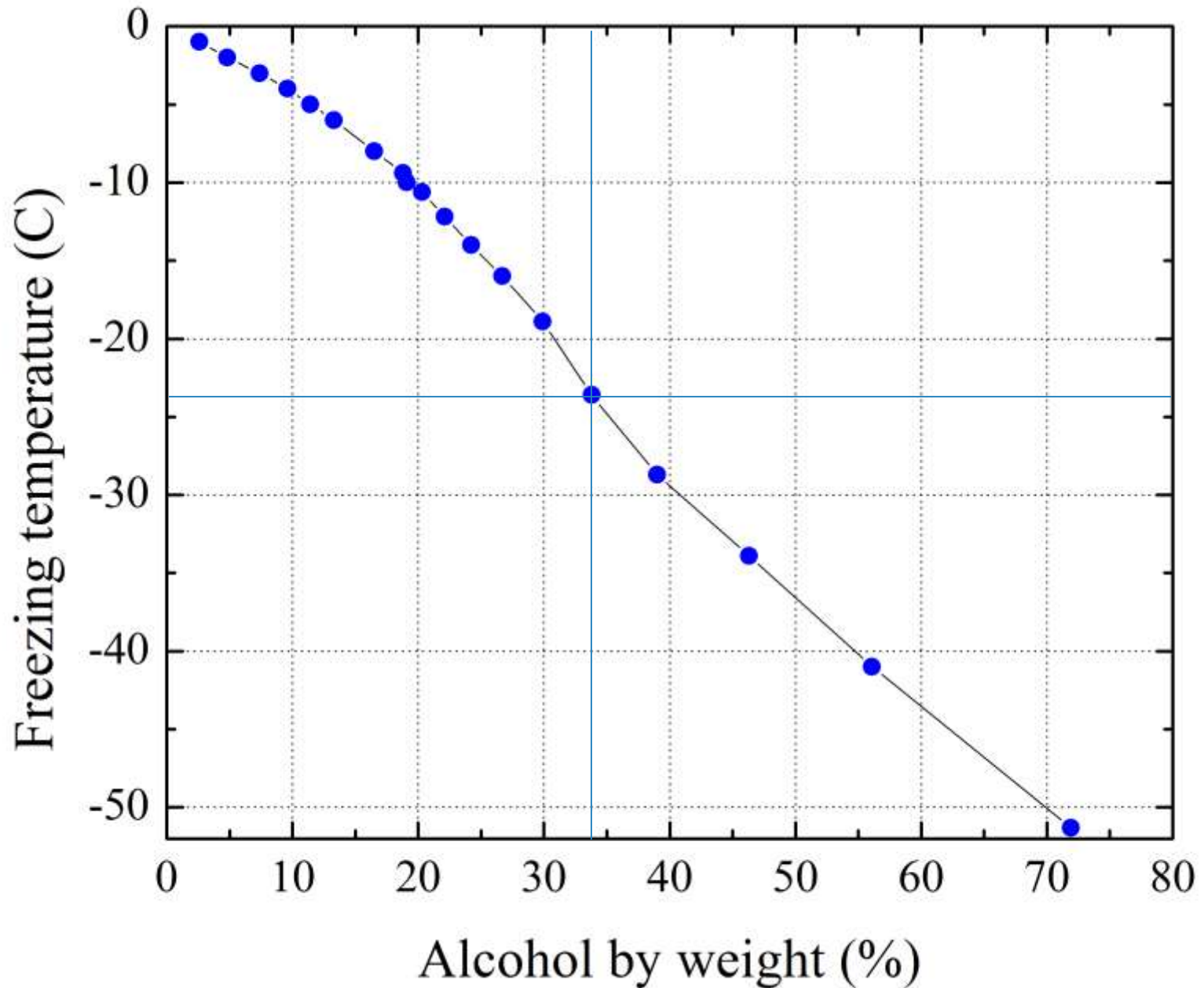
DOES VODKA CATCH FIRE AND BURN ?



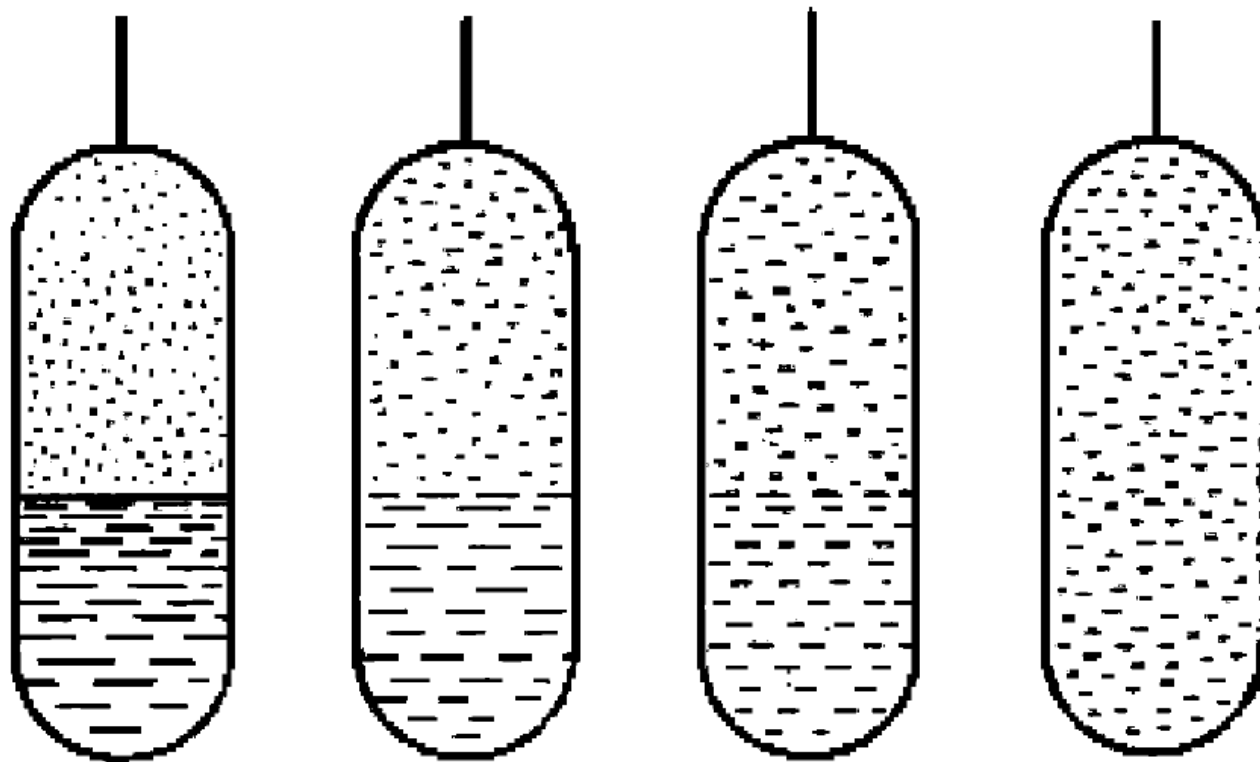
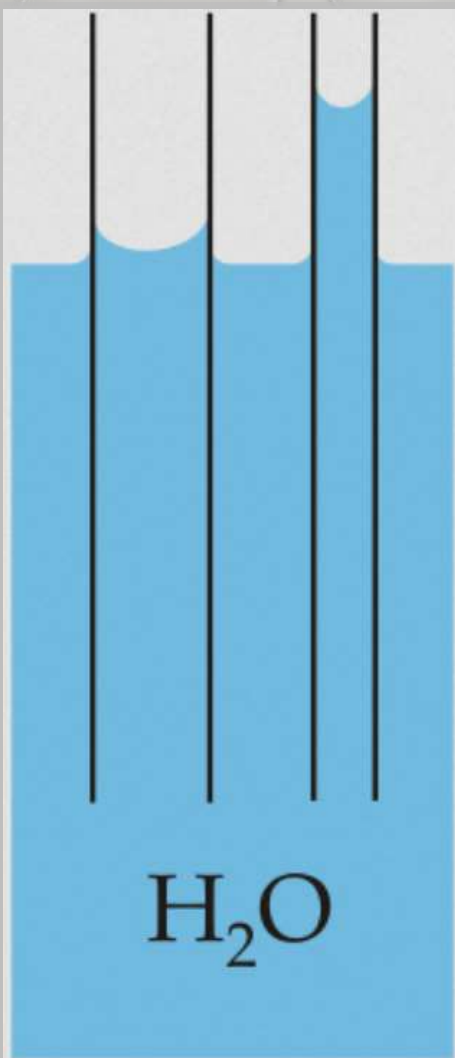
VISCOSITY - “DRINK WHEN COLD”



VODKA - ANTIFREEZE

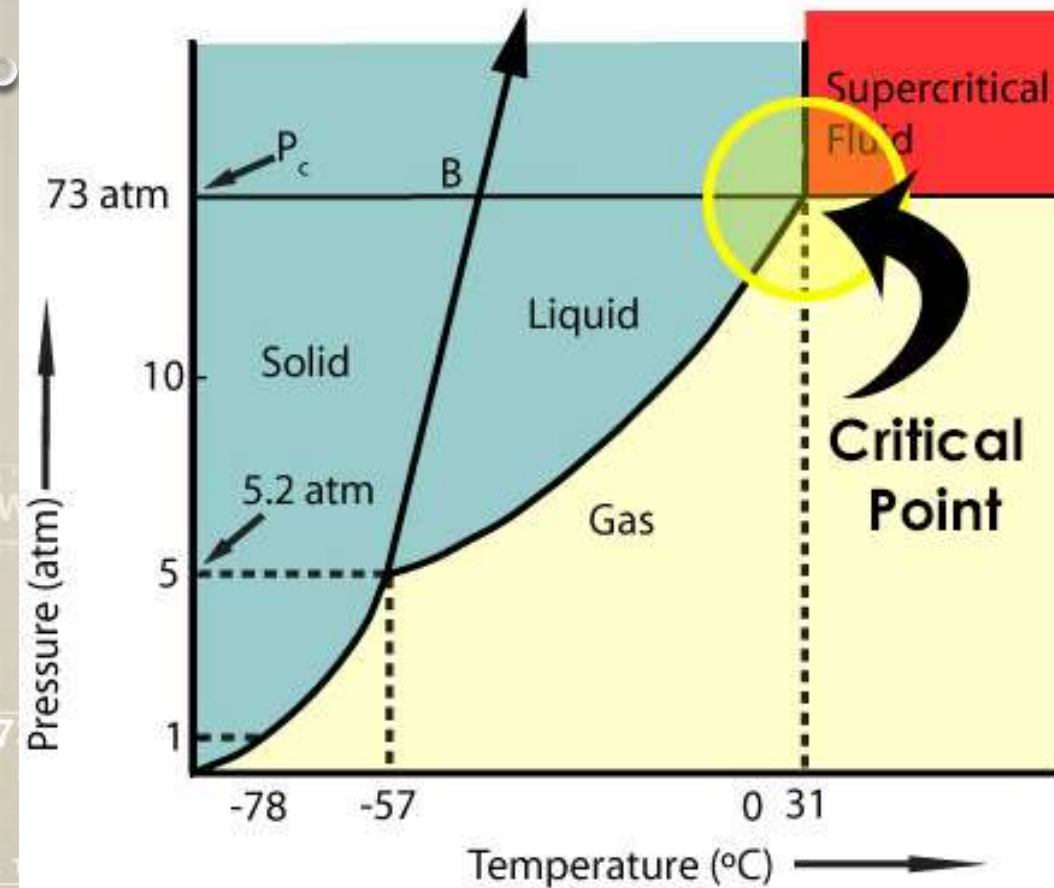


MENDELEEV EXPERIMENTS IN HEIDELBERG (1859-1861)



ную путем сглаживания отличий между фазами иллюстрирует рисунок. Если объем ампулы меньше критического, то по мере нагревания происходит конденсация, и мениск жидкости, не расплываясь, достигает верха ампулы. Если объем ампулы больше критического, то по мере нагревания происходит испарение, и мениск, не расплываясь, опускается до дна. Эта техника была уже известна. Ее использовали Киньяр-де ла Тур (Ch. Cagniard de la Tour, 1822), Фарадей [3], Франкенгейм (1835), и современники Менделеева (Бруннер и Вольф (1857–1858), Дрион (1859), см. ссылку).

SUPERCRITICAL FLUIDS



Substance	Critical temperature		Critical pressure	
	K	C	Pa	atm
Water	647.4	374.3	$22.12 \cdot 10^6$	219.0
Sulfur dioxide	430.7	157.6	$7.88 \cdot 10^6$	78.0
Ammonia	405.5	132.4	$11.28 \cdot 10^6$	111.7
Carbon dioxide	304.2	31.1	$7.39 \cdot 10^6$	73.2
Oxygen	154.8	-118.4	$5.08 \cdot 10^6$	50.3
Nitrogen	126.2	-146.9	$3.39 \cdot 10^6$	33.6
Hydrogen	33.3	-239.9	$1.30 \cdot 10^6$	12.9
Helium	5.3	-267.9	$0.229 \cdot 10^6$	2.27

Decaffeinate coffee beans by S.Crit. CO_2



Kurt Zosel, 1963

Properties of liquid phase, gas phase, and supercritical fluid (SCF)

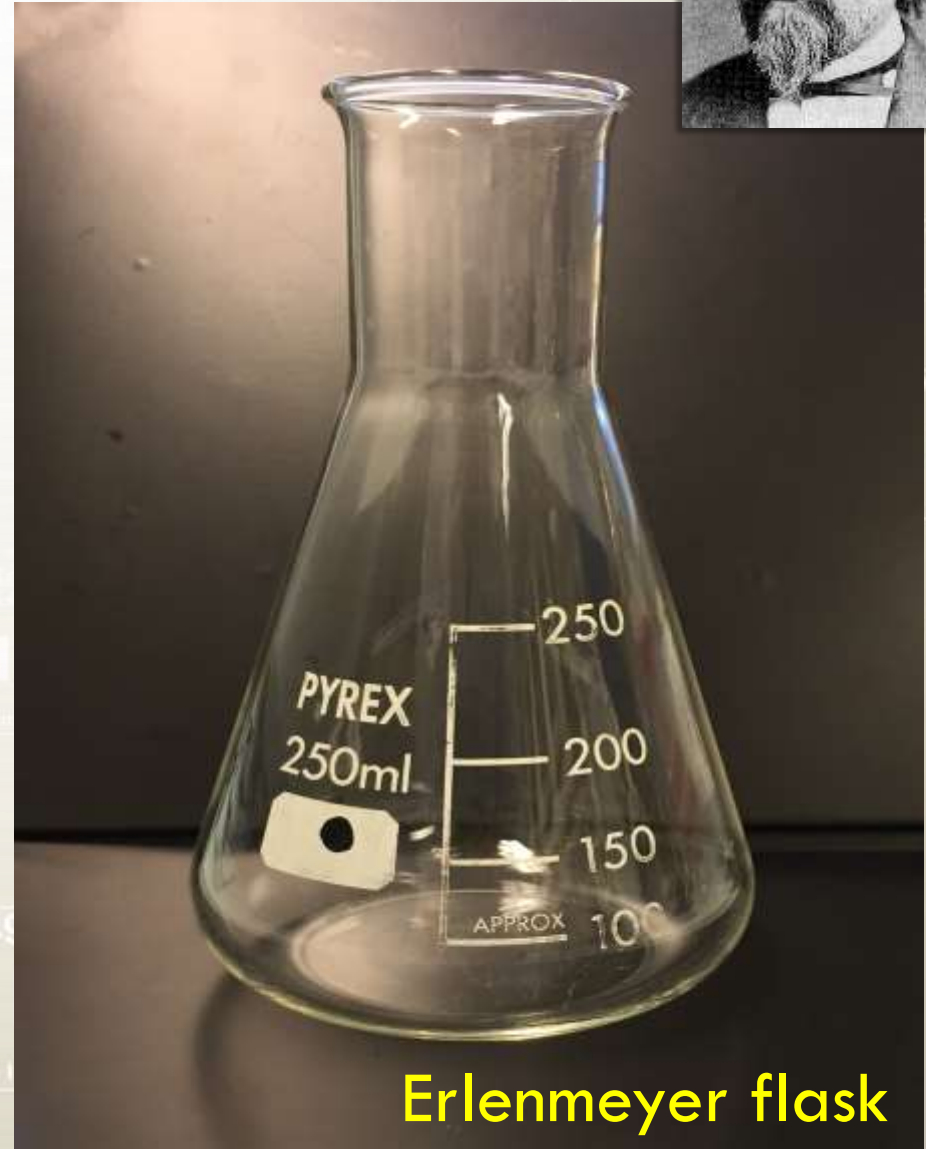
	Liquid	SCF	Gas
Density (g/cm^3)	1	0.1 – 1	10^{-3}
Viscosity (Pa-s)	10^{-3}	$10^{-4} - 10^{-5}$	10^{-5}
Diffusivity (cm^2/s)	10^{-5}	10^{-3}	10^{-1}

Also - cocoa butter from cocoa beans, soybean oil from soybeans, essential oils from spices

HEIDELBERG MENTORS: BUNSEN & ERLENMEYER



Bunsen burner



Erlenmeyer flask

RUSSIAN STUDENTS IN HEIDELBERG

1859-1861

ALEXANDER BORODIN

DIM



"PRINCE IGOR" OPERA

MENDELEEV IN SWITZERLAND 1860

WITH ALEXANDER BORODIN



PARENTS (& 10 BROTHERS AND SISTERS)

Maria (1793-1850)

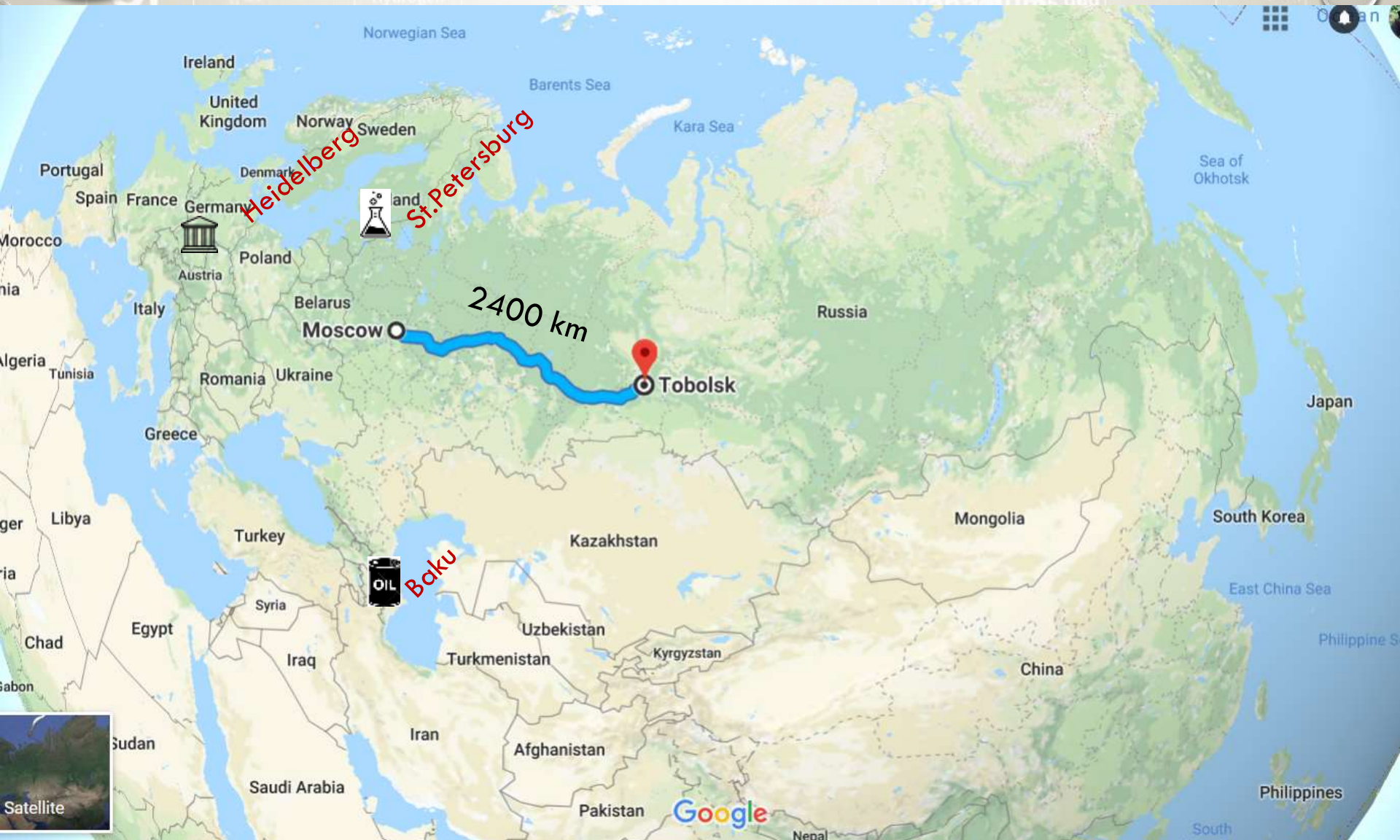


Ivan (1783-1847)



TOBOSLK – CAPITAL OF SIBERIA

1587 - 1838



TOBOLSK NOWADAYS

51

DIM Gymnasium and Museum
(1892 bld.)

Kremlin

Junction of rivers
Tobol and Irtysh



Transit of Venus 1761 observation site

DIM father gymnasium (1810)

MENDELEEV'S FAMILY

(1834-1907)



m. 1862

Vladimir (1865-1898)



Olga (1868-1950)



Feozva Lescheva (1828-1905)

Ufficiale della Marina

Gestore di cani

m. 1882

* 10,000 R



Anna Popova (1860-1942)

Lyuba
1881-1939



Attrice

Ivan
1883-1936



Matematico

Maria
1886-1952



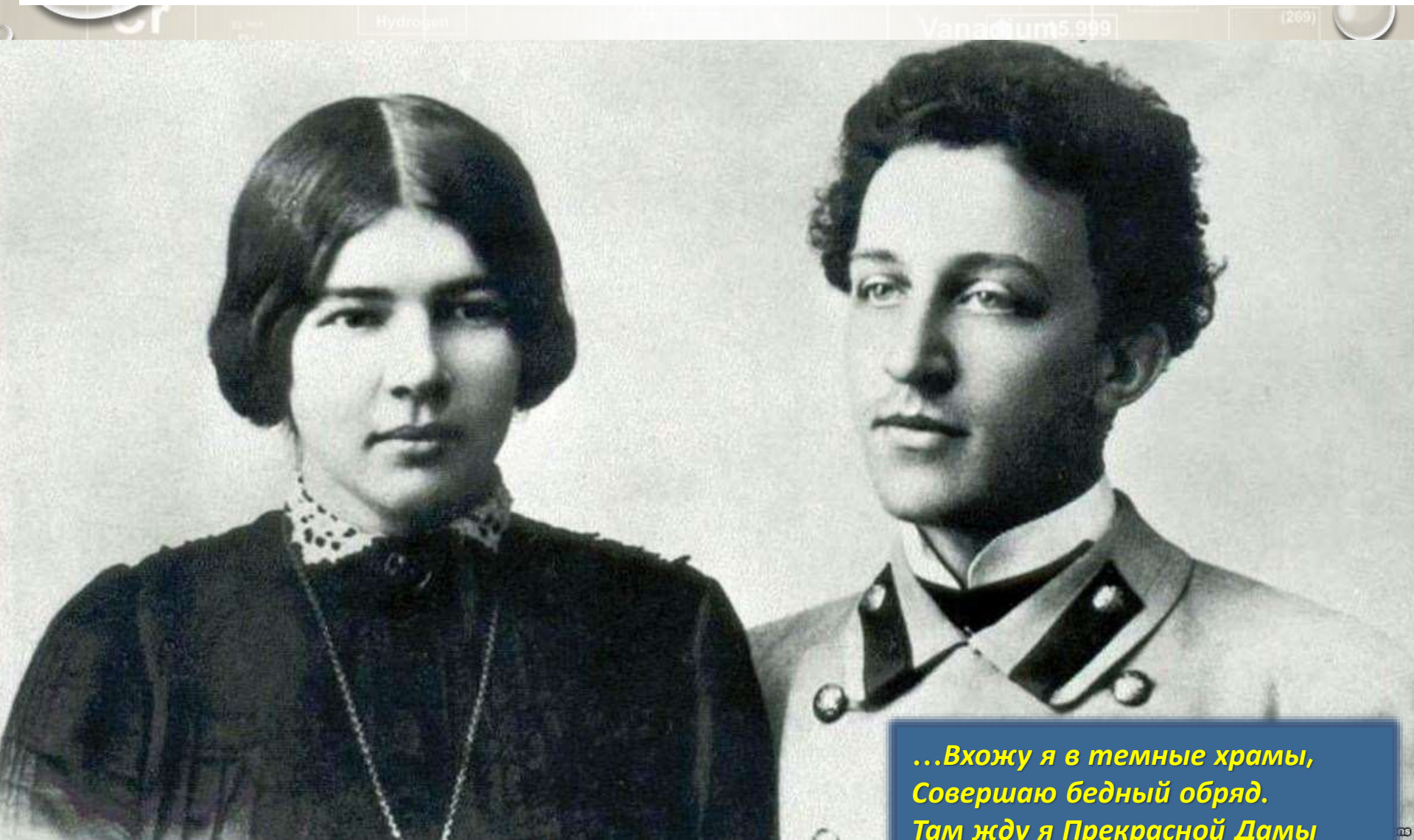
Gestore di cani
#1 in USSR

Vasily
1886-1922



Ingegnere
serbatoio

Lyuba Mendeleeva & Alexander Blok, m.1903.



*...Вхожу я в темные храмы,
Совершаю бедный обряд.
Там жду я Прекрасной Дамы
В мерцаньи красных лампад.*

«Poesie su una bella signora» - 129 (!) [1901-1902]

Google Books Ngram Viewer

$$INDEX_{YEAR} = \frac{\#[WORD]_{YEAR}}{\#[ALL WORDS]_{YEAR}}$$

between 1900 and 2008 from the corpus Russian with smoothing of 3 Search lots of books

Менделеев and Блок



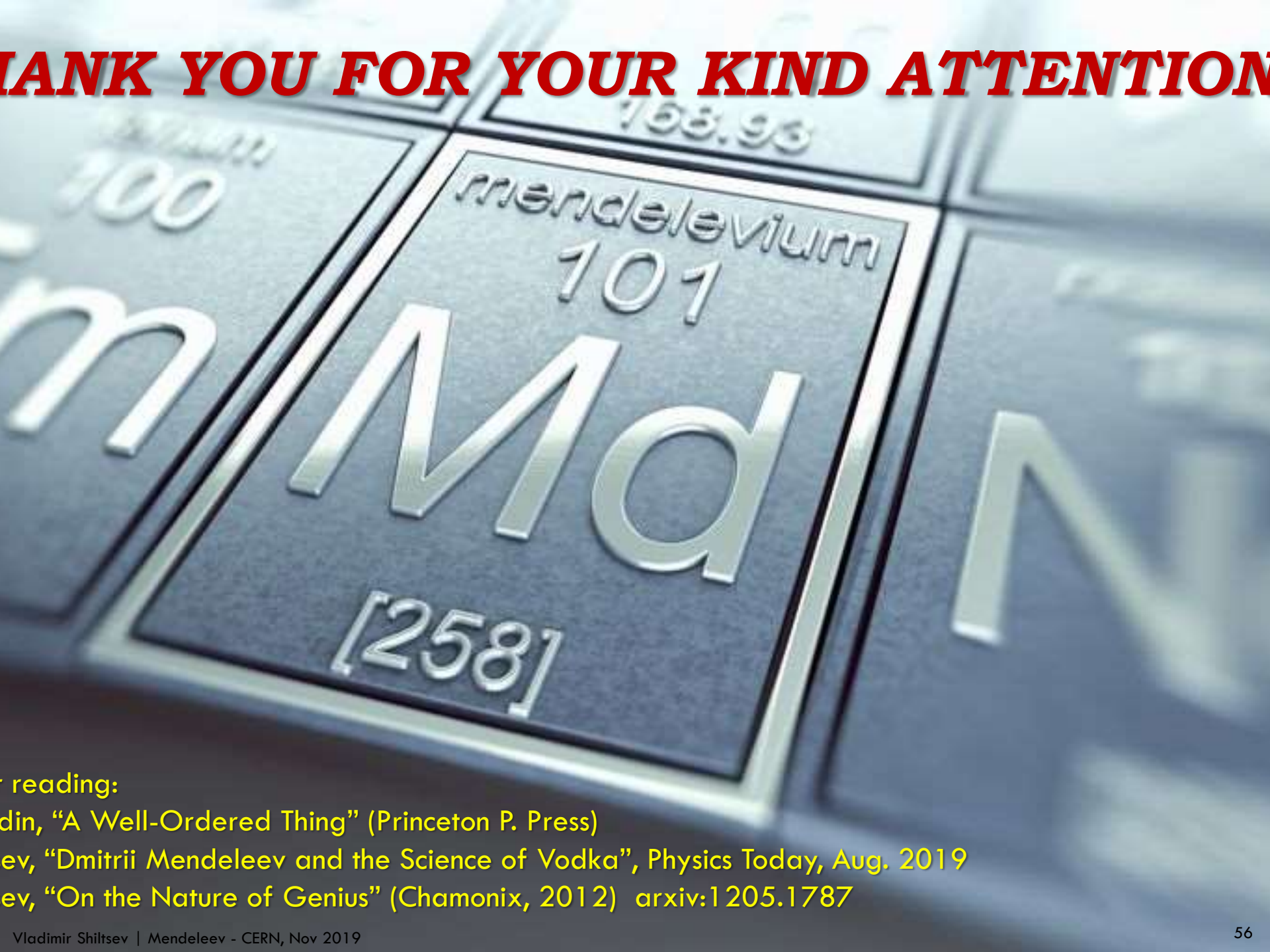
MENDELEEV'S FAME

- **THE PERIODIC TABLE OF ELEMENTS**
- **NON-ELECTION** TO THE RUSSIAN ACADEMY OF SCIENCES IN 1880
- MEMBER OF 150 ACADEMIES AND SOCIETIES: FOR.MEM.R.S., PARIS, BOLOGNA, ACCADEMIA DEI LINCEI, ROME, ETC
- BROAD SPECTRUM OF INTERESTS AND PUBLICATIONS (25 VOLUMES)



In mantle of honorary doctor of
Edinburgh University

THANK YOU FOR YOUR KIND ATTENTION



reading:

udin, "A Well-Ordered Thing" (Princeton P. Press)

ev, "Dmitrii Mendeleev and the Science of Vodka", Physics Today, Aug. 2019

ev, "On the Nature of Genius" (Chamonix, 2012) arxiv:1205.1787