FROM *LOMONOSOV* TO *MENDELEEV* AT THE *BOLOGNA ACADEMY OF SCIENCES*

VLADIMIR SHILTSEV

FERMI NATIONAL ACCELERATOR LABORATORY, BATAVIA, IL, USA

AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE - FELLOW

AMERICAN PHYSICAL SOCIETY – DPB CHAIR, FELLOW

EUROPEAN PHYSICAL SOCIETY

PHD (1994) – NOVOSIBIRSK (RUSSIA)
FERMILAB (CHICAGO, USA) – SINCE 1996

- **Head of the Tevatron Collider 2001-2006**

- **Invented** *electron lenses for supercolliders* **(Tevatron, RHIC, LHC)**
- **Director of Accelerator Physics Center 2007-2018**

CONTENT:

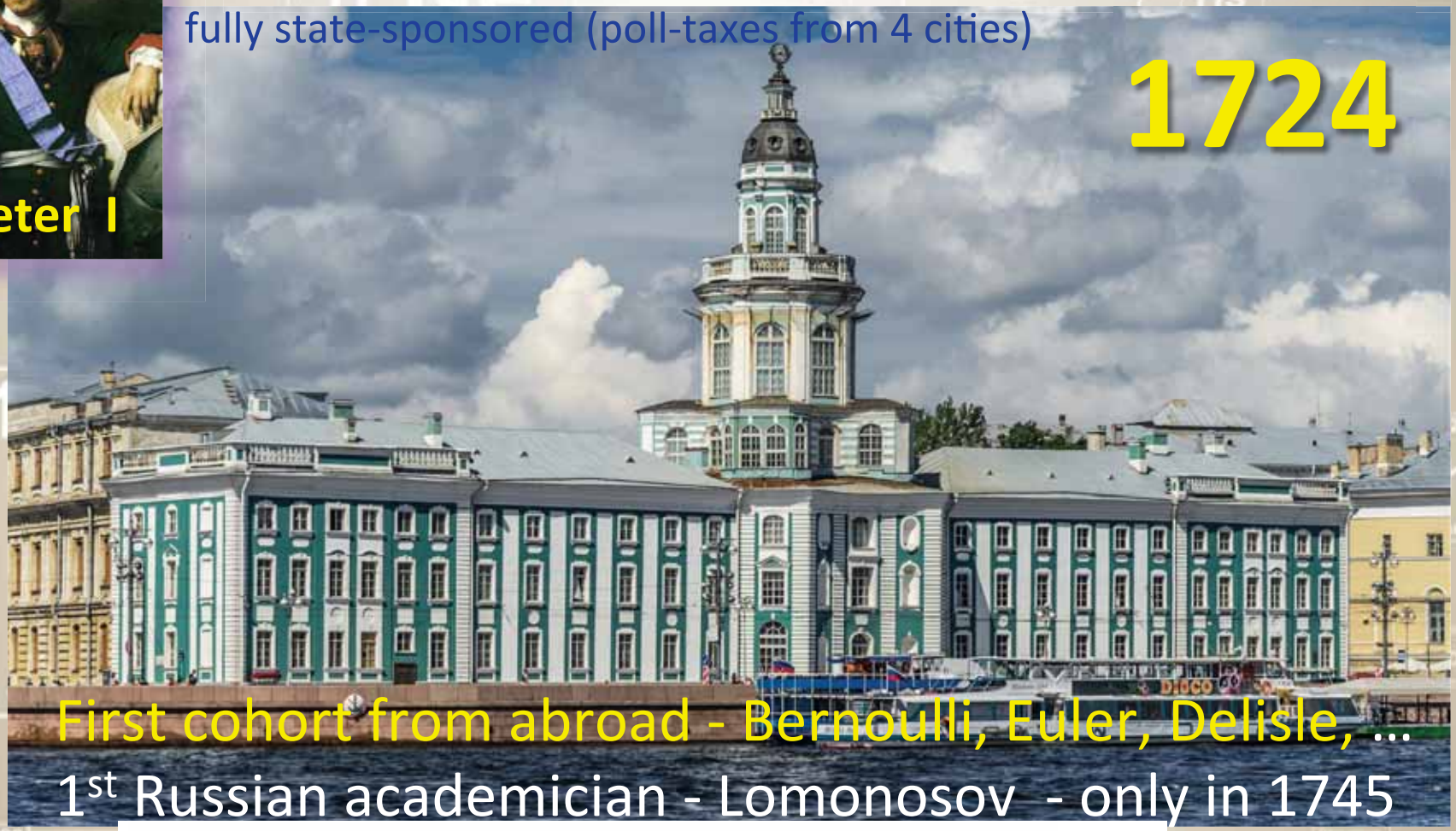
- ***ST. PETERSBURG ACADEMY* OF SCIENCES AND *BOLOGNA ACADEMY***
- **MIKHAIL LOMONOSOV (1711-1765)**
- **DMITRI MENDELEEV (1834-1907)**
- **OUTLOOK**

HISTORY OF RUSSIAN SCIENCE

SAINT-PETERSBURG ACADEMY

fully state-sponsored (poll-taxes from 4 cities)

1724



First cohort from abroad - Bernoulli, Euler, Delisle, …

1st Russian academician - Lomonosov - only in 1745

- **IMPERIAL ACADEMY OF SCIENCES** **1747**
- **RUSSIAN ACADEMY OF SCIENCES** **1917**
- **USSR ACADEMY OF SCIENCES** **1925**
- **RUSSIAN ACADEMY OF SCIENCES** **1991**

ACCADEMIA DELLE SCIENZE
DELL'ISTITUTO DI BOLOGNA (1690)

Previous Bologna Academies:
1511 *Il Viridario*
1588 *Gelati*

Accademia degli Inquiete - **Eustachio Manfredi**

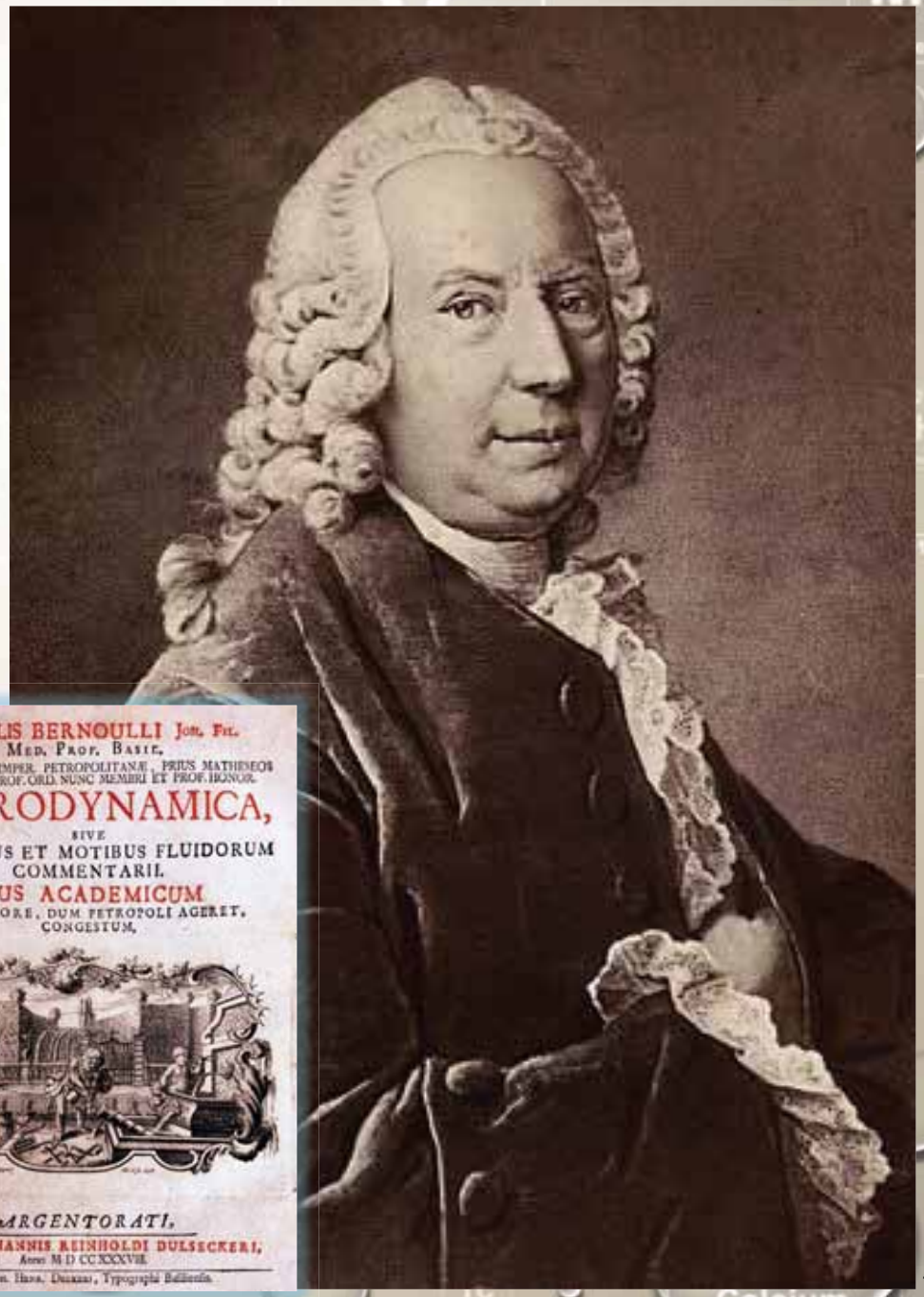
COMPETITION FOR BERNOULLI

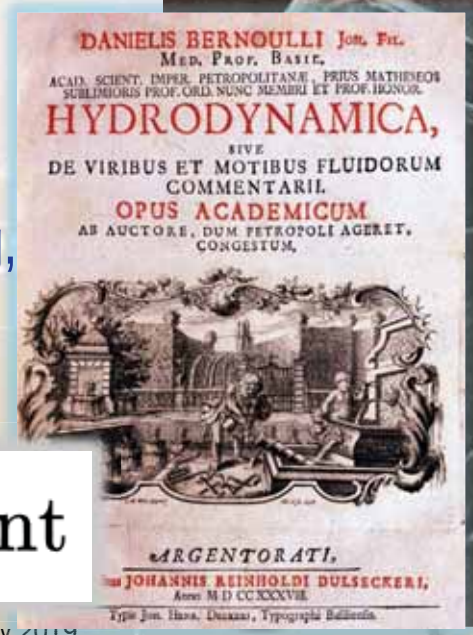
Daniel Bernoulli (1700-1782)

Elected *Bologna Academy* – 1724

Elected *St.Petersburg Academy* - 1724

-chose to go to St.Petersburg, worked there till 1733, then Basel




DANIELIS BERNOULLI Joh. Fil.
Med. Prof. Basil.
ACAD. SCIENT. IMPER. PETROPOLITANÆ, PRIUS MATHESEOS SUBLIMIORIS PROF. ORD. NUNC MEMBRI ET PROF. HONOR.
HYDRODYNAMICA,
SIVE
DE VIRIBUS ET MOTIBUS FLUIDORUM COMMENTARII.
OPUS ACADEMICUM
AB AUCTORE, DUM PETROPOLI AGERET, CONGESTUM.
ARGENTORATI,
Sumptibus JOHANNIS REINHOLDI DULSECKERI,
Anno M D CCXXXVII.
Typis Joan. Henr. Decker, Typographi Basiliensis.

$$\frac{1}{2}\rho u^2 + P = \text{constant}$$

LOMONOSOV

MIKHAIL LOMONOSOV

1711 – 1765

"Father of Russian Science"

TRUE POLYMATH:

- **PHYSICIST AND CHEMIST**
- **POET AND ARTIST**
- **ENGINEER AND ENTREPRENEUR**
- **COURTIER AND ADMINISTRATOR**
- **PHILOLOGIST AND ASTRONOMER**
- **GEOLOGIST AND MINERALOGIST**
- **ETC ETC**

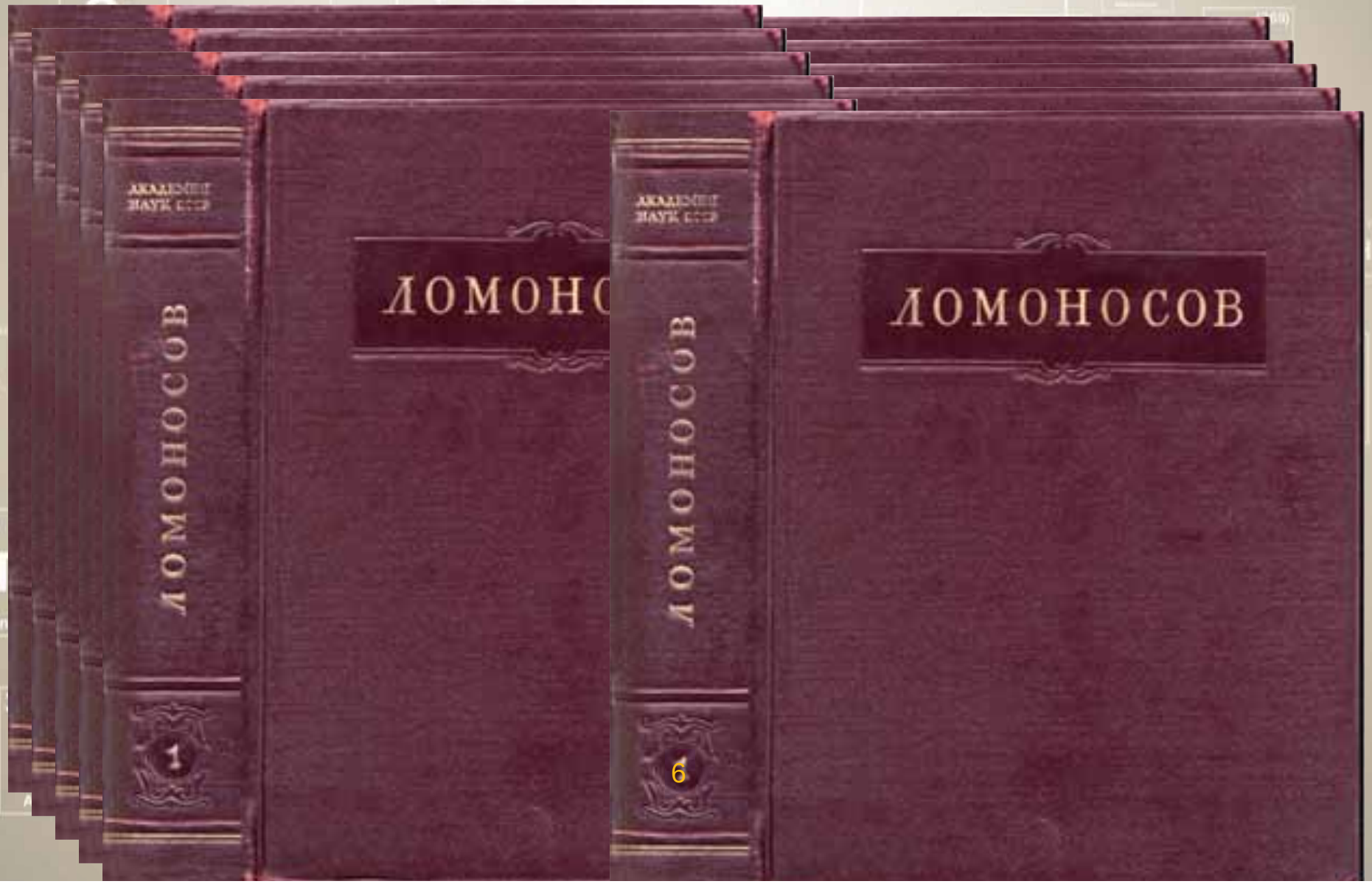
NAMED AFTER LOMONOSOV

- **MOSCOW STATE UNIVERSITY** – RUSSIAN "NUMBER ONE"
- **TOWN (NEAR ST. PETERSBURG)**, HOME VILLAGE IN THE NORTH
- **RANGE** IN ARCTIC OCEAN, OCEAN STREAM, PENINSULA, MOON CRATER, MINERAL, CRAYFISH SPECIES
- THREE OTHER UNIVERSITIES
- ONE THEATER
- **RUSSIAN STATE PORCELAIN FACTORY**
- 8 SCHOOLS
- 54 STREETS AND SQUARES
- RUSSIAN STATE-WIDE TERCENTENNIAL CELEBRATION IN 2011

Moscow State University
Named after M.V.Lomonosov
https://ittorina.spbland.ru/

ROOTS & EARLY LIFE

LOMONOSOV *COMPLETE WORKS* **1950-83**

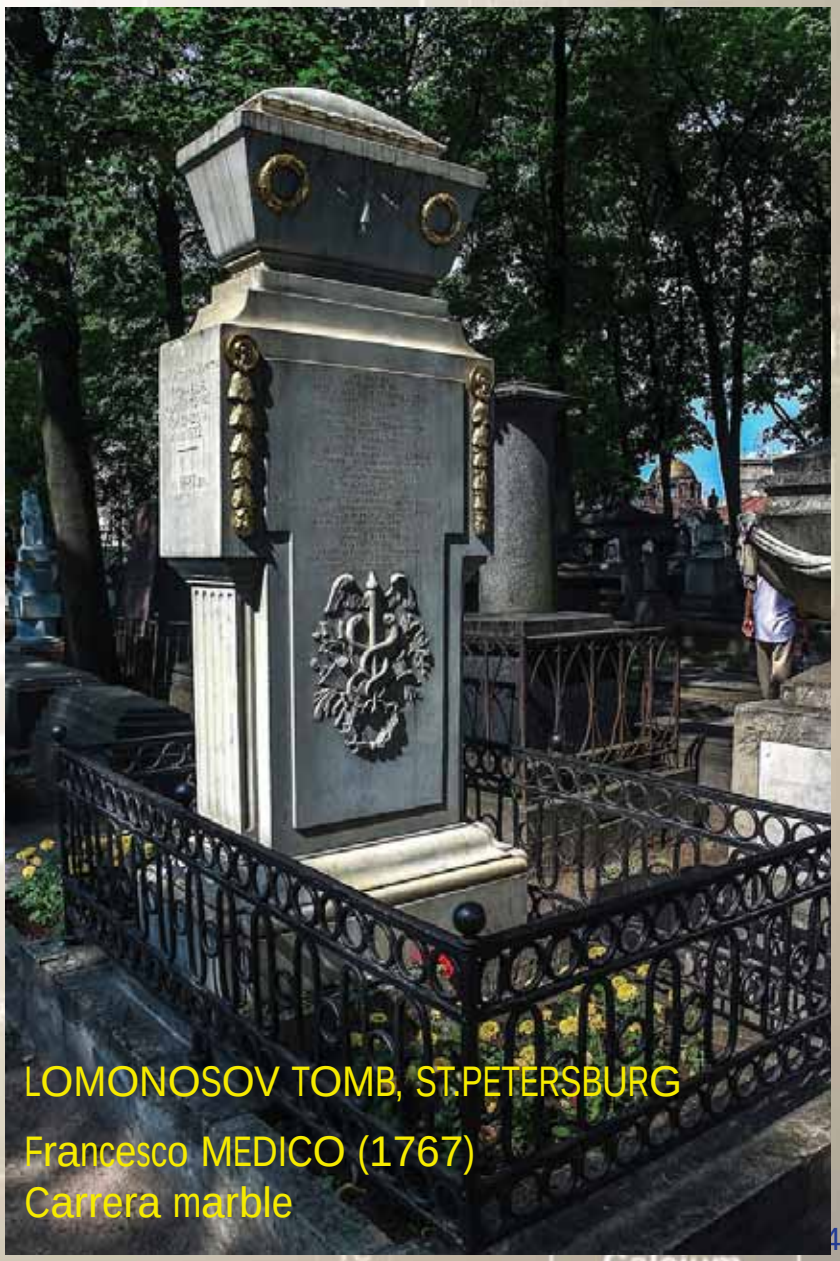


6 volumes out of 11 on Natural Sciences: Physics, Chemistry, Astronomy, Geology, Geography

LOMONOSOV AND BOLOGNA ACADEMY

(knew Italian)

STATE CHANCELLOR OF RUSSIAN EMPIRE (1758-1765)



LOMONOSOV TOMB, ST.PETERSBURG

Francesco MEDICO (1767)
Carrera marble

VORONTSOV'S 1764 TRIP TO ITALY

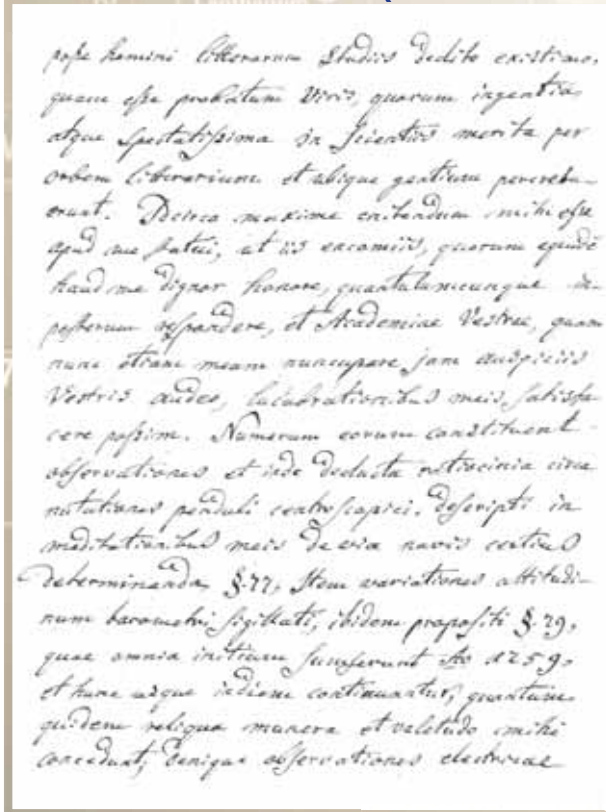
1) arranged article on mosaics in "*Novelle Letterarie Firenze*" via Francesco ALGAROTTI
2) Recommended LOMONOSOV to Bologna Academy
3) Passed LOMONOSOV's convolute "*Opera Academica*" to Bologna (ZANOTTI)

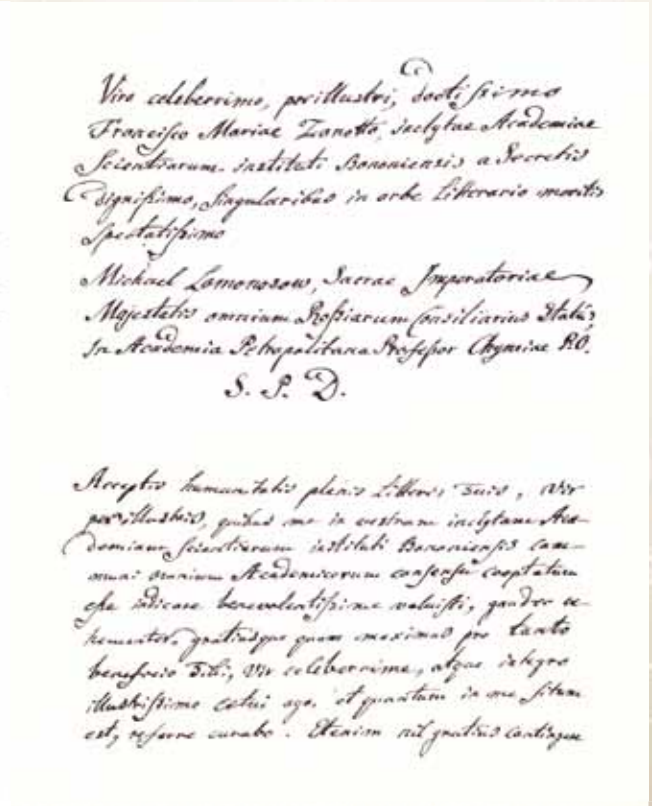
LOMONOSOV GOT ELECTED

FOREIGN MEMBER OF *BOLOGNA ACADEMY APRIL 6, 1764*

COMMUNICATIONS WITH **FRANCESCO MARIA ZANOTTI**, ACADEMY SECRETARY (APRIL – MAY 1764)

(Reproduced with kind permission of *Biblioteca Universitaria di Bologna*)

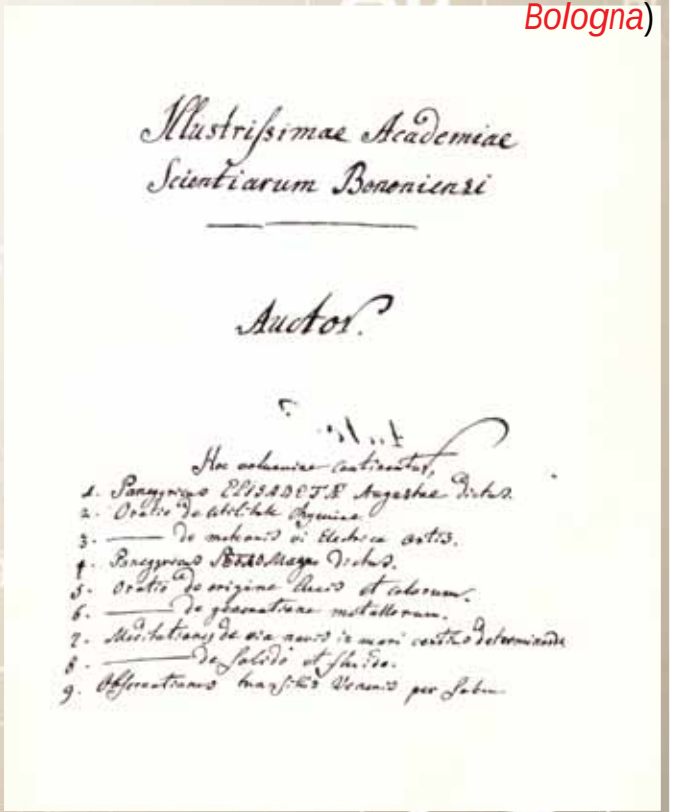




Viro celeberrimo, perillustri, doctissimo
Francisco Mariae Zanotti, sacrae Academiae
Scientiarum instituti Bononiensis a Secretis
Dignissimo, singularibus in orbe Litterario meritis
Spectatissimo

Michael Lomonosow, Sacrae Imperatoriae
Majestatis omnium Rossiarum consiliarius Status
in Academia Petropolitana Professor Chymiae RO.
S. P. D.

Accepto humanitatis plenis Litteris Tuis, Vir
perillustris, quibus me in eximiam insignem Aca-
demiam Scientiarum instituti Bononiensis com-
munis omnium Academicorum consensu cooptatum
esse indicasti benevolentissime valuisti, gaudeo ve-
hementer, gratiasque quam maximas pro tanto
beneficio Tibi, Vir celeberrime, atque integro
illustrissimo coetui ago, et quantum in me situm
est, referre curabo. Etenim nil gratius contigit



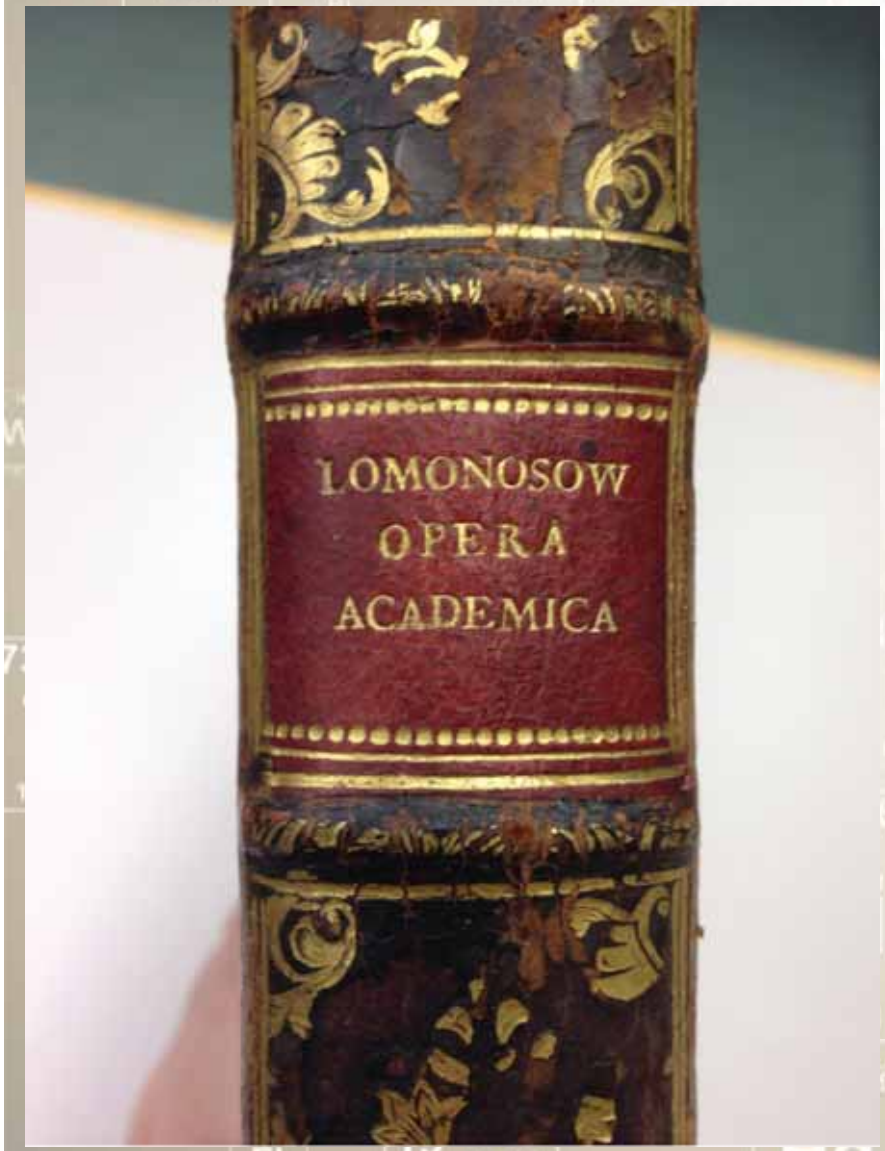
Illustrissimae Academiae
Scientiarum Bononiensi

Auctor.

Hic volumine continentur,
1. Panegyricus ELISABETH Augustae dictus.
2. Orationes de utilitate Chymiae.
3. —— de mutatione ai electrica aetis.
4. Panegyricus Petro Magno dictus.
5. Orationes de origine Maris et colorum.
6. —— de generatione metallorum.
7. Meditationes de via navis in mari centro determinanda.
8. —— de solido et fluido.
9. Observationes magnetis Veneris per solem

Thanks to: M.Caroli, L.Nanetti, L.Cifarelli, A.Oleandri, S.Romaschenko

OPERA ACADEMICA CONVOLUTE (9 PAPERS)



I. PANEGYRICUS ELISABETAE AUGUSTAE (1751, LATIN)

II. ORATIO DE UTILITATE CHEMIAE (1752, LATIN)

III. ORATIO DE METEORIS VI ELECTRICA ORTIS. (1753, LATIN)

IV. PANÉGIRIQUE DE PIERRE LE GRAND (1755, FRENCH)

V. ORATIO DE ORIGINE LUCIS SISTENS NOVAM THEORIAM COLORUM (1756, LATIN)

VI. ORATIO DE GENERATIONE METALLORUM A TERRAE MOTU (1757, LATIN)

VII. MEDITATIONES DE VIA NAVIS IN MARI (1759, LATIN)

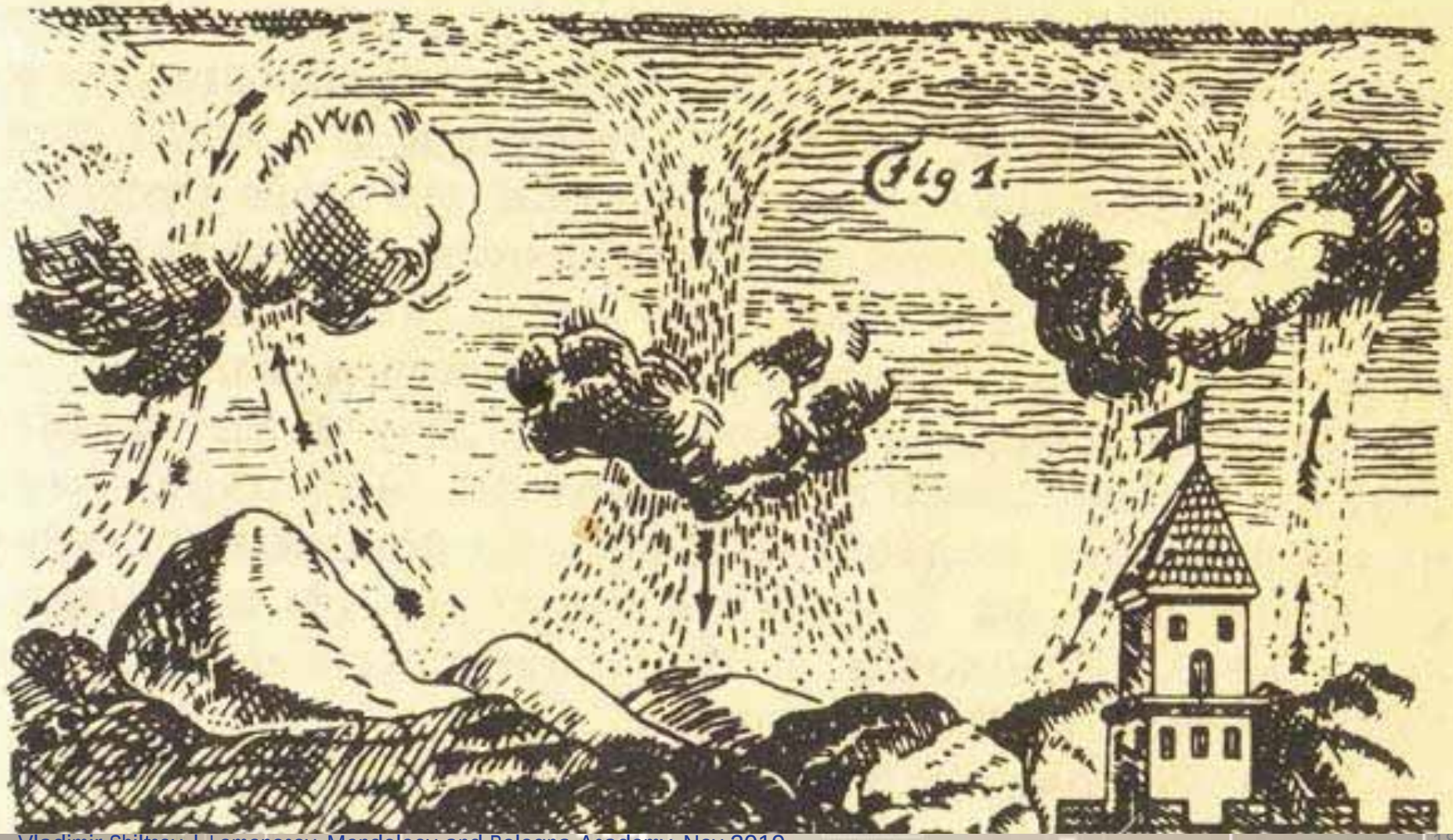
VIII. MEDITATIONES DE SOLIDO ET FLUIDO (1760, LATIN)

IX. ERSCHEINUNG DER VENUS… (VENUS ATMOSPHERE - 1761, GERMAN)

THEORY OF ATMOSPHERIC ELECTRICITY

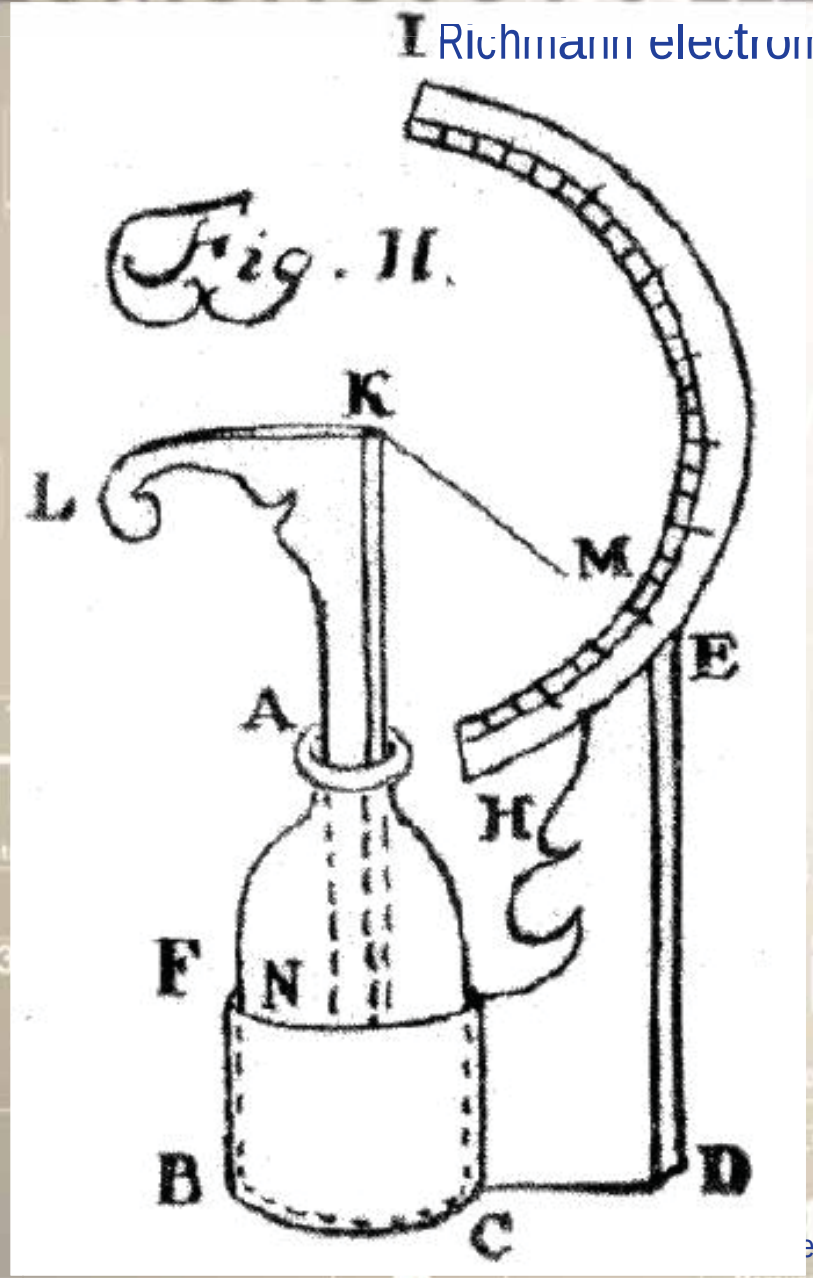
Air density increase due to lower temperature in upper atmosphere is ~2.5 times stronger than density decrease due to high elevation

1753



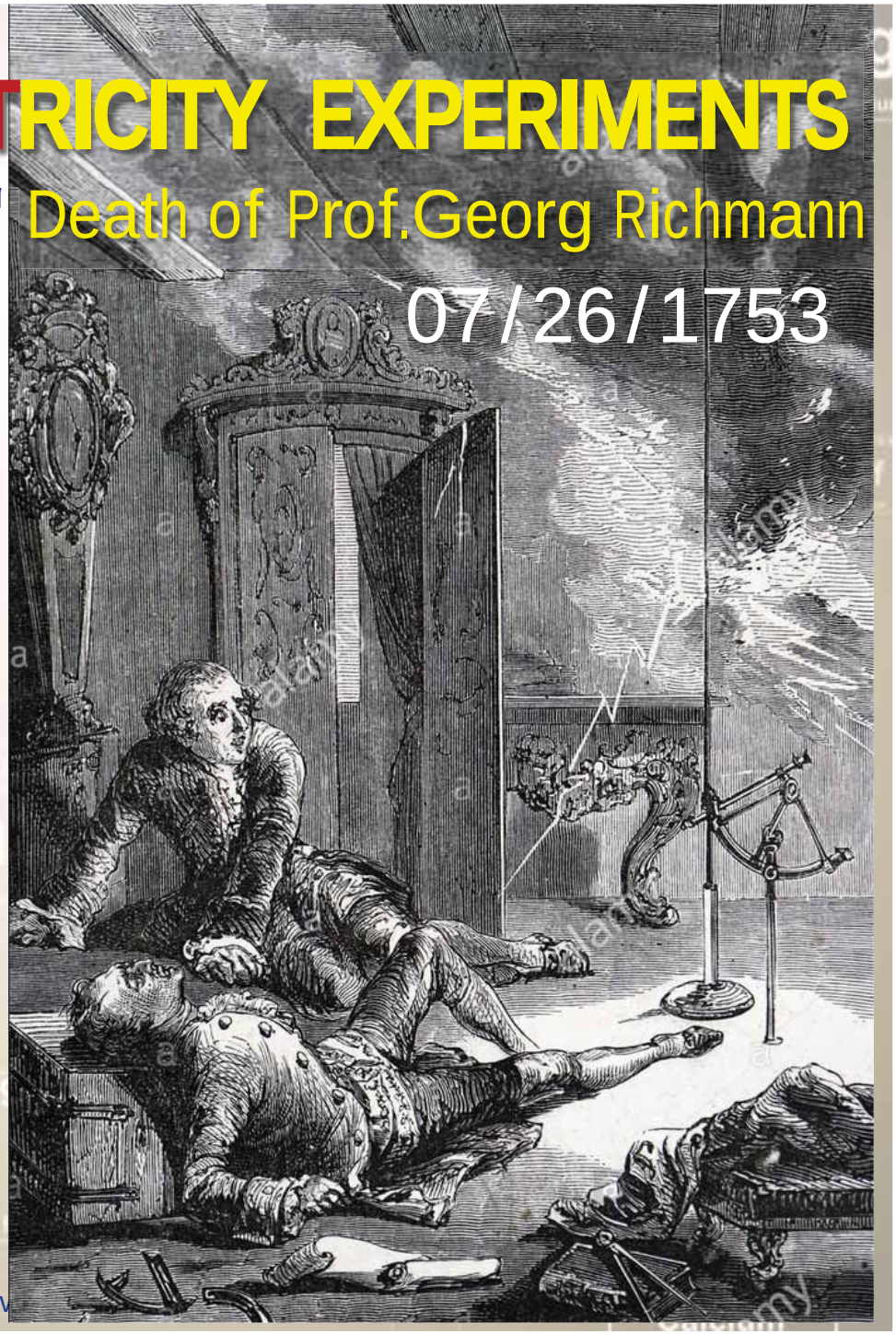
LOMONOSOV'S ELECTRICITY EXPERIMENTS

Richmann electrometer



Death of Prof.Georg Richmann

07/26/1753



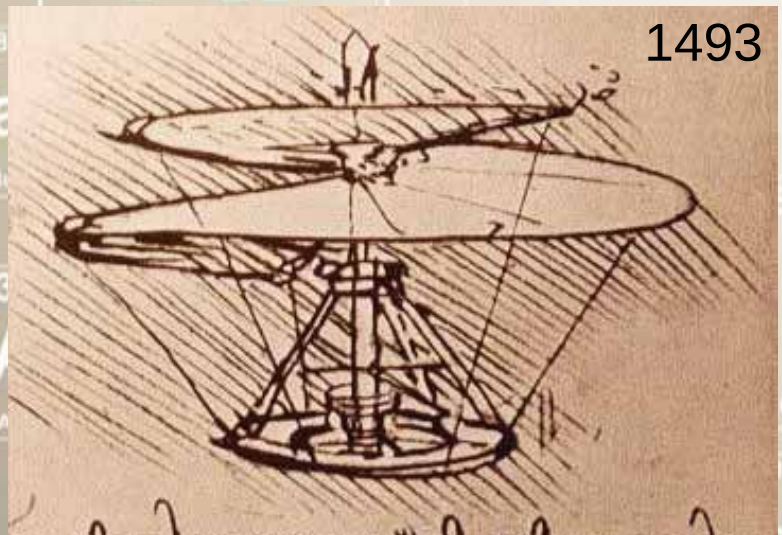
emy, Nov

1754 LOMONOSOV'S "AERODYNAMIC MACHINE"

9 grams of thrust !

Chinese top
4th cent. A.D.

Leonardo's "airscrew"
1493



* counter-rotating blades
**for atmospheric research

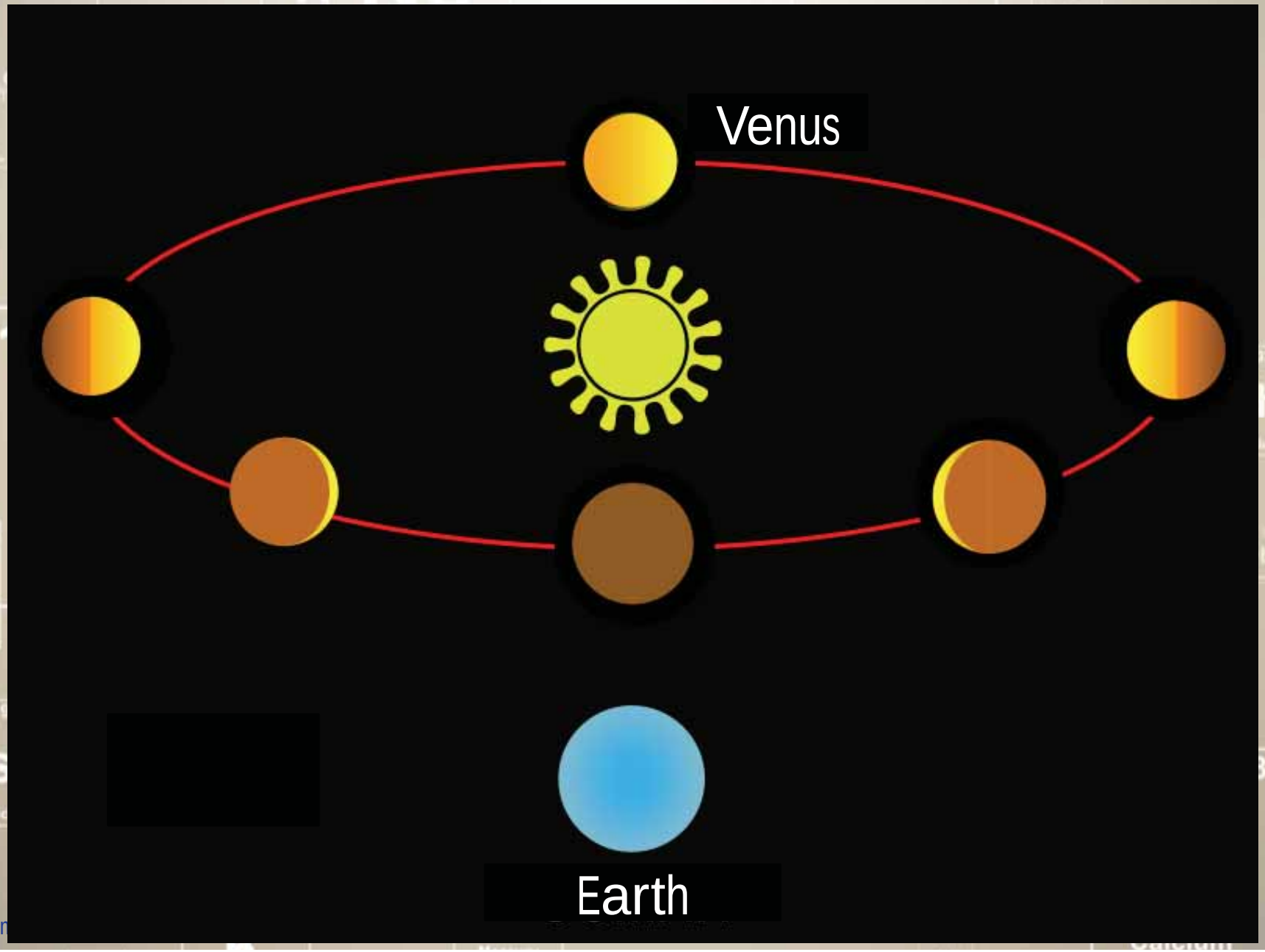
DISCOVERY OF VENUS'S ATMOSPHERE

- **IN 1761, MIKHAIL LOMONOSOV OBSERVING THE TRANSIT OF VENUS NOTED APPEARANCE OF LUMINOUS ARC OVER THE PART OF THE PLANET OFF THE SUN'S DISC AT EGRESS:**

«…FROM THESE OBSERVATIONS, MR. COUNCILOR LOMONOSOV CONCLUDES THAT THE PLANET VENUS IS SURROUNDED BY A SIGNIFICANT AIR ATMOSPHERE SIMILAR TO (IF NOT EVEN GREATER THAN) THAT WHICH SURROUNDS OUR TERRESTRIAL GLOBE…»

Source: "The Appearance of Venus On The Sun, Observed At The St.Petersburg Imperial Academy Of Sciences On May 26, 1761." , StP.Acad.Sci. Print, July 17, 1761

SUN, VENUS AND EARTH



TRANSITS OF VENUS OVER SUN'S DISC

lasts about 6 hours

1761: JUNE 6

1769: JUNE 3-4

1874: DEC 8-9

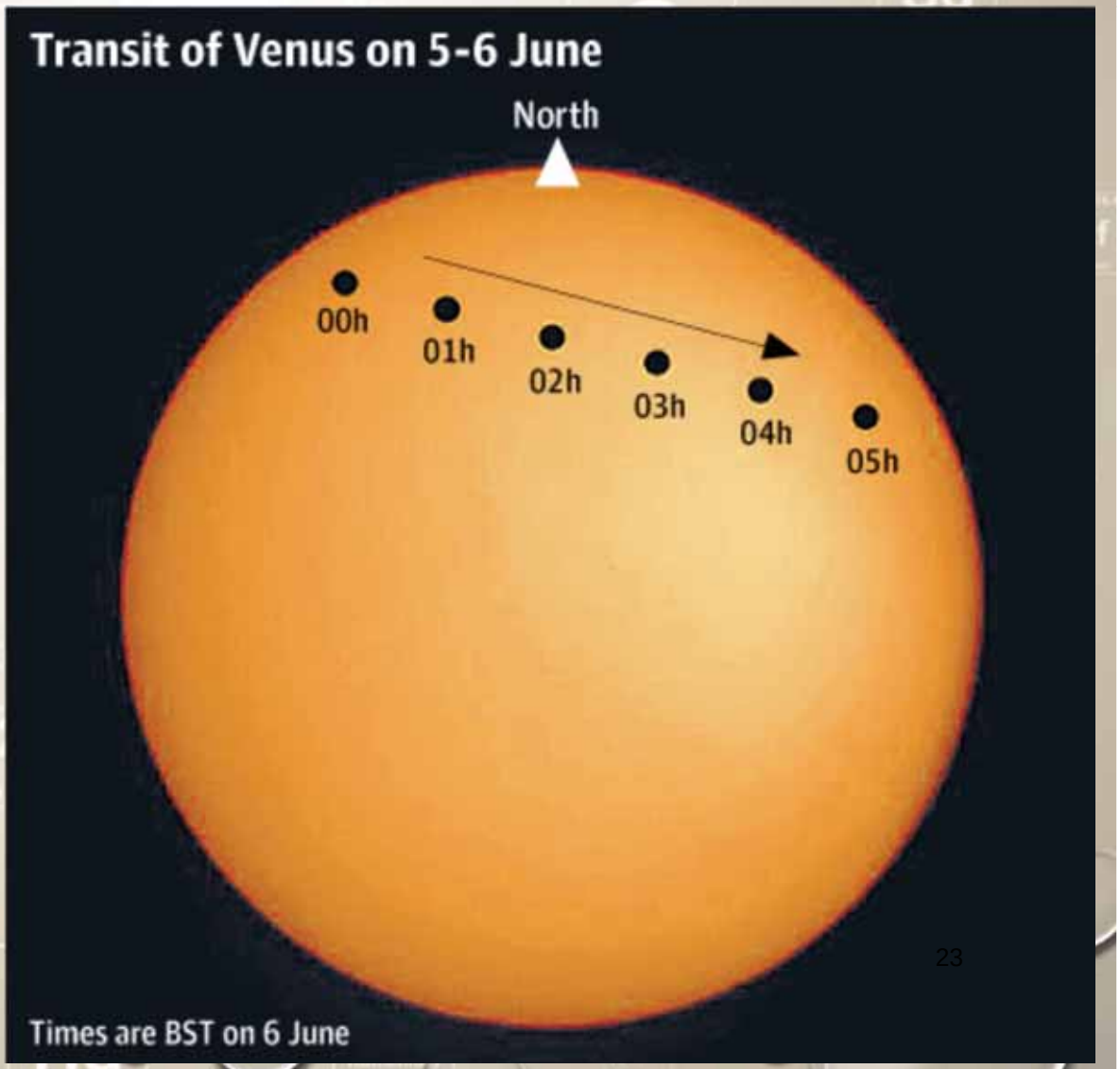
1882: DECEMBER 6

2004: JUNE 8

2012: JUNE 5-6

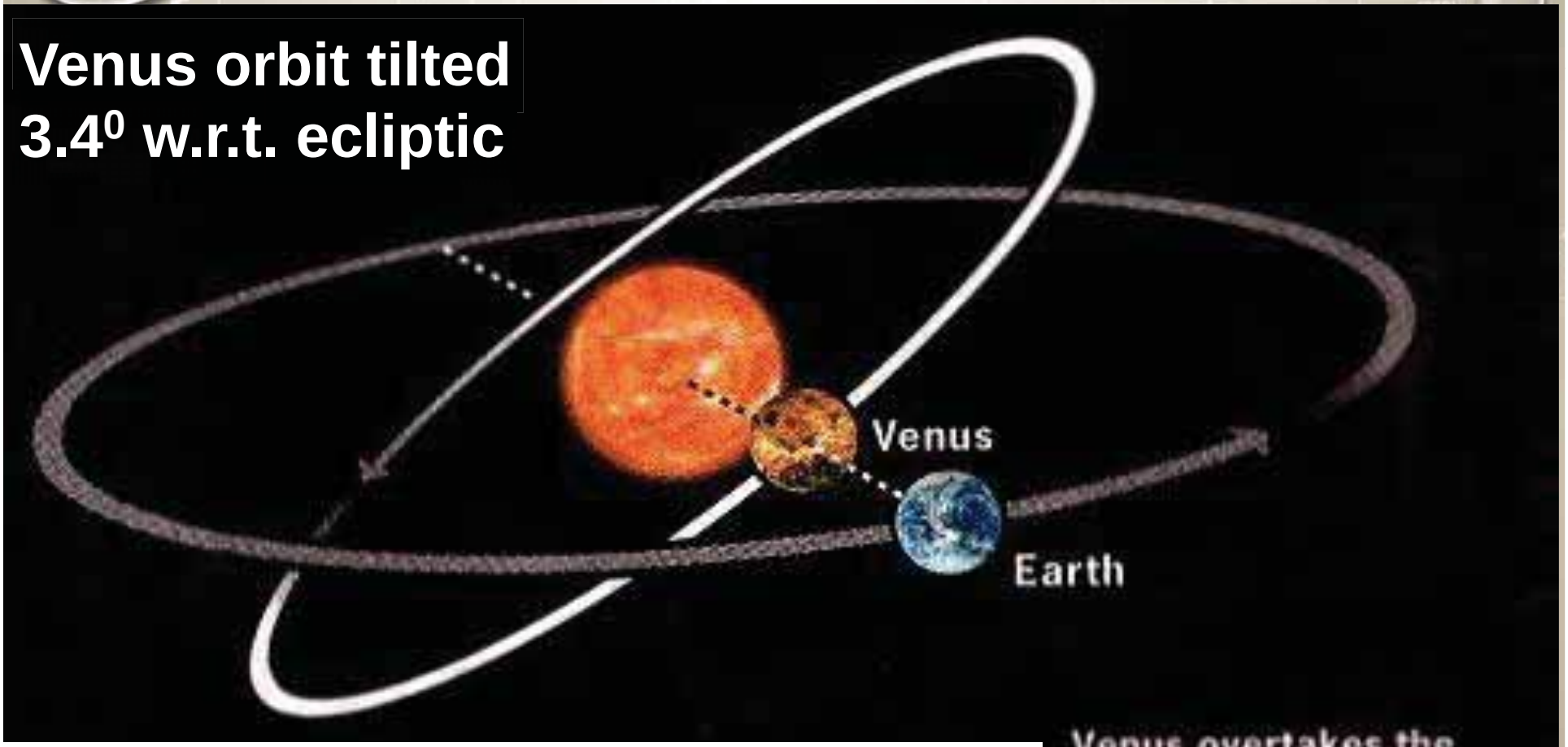
2117: DEC 11

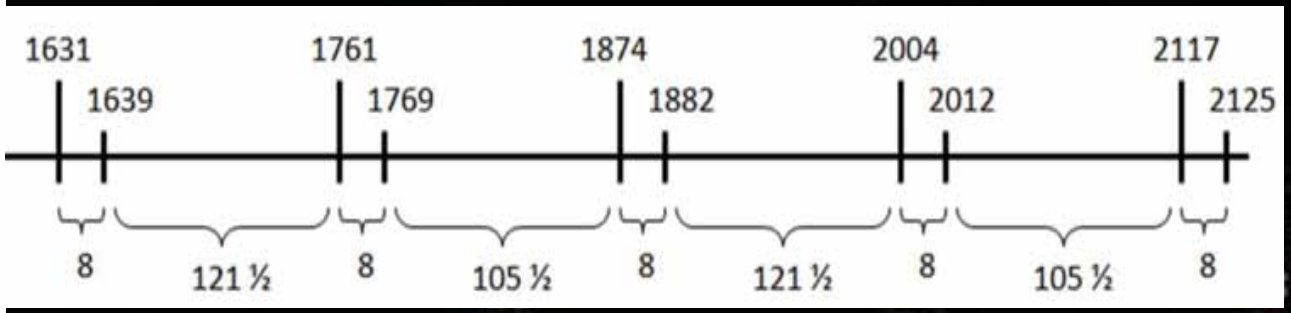
2125: DECEMBER 8



WHY SO RARELY? TILTED ORBITS

Venus orbit tilted
3.4^0 w.r.t. ecliptic

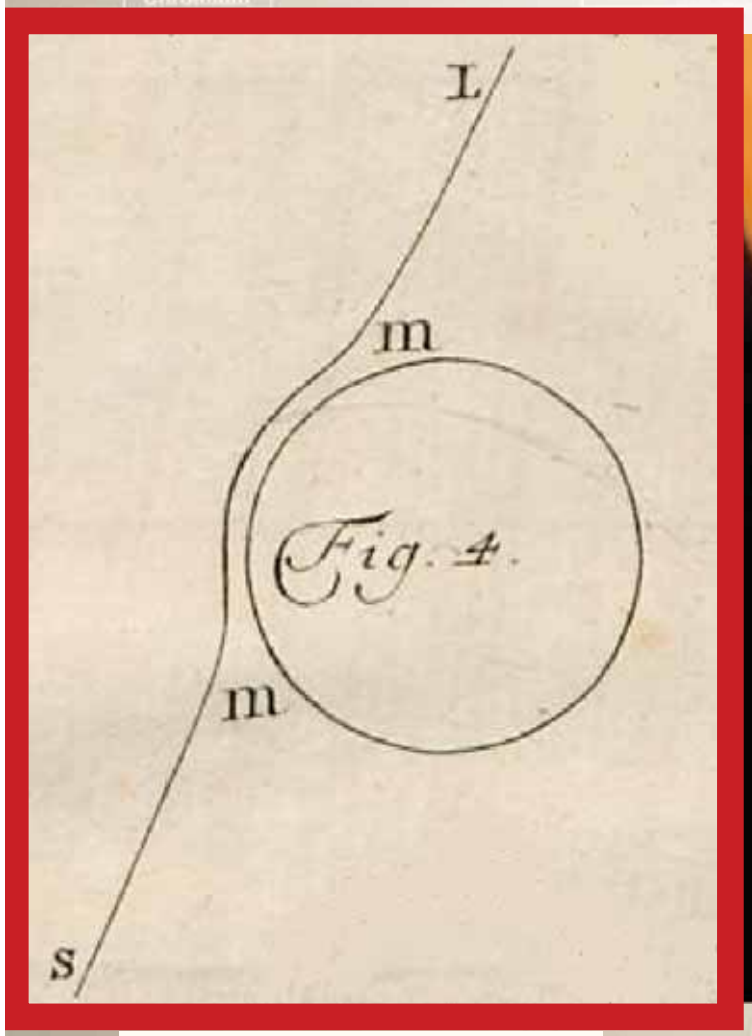




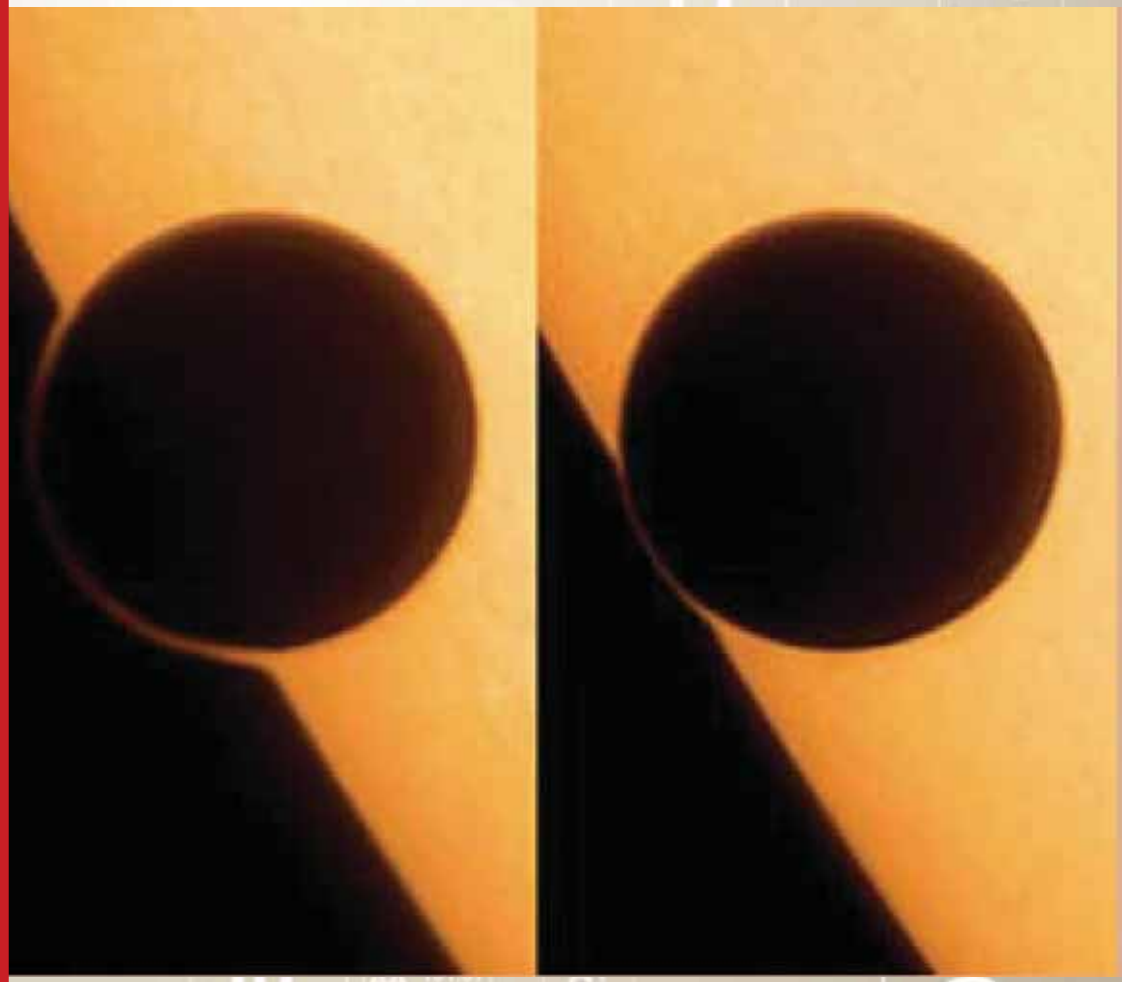
Venus overtakes the Earth on the inside every 584 days, but because of the inclined orbit, transits occur only four times every 243 years

VENUS ATMOSPHERE → *LOMONOSOV'S ARC*

1761 AND NOW



From Lomonosov's 1761 paper



COMOLLI (HTTP://ASTROSURF.COM/COMOLLI)

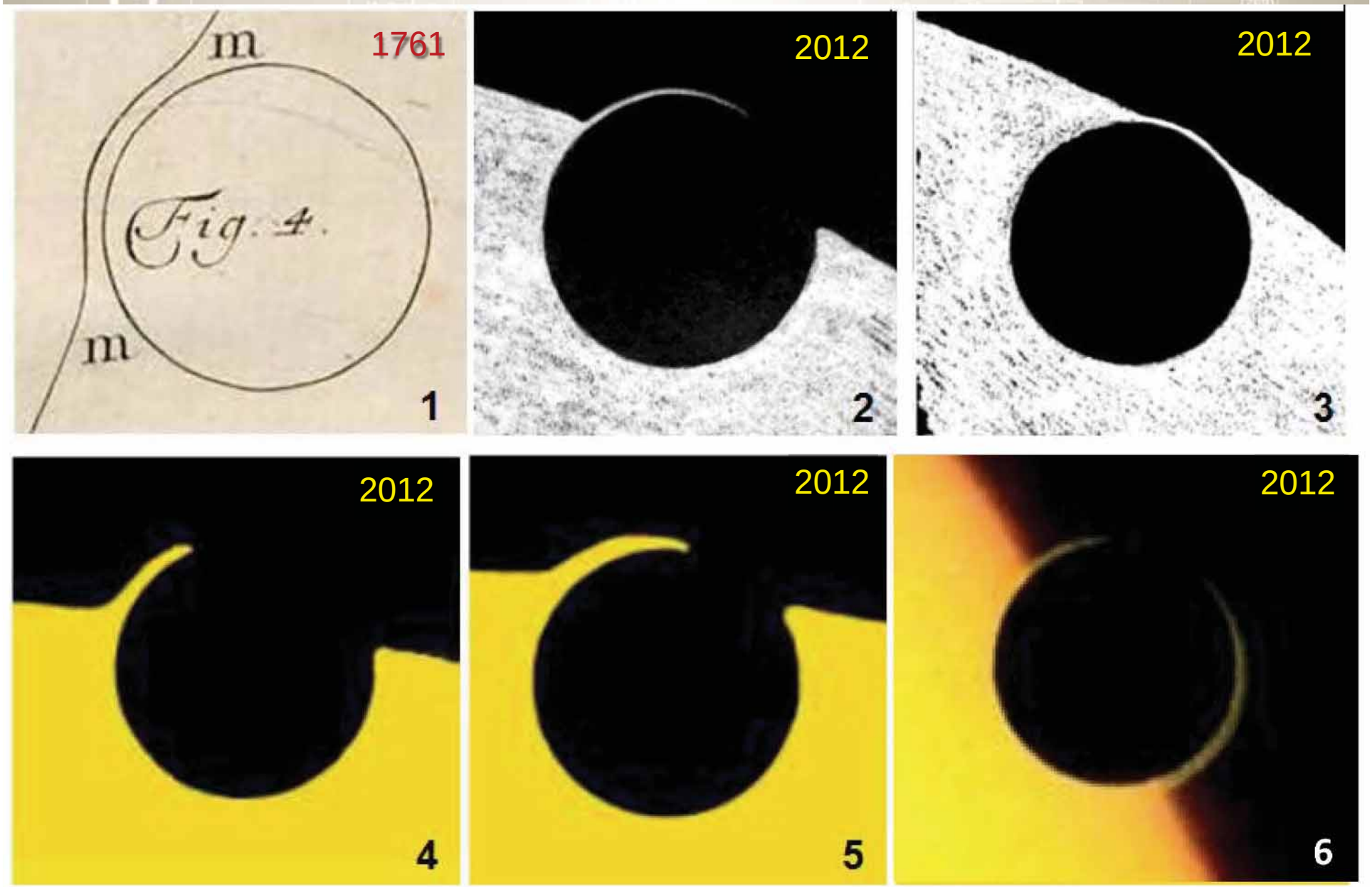
Modern-day telescope image showing aureole appearing at early stages the 2004 Transit of Venus

TRANSIT JUNE 5-6, 2012

SIMULTANEOUS OBSERVATIONS WITH ANTIQUE TELESCOPES

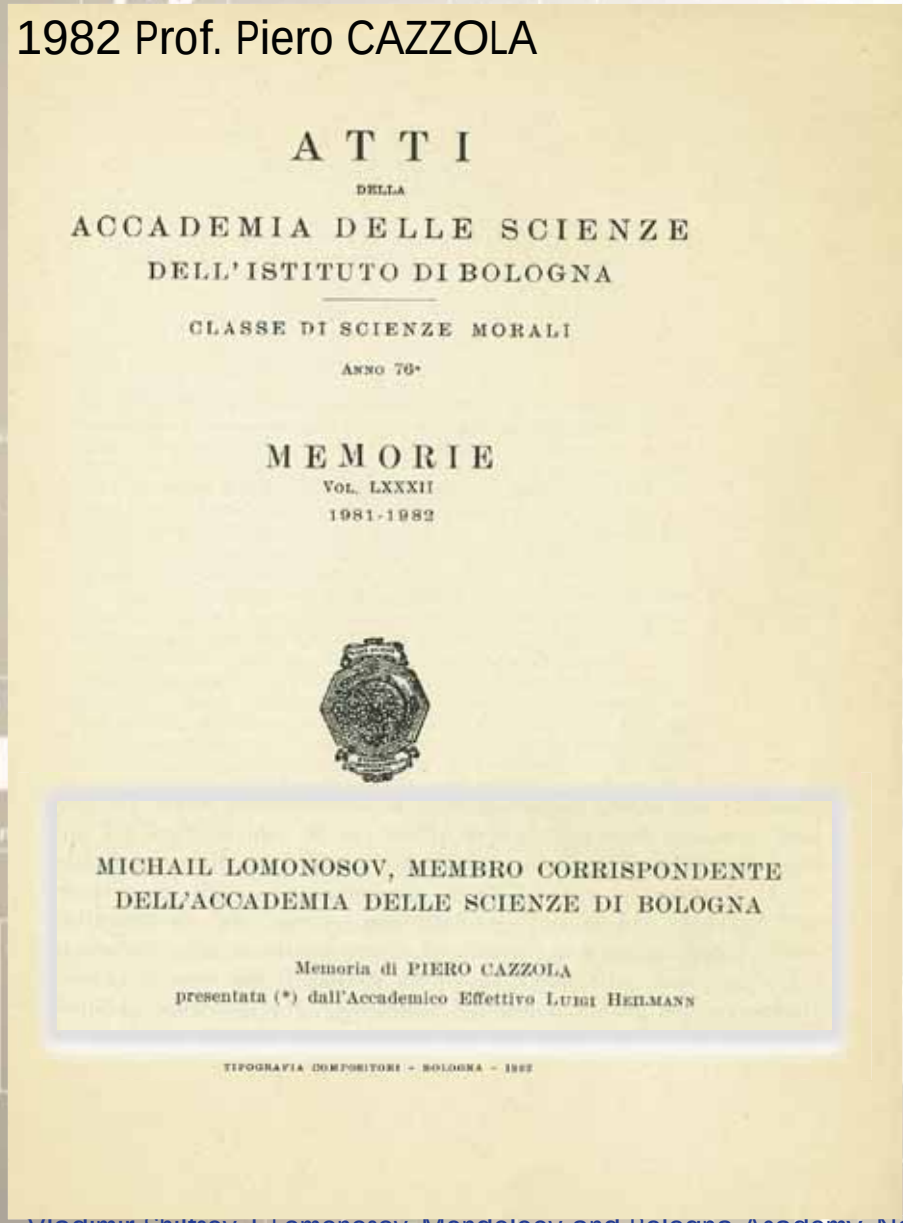
Our Antique Telescopes
"of two lenses" (achromats)

RESULTS OF 2012 REPLICATION



MORE IN THE ARTICLES BY

1982 Prof. Piero CAZZOLA



ATTI

DELLA

ACCADEMIA DELLE SCIENZE

DELL'ISTITUTO DI BOLOGNA

CLASSE DI SCIENZE MORALI

ANNO 76°

MEMORIE

VOL. LXXXII

1981-1982

MICHAIL LOMONOSOV, MEMBRO CORRISPONDENTE DELL'ACCADEMIA DELLE SCIENZE DI BOLOGNA

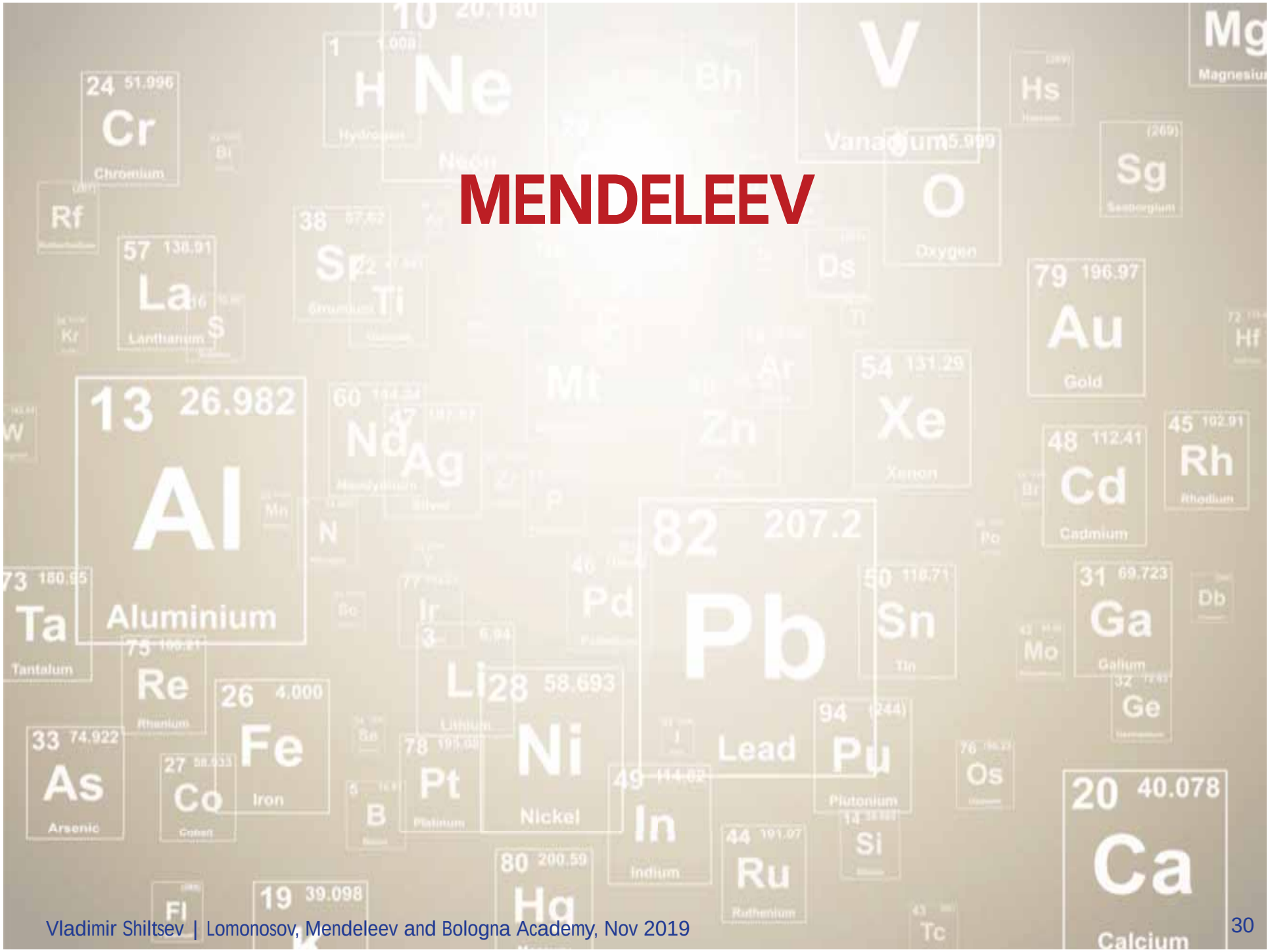
Memoria di PIERO CAZZOLA

presentata (*) dall'Accademico Effettivo LUIGI HEILMANN

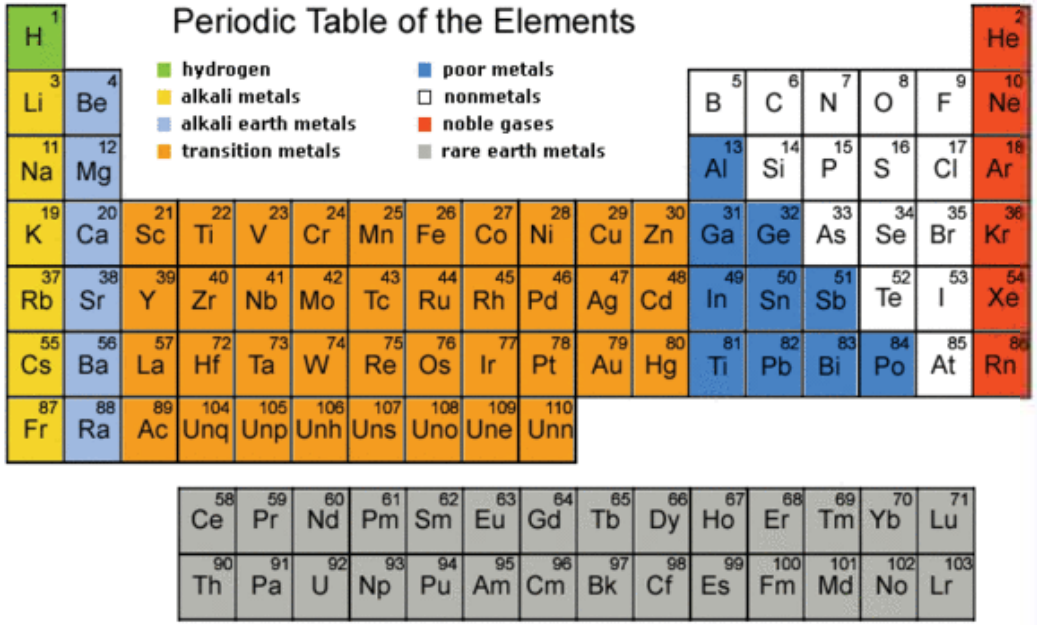
TIPOGRAFIA COMPOSITORI - BOLOGNA - 1982

2017 Profs. Robert CREASE and Vladimir SHILTSEV

MENDELEEV


Cr
Chromium
Ne
Neon
V
Vanadium
O
Oxygen
Sg
Seaborgium
Au
Gold
Xe
Xenon
Cd
Cadmium
Rh
Rhodium
Al
Aluminium
Pb
Lead
Sn
Tin
Ga
Gallium
Ge
Ta
Tantalum
Re
Rhenium
Fe
Iron
Li
Lithium
Ni
Nickel
Pt
Platinum
Pu
Plutonium
Os
As
Arsenic
Co
Cobalt
In
Indium
Ru
Ruthenium
Si
Ca
Calcium
Hg
Fl
Tc
Mg
Magnesium
Hs
Rf
La
Lanthanum
Ti
Mt
Ds
Ar
Zn
Nd
Ag
Silver
Pd
Ir
B
Mo
Db
Hf
Kr
W
N
P
Br
Po

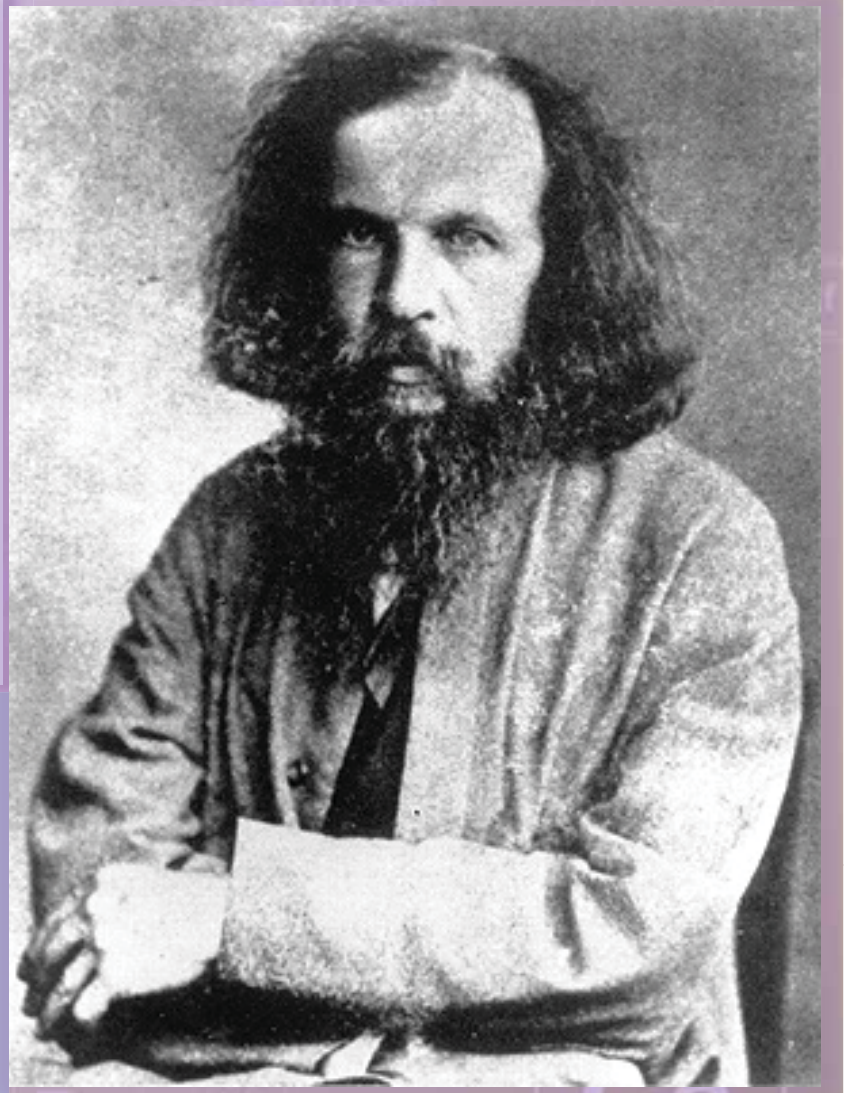
DMITRII MENDELEEV (1834-1907)



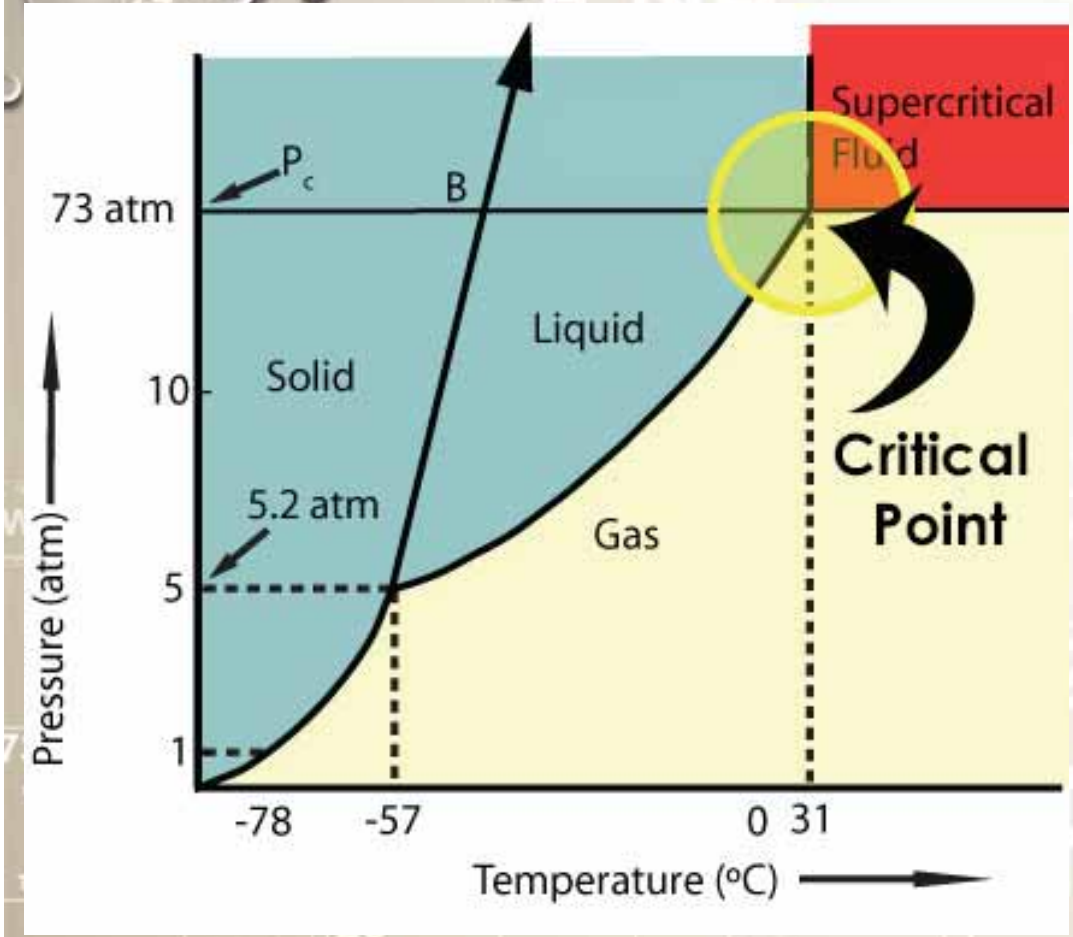
- **PERIODIC LAW (1869)**
- **FINALIZED EQUATION FOR IDEAL GAS (1874), CLAPEYRON**

$$PV = nRT$$

- **TEMPERATURE OF ABSOLUTE BOILING – CRITICAL T (1860)**



SUPERCRITICAL FLUIDS (1860)



Substance	Critical temperature		Critical pressure	
	K	C	Pa	atm
Water	647.4	374.3	22.1210^6	219.0
Sulfur dioxide	430.7	157.6	7.8810^6	78.0
Ammonia	405.5	132.4	11.2810^6	111.7
Carbon dioxide	304.2	31.1	7.3910^6	73.2
Oxygen	154.8	−118.4	5.0810^6	50.3
Nitrogen	126.2	−146.9	3.3910^6	33.6
Hydrogen	33.3	−239.9	1.3010^6	12.9
Helium	5.3	−267.9	0.22910^6	2.27

Decaffeinate coffee beans by S.Crit. CO_2

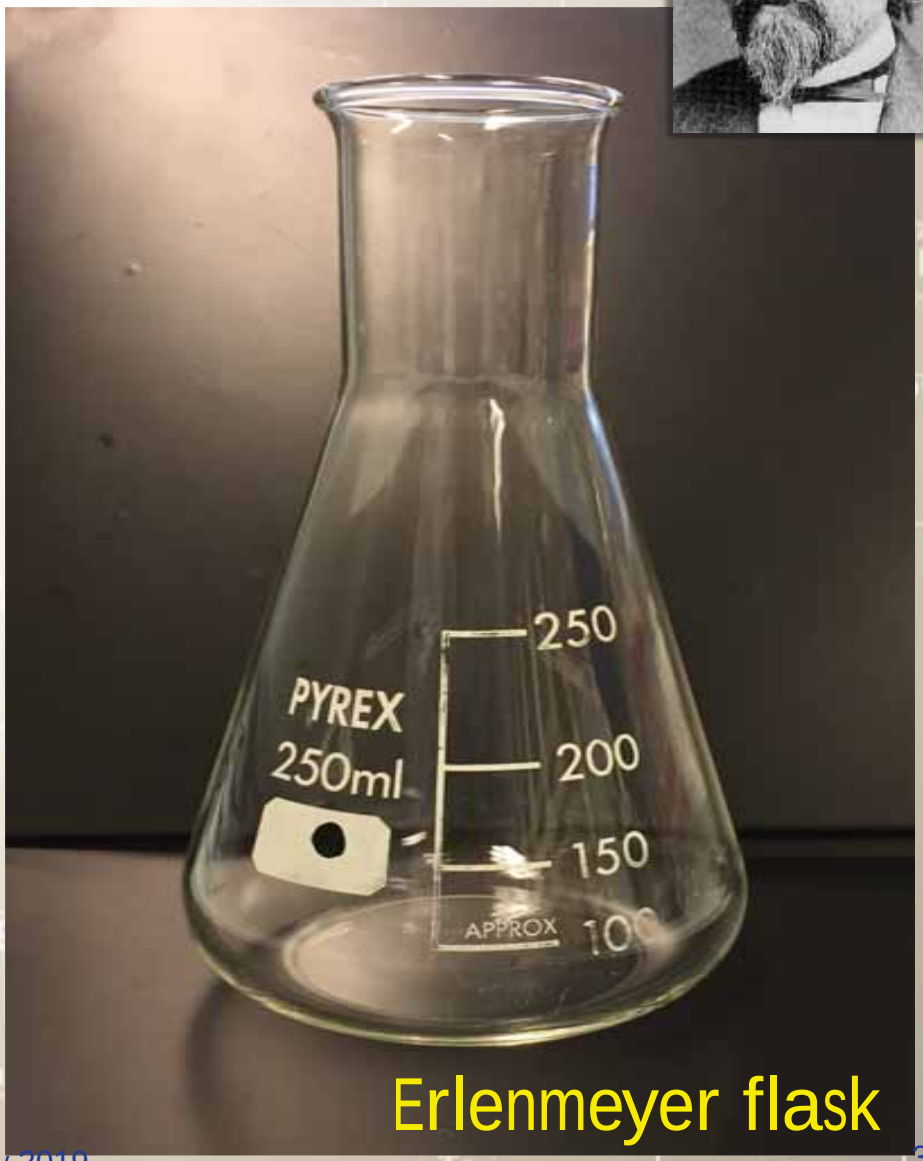
Kurt Zosel, 1963

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

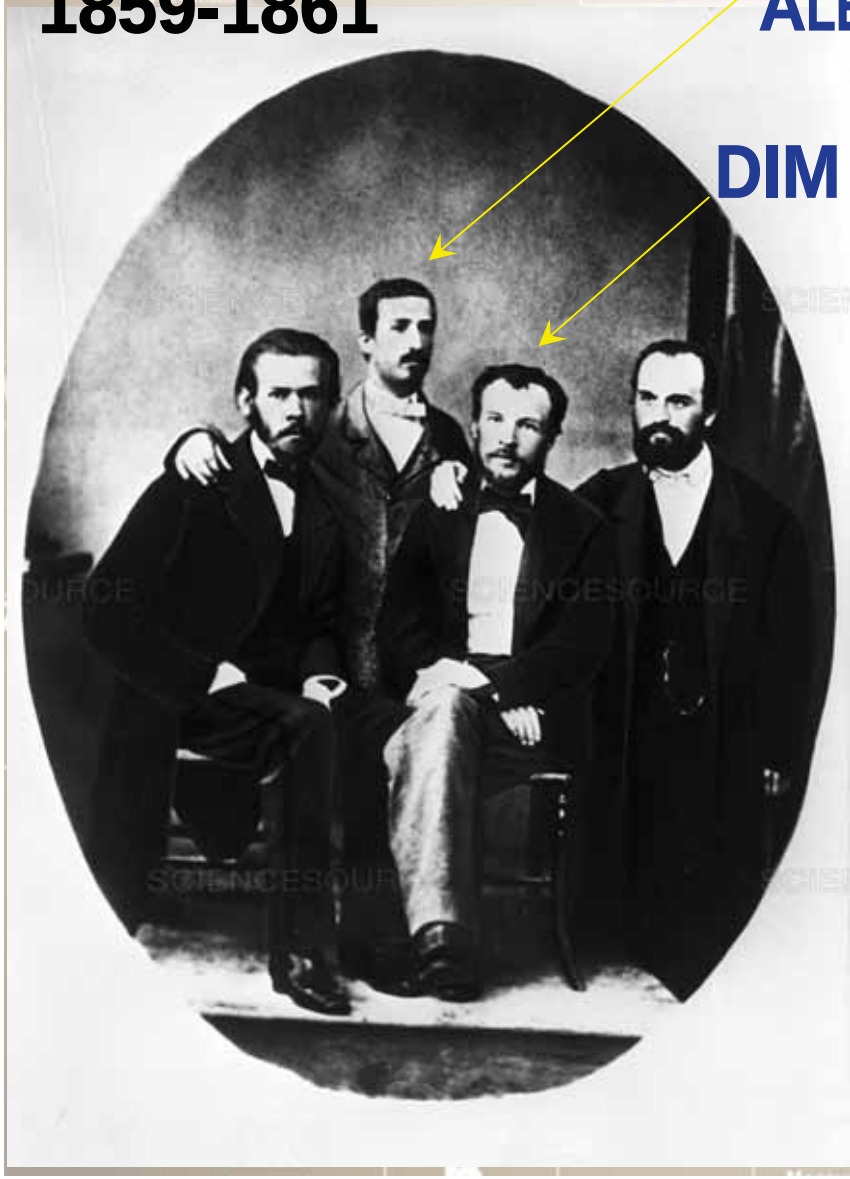


RUSSIAN STUDENTS IN HEIDELBERG

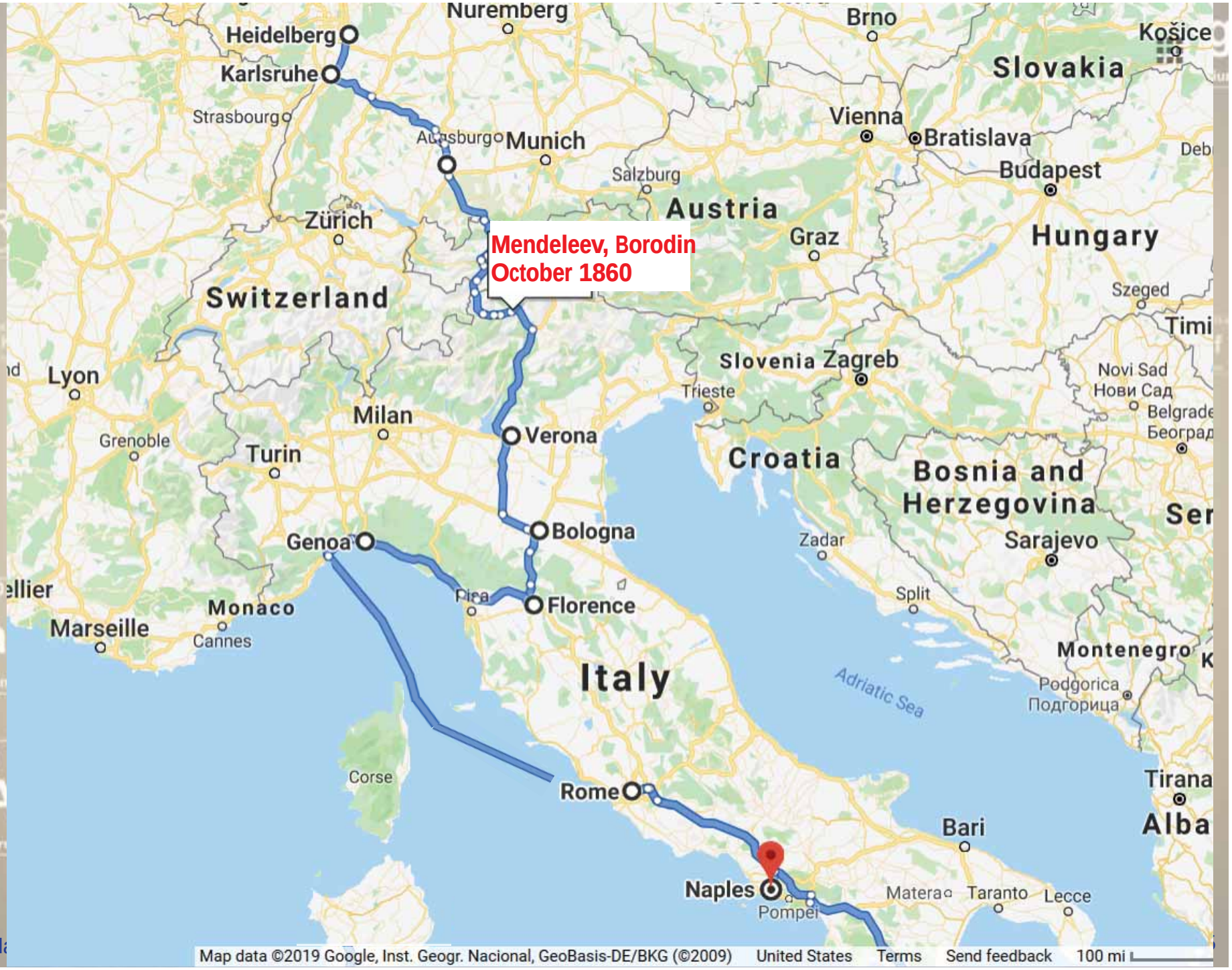
1859-1861

ALEXANDER BORODIN

DIM



"PRINCE IGOR" OPERA

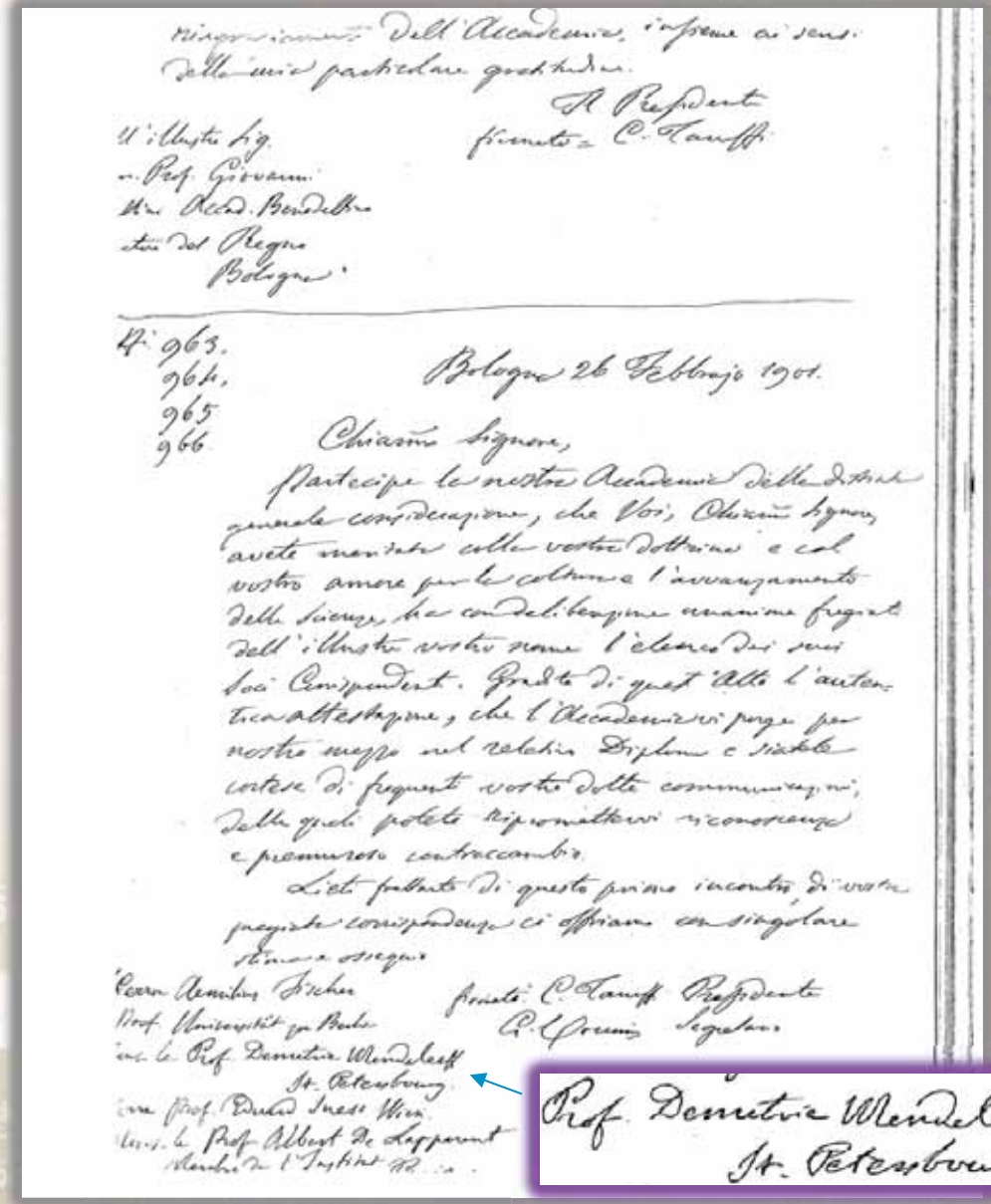

Mendeleev, Borodin
October 1860
Heidelberg
Karlsruhe
Nuremberg
Brno
Košice
Slovakia
Strasbourg
Augsburg
Munich
Vienna
Bratislava
Budapest
Salzburg
Austria
Graz
Hungary
Zürich
Switzerland
Szeged
Lyon
Slovenia
Zagreb
Trieste
Novi Sad
Нови Сад
Belgrade
Београд
Milan
Verona
Grenoble
Turin
Croatia
Bosnia and
Herzegovina
Sarajevo
Bologna
Genoa
Zadar
Pisa
Florence
Split
Monaco
Marseille
Cannes
Montenegro
Podgorica
Подгорица
Italy
Adriatic Sea
Corse
Rome
Tirana
Bari
Naples
Pompei
Matera
Taranto
Lecce
Map data ©2019 Google, Inst. Geogr. Nacional, GeoBasis-DE/BKG (©2009)
United States
Terms
Send feedback
100 mi

Cles
Cavalese
Primiero
Trient
Borgo
Belluno
Tagliamento
Udine
Riva
Roveredo
Gardasee
Bassano
Piave
Brescia
Vicenza
Verona
Brenta
Treviso
TRIEST
Adelsberg
Sessana
Gorz
Gradisca
Padua
Mincio
Chiese
Mantua
Etsch
Adria
Po
Parma
Ferrara
Panaro
Reno
Secchia
Bologna
Imola
Ravenna
"…How proud such country should be… which can produce people like Garibaldi !" (D.Mendeleev)

MENDELEEV FOR BOLOGNA ACADEMY

(26 FEBRUARY 1901)

Academy Correspondence Book
Courtesy Prof. Luisa CIFARELLI



Bologna 26 Febbrajo 1901.

Chiarmi Signore,

Partecipe la nostra Accademia delle Scienze generale considerazione, che Voi, Chiarmi Signore, avete meritato colla vostra dottrina e col vostro amore per le coltivazione e l'avanzamento delle Scienze, ha con deliberazione unanime fregiato dell'illustre vostro nome l'elenco dei suoi Soci Corrispondenti. Gradite di quest'atto l'autentica attestazione, che l'Accademia vi porge per nostro mezzo nel relativo Diploma e siate cortese di frequenti vostre dotte comunicazioni, delle quali potete ripromettervi riconoscenza e premurosi contraccambi.

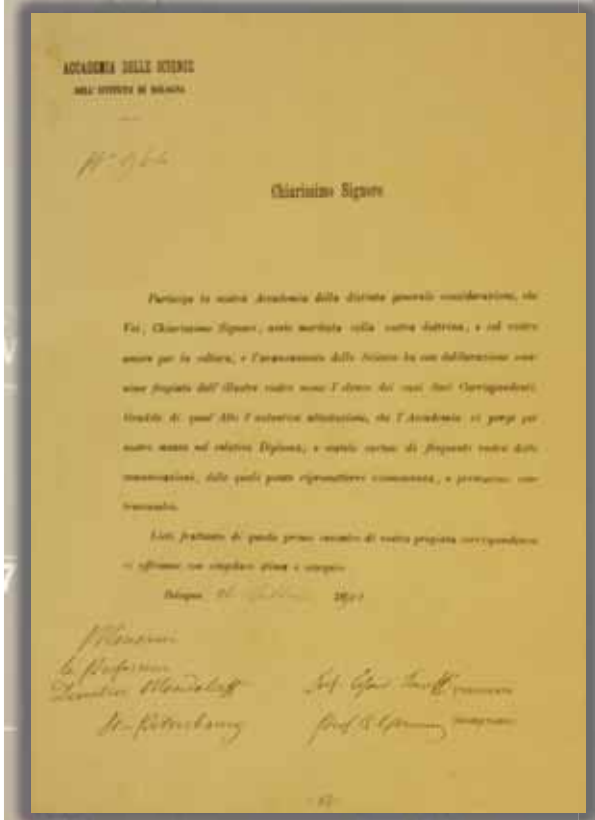
Lieti fintanto di questo primo incontro di vostra pregiata corrispondenza ci offriamo con singolare stima e ossequio

Prof. Demetrio Mendeleeff
St. Petersbourg

Copy of the letter sent to Mendeleev

"Chiarmi Signore, …. [diploma 964 sent to] Mendeleev [Firmati Presidente + Segretair]

LETTER AND DIPLOMA



ACCADEMIA DELLE SCIENZE
DELL'ISTITUTO DI BOLOGNA

Chiarissimo Signore

Partecipo la nostra Accademia della distinta generale considerazione, che Voi, Chiarissimo Signore, avete meritata colla vostra dottrina, e col vostro amore per la coltura, e l'avanzamento delle Scienze ha con deliberazione unanime fissato dall'Ispettore vostro nome l'elenco dei suoi Soci Corrispondenti. Gradite di quest'Alto l'autorevole attestazione, che l'Accademia vi porge per mezzo nuovo nel relativo Diploma, e capitolo cartaceo di frequenti vostre dotte comunicazioni, delle quali potete rigorosamente commensa, e prerogativa conservando.

Lieti frattanto di questo primo incontro di vostra pregiata corrispondenza vi affermo con singolare stima e congegno.

Bologna [illegible] 1901

Il Presidente
Le Professeur
Dmitri Mendeleeff
St-Pétersbourg

Prof. Cyr. Ferraff
Prof. R. Ciamician

Academia Scientiarum
Instituti Bononiensis.

Quod ad gravioribus disciplinarum incrementum, et hujusce Civitatis dignitatem pertinebat, Societate nostra Aloysio Ferdinando Marsilio Com. auctore a Senatu Bononiensi in has leges recepta, et a Benedicto XIIII. Pont. Max. ad majus communis Patriae decus honoribus, praerogativisque aucta, quae scientiarum studiis provehendis impensam operam navaret, ad publicam utilitatem, et ad Societatis ejusdem ornamentum conferre duximus, si Te quoque Demetrio Mendeleeff Vir Praeclarissime, cujus ingenium nobis perspectum, et doctrina longe probata est, in numerum Sodalium eadem disciplinarum nobisum Communicantium coptaremus. Atque litteras hasce coptationis tuae testes libenti animo ad Te mittimus, Istique Civitas nostri splendorem curae vehementer fore non dubitamus.

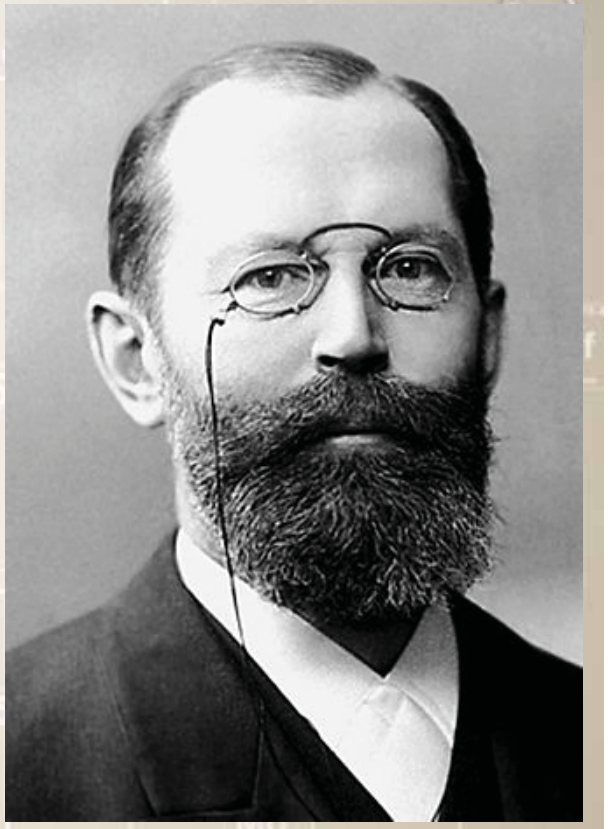
Dat. Bononiae ex Aedibus Instituti Die 27. Mensis Januarii Anno 1901

Caesar Ferraff — Praeses.
Hieronymus Ceconi Ab Actis.

Soci Corripondenti

Coutesy Prof. I.Dmitriev, Director Mendeleev Museum and Archives, St.Petersburg State University

WHO WAS IN THE PACK WITH MENDELEEV



ALBERT DE LAPPARENT

PARIS, GEOLOGY

CHANNEL TUNNEL PROPOSAL

EDWARD SUESS

WIEN, GEOLOGY

GONDWANA SUPERCONTINENT

EMIL FISCHER

BERLIN, CHEMISTRY

1902 NOBEL PRIZE

SUGARS

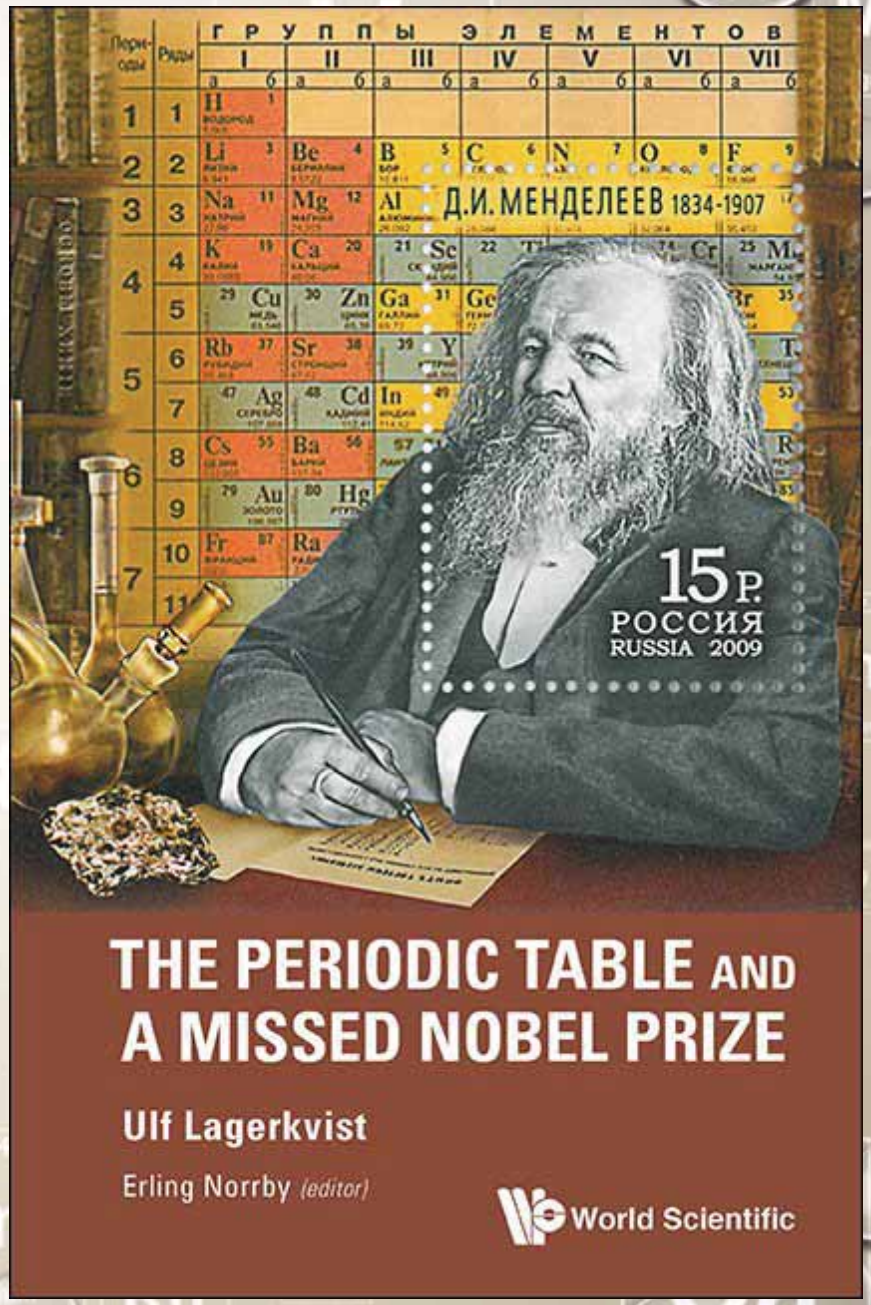
WHY NO NOBEL PRIZE FOR MENDELEEV?

NOMINATED IN 1905, 1906, 1907

DIED 1907

"…In 1906, Mendeleev **was selected** by the prize committee to win the honor, but the Royal Swedish Academy of Sciences stepped in and overturned the decision. Why? The intervention was spearheaded by Swedish chemist **Svante Arrhenius,**

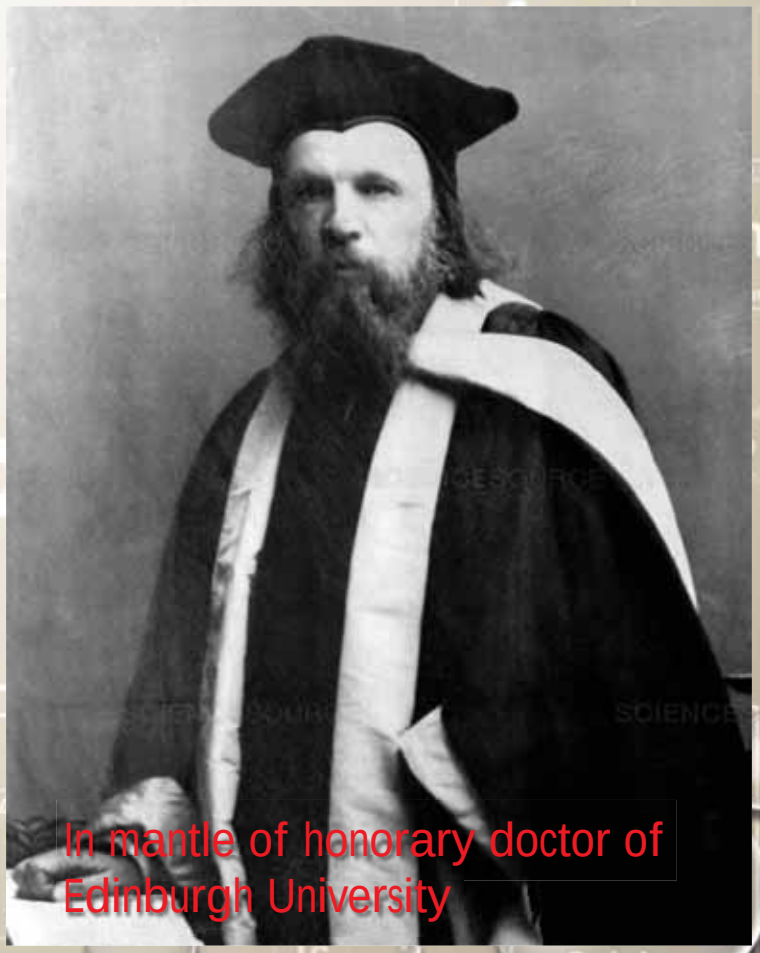
who had himself won the prize in 1903 for his theory of electrolytic dissociation. Mendeleev had been an outspoken critic of the theory, and Arrhenius seized the opportunity as the perfect chance to squeeze a few sour grapes…"



MENDELEEV HAD COLD RELATIONS WITH NOBEL BROTHERS DUE TO BAKU OIL TARIFFS

MENDELEEV'S FAME

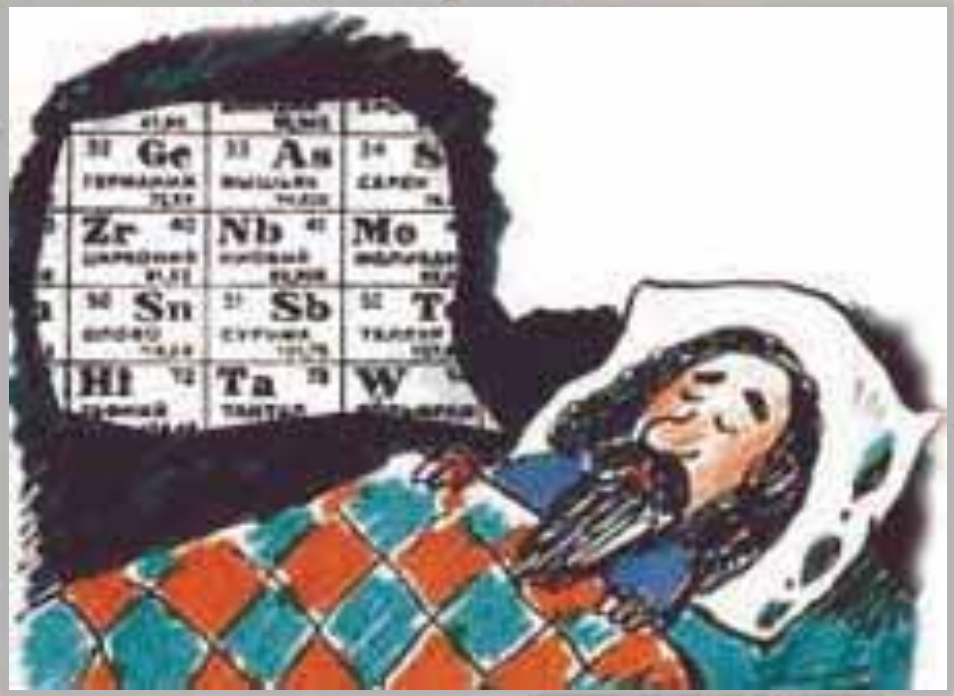
- **THE PERIODIC TABLE OF ELEMENTS**
- **NON-ELECTION** TO THE RUSSIAN ACADEMY OF SCIENCES IN 1880
- MEMBER OF 150 ACADEMIES AND SOCIETIES: FOR.MEM.R.S., PARIS, BOLOGNA, ACCADEMIA DEI LINCEI, ROME, ETC
- BROAD SPECTRUM OF INTERESTS AND PUBLICATIONS (25 VOLUMES)
- **MYTHS**



In mantle of honorary doctor of Edinburgh University

“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)

"FATH

- Interp
- DIM v
  Tarift
  stand
  - o
  - o
  - o

PHYSICS TODAY

HOME BROWSE INFO RESOURCES JOBS

DOI:10.1063/PT.6.4.20190822a

22 Aug 2019 in People & History

Dmitri Mendeleev and the science of vodka

Separating fact from fiction regarding the popular spirit and its link to the legendary chemist.

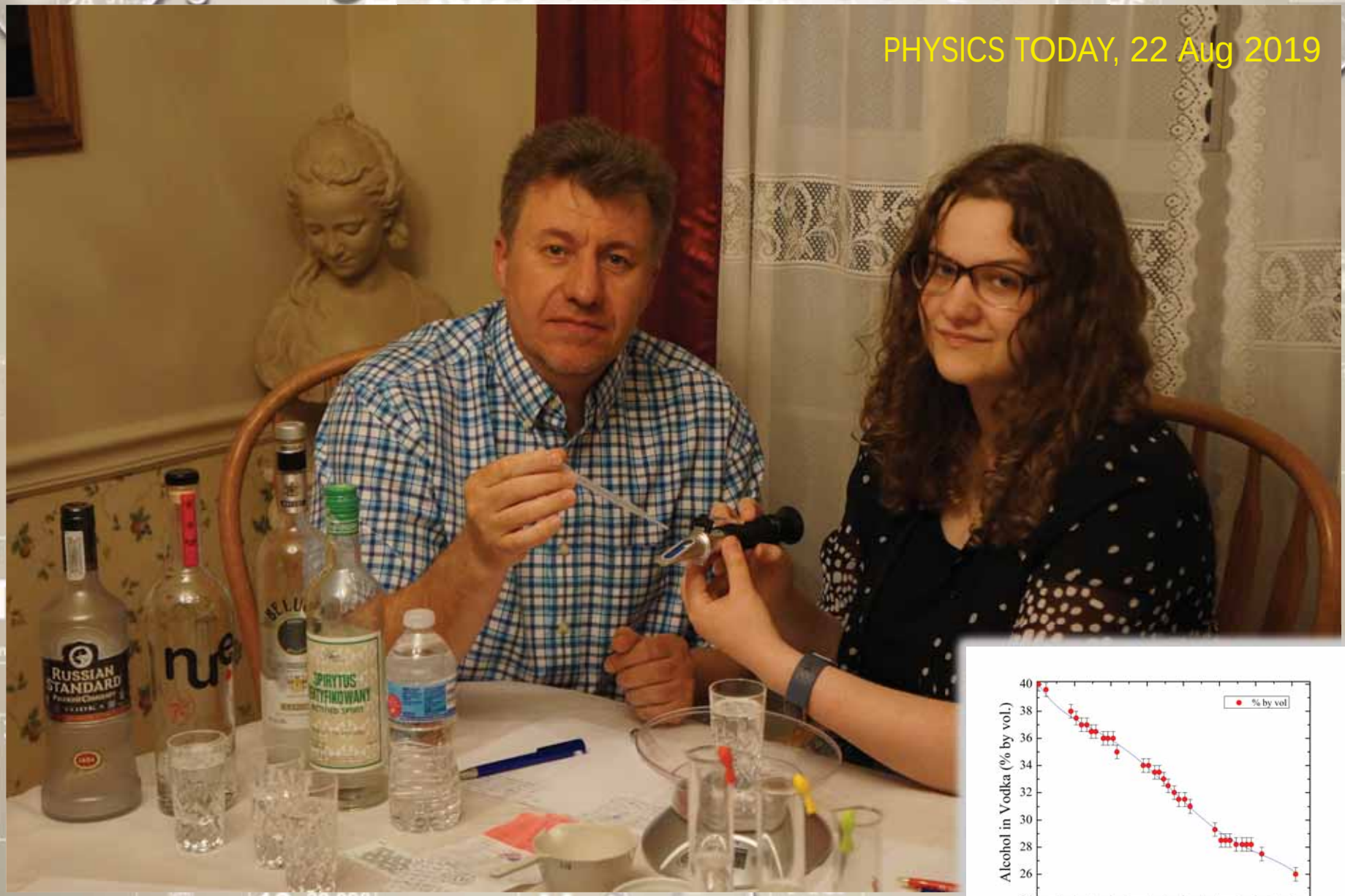
Vladimir Shiltsev

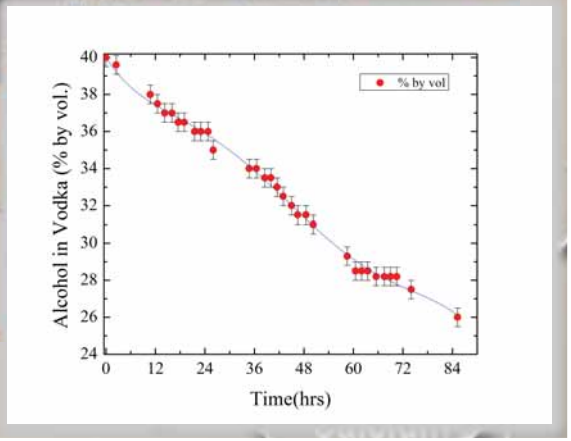
2 COMMENTS 858 SHARES

PREV NEXT

Nullius in verba !

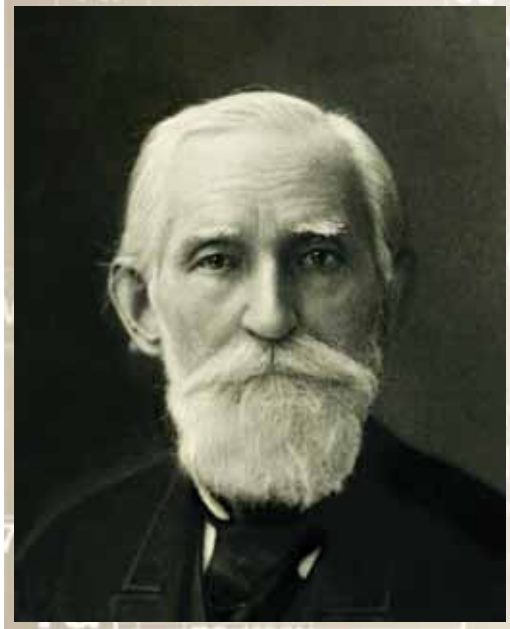
PHYSICS TODAY, 22 Aug 2019





OUTLOOK

OTHER RUSSIAN MEMBERS OF BOLOGNA ACADEMY



CHEBYSHEV

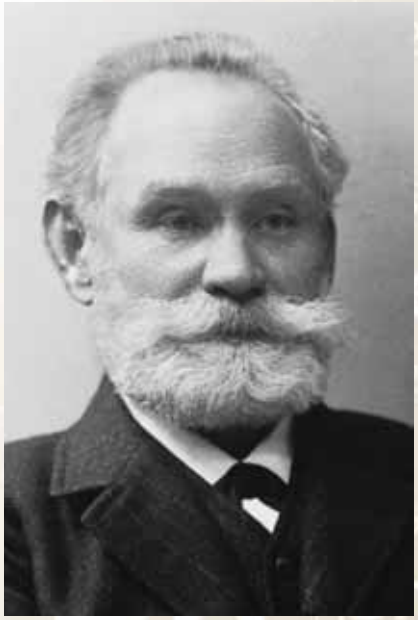
1873

MATHEMATICS

KARPINSKY

1901

GEOLOGY



PAVLOV

1911

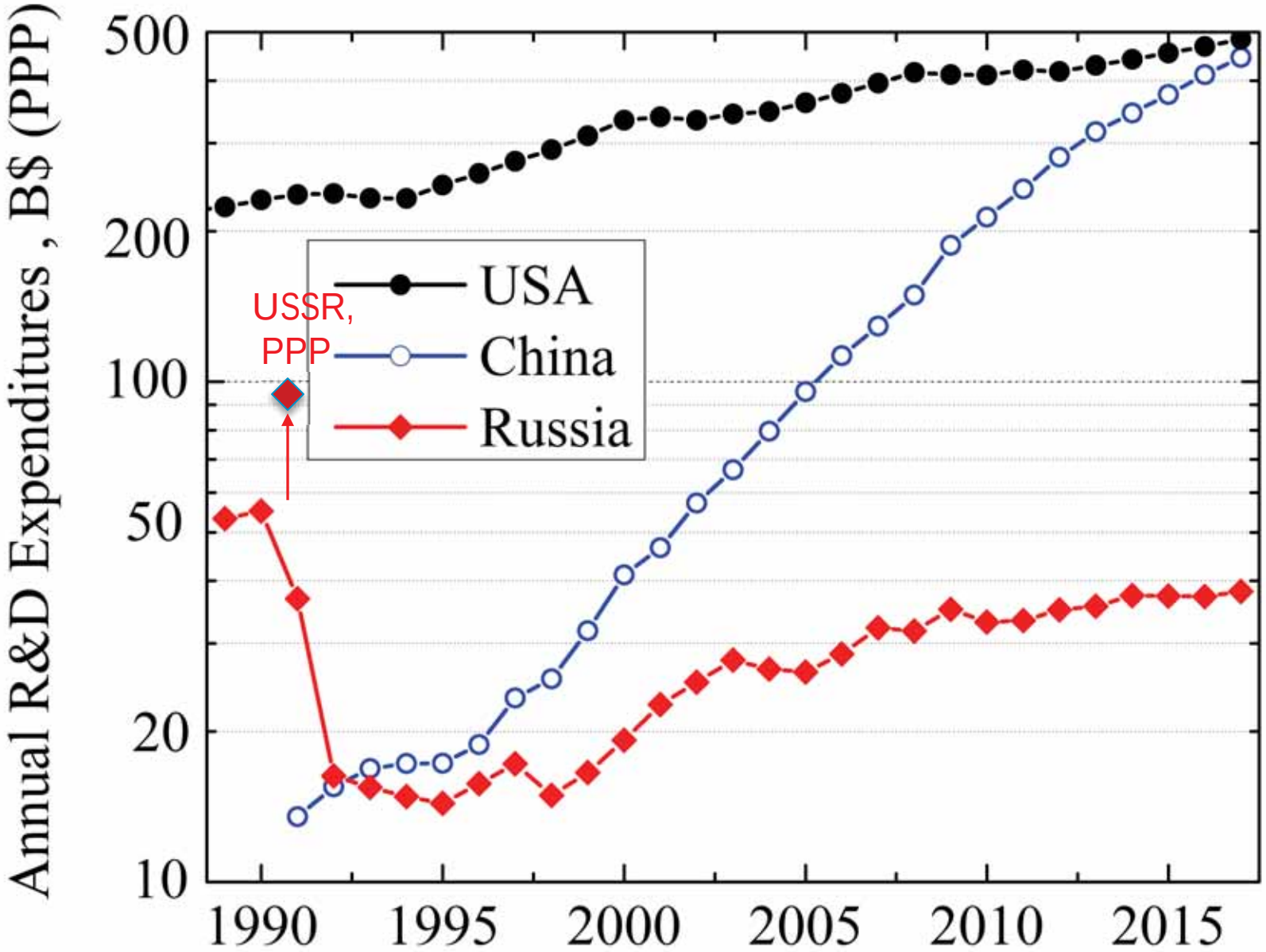
PHYSIOLOGY

LOBODANOV

2016

LINGUISTICS

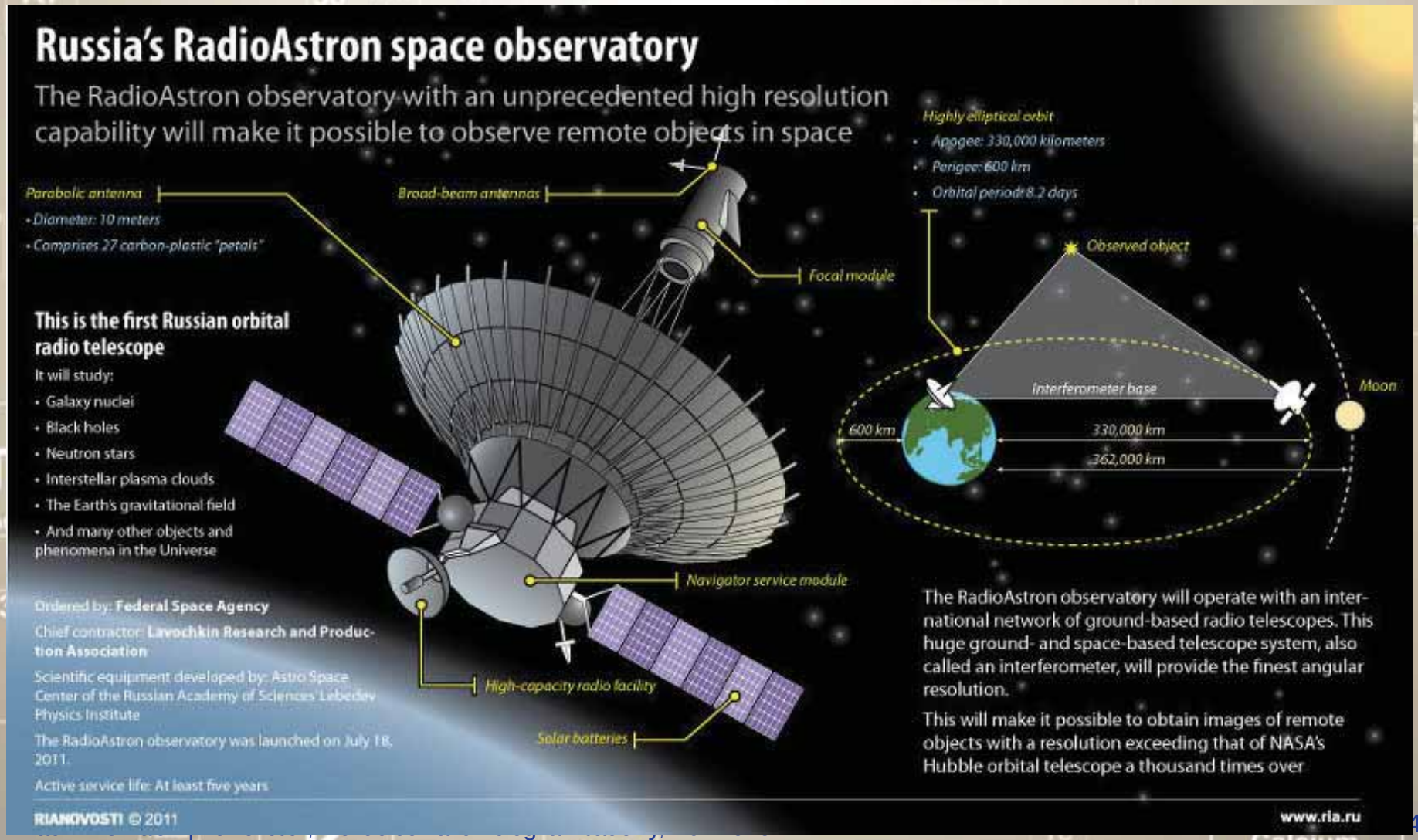
OECD RESEARCH & DEVELOPMENT DATA



“RADIO-ASTRON” (SPEKTR-R) 2011-2019

10 м, Λ=1.2-92см *LEBEDEV PHYSICS INSTITUTE*

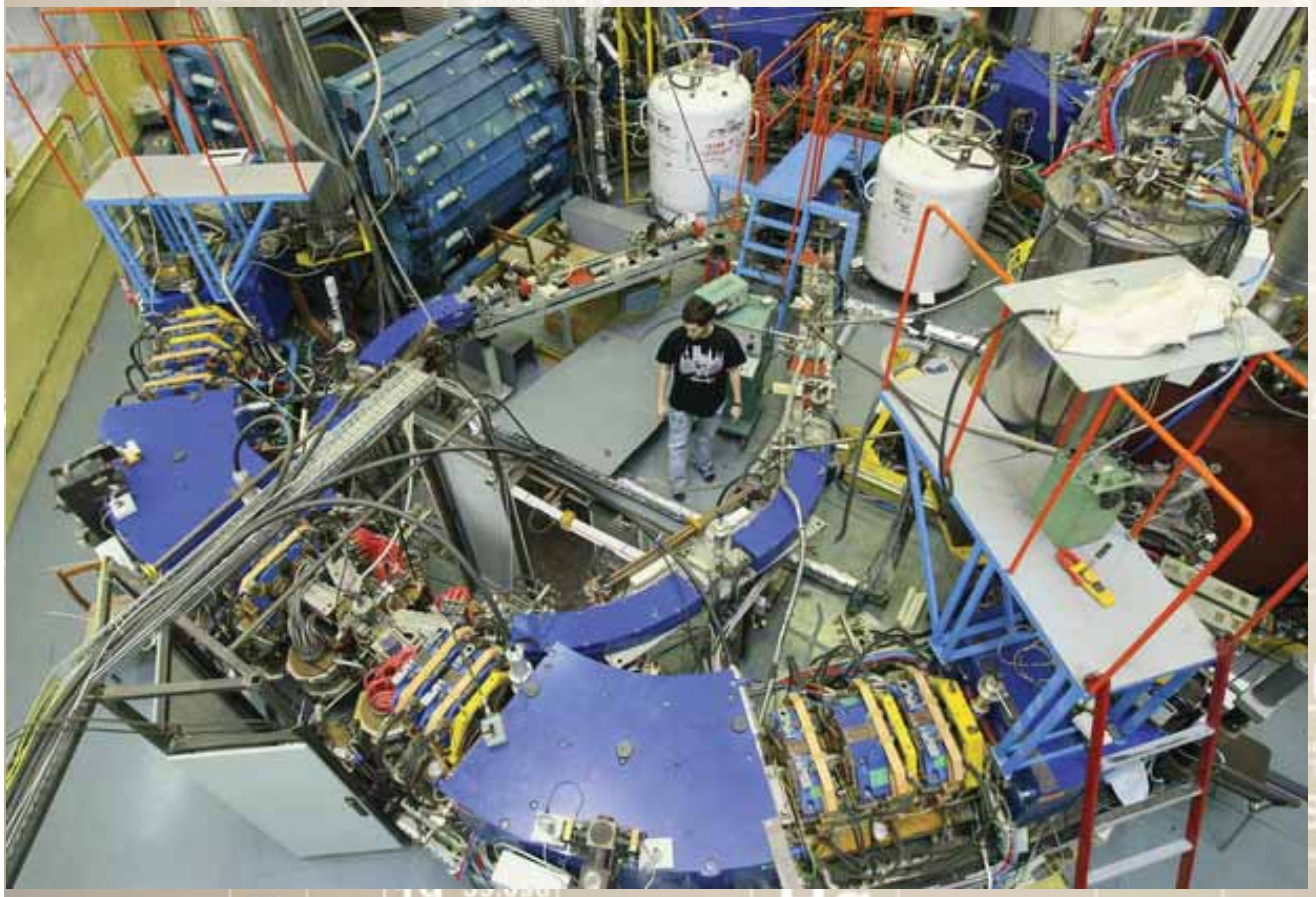
20 EARTH DIAM’S BASE → 7 MICROARC SEC (RECORD)



COLLIDING BEAMS 1-6 GEV CME

BUDKER INSTITUTE OF NUCLEAR PHYSICS (NOVOSIBIRSK)

- "ROUND BEAMS" FOR RECORD HIGH BEAM-BEAM TUNE SHIFT $\Xi=0.25$
- "RESONANT DEPOLARIZATION" RECORD ENERGY PRECISION $\Delta E/E\sim 1E\text{-}7$



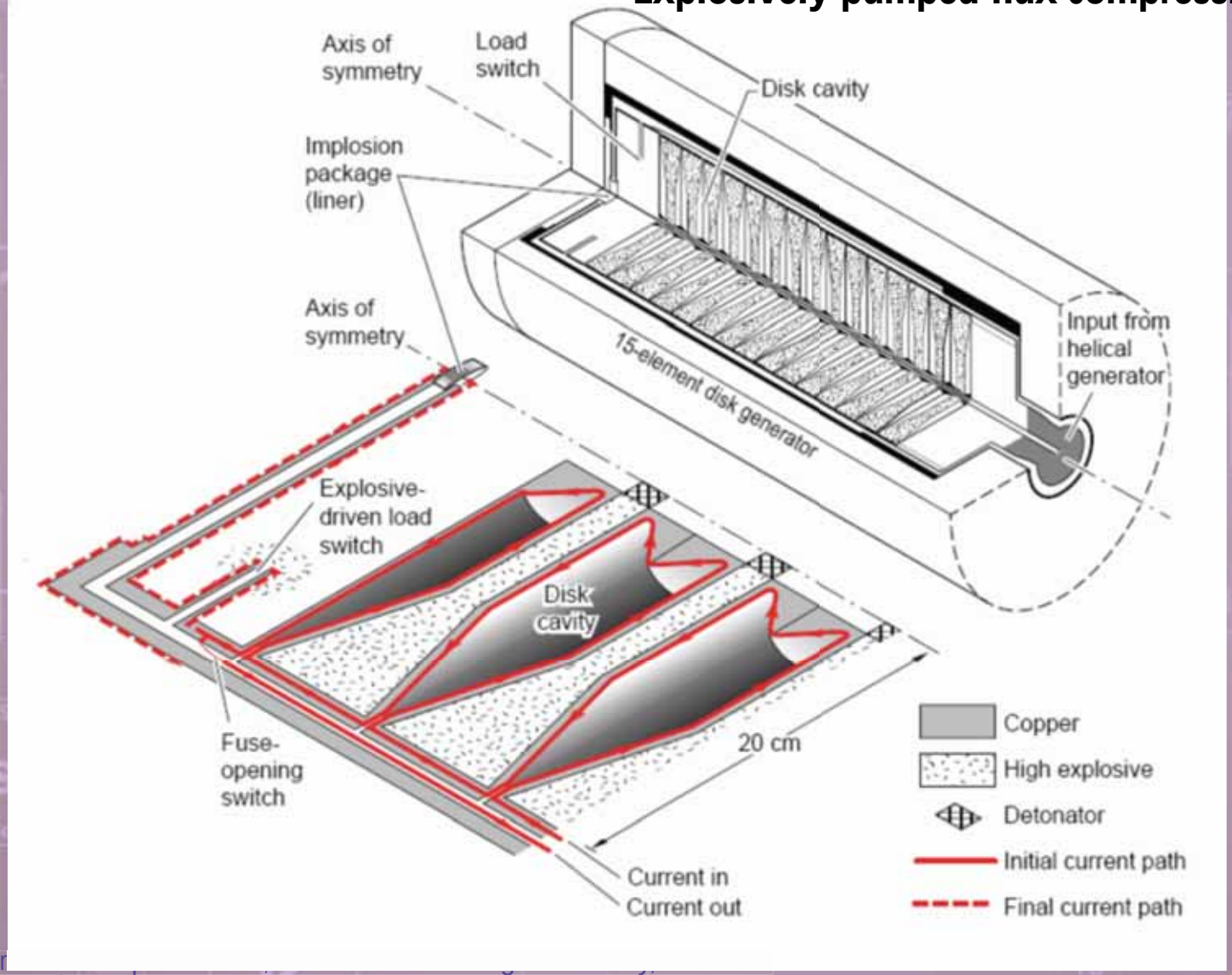
Russia: 2 out of 7 Colliders

- VEPP-2000
- VEPP-4M
- DAFNE (Italy)
- BEPC (China)
- Super-B (Japan)
- RHIC (USA)
- LHC (Europe)

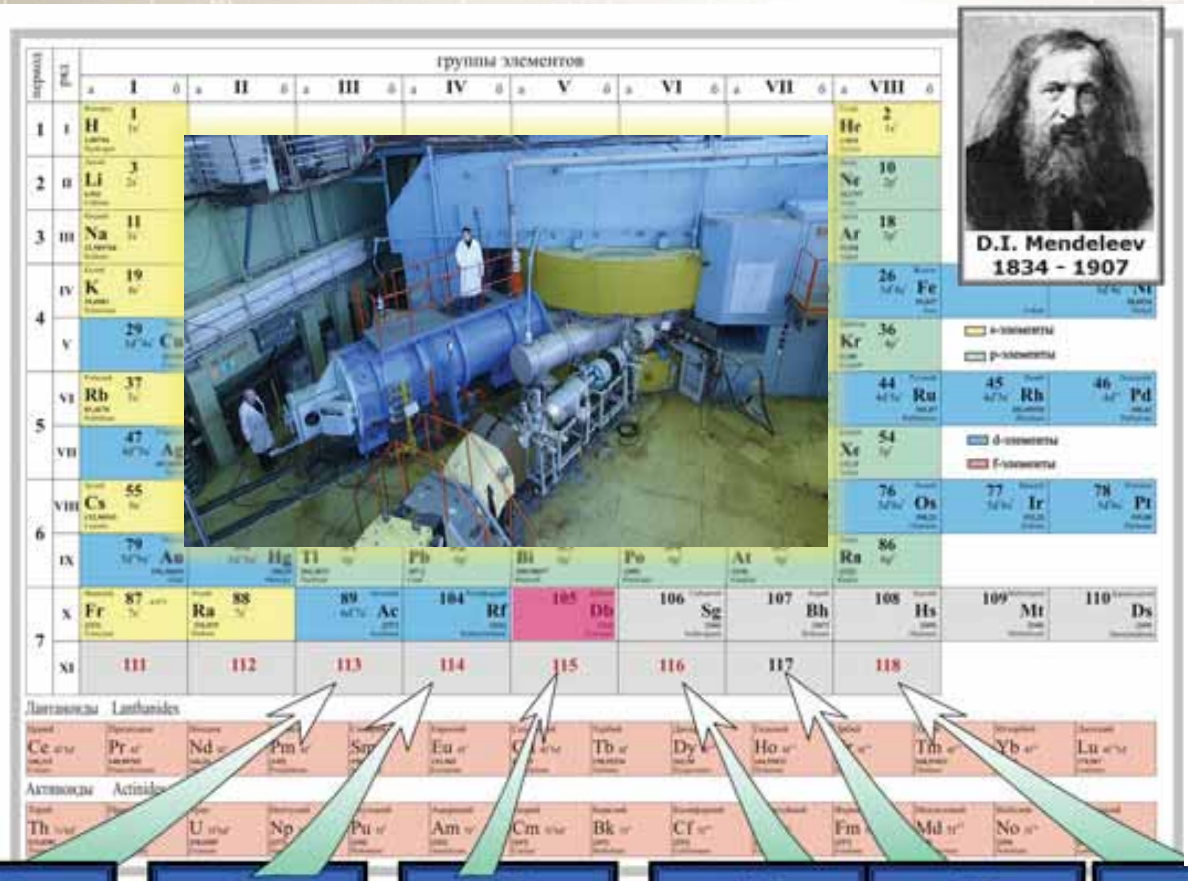
- (NICA – constr'n)

RECORD HIGH MAGNETIC FIELD 2400 T
VNIITEF (SAROV)

Explosively pumped flux compression generator



NEW ELEMENTS 113-118
JOINT INSTITUTE FOR NUCLEAR RESEARCH (DUBNA)



113 Discovered at JINR in 2003

114 Discovered at JINR in 1999

115 Discovered at JINR in 2003

116 Discovered at JINR in 2000

117 Discovered at JINR in 2009

118 Discovered at JINR in 2001

IUPAP:

December 30, 2015

#113 RIKEN

#115 JINR,LLNR,ORNL

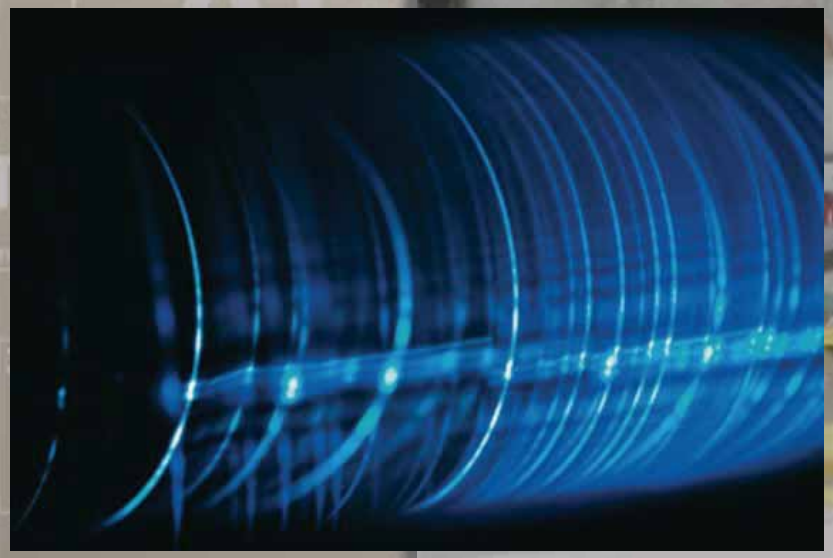
#117 JINR,LLNR,ORNL

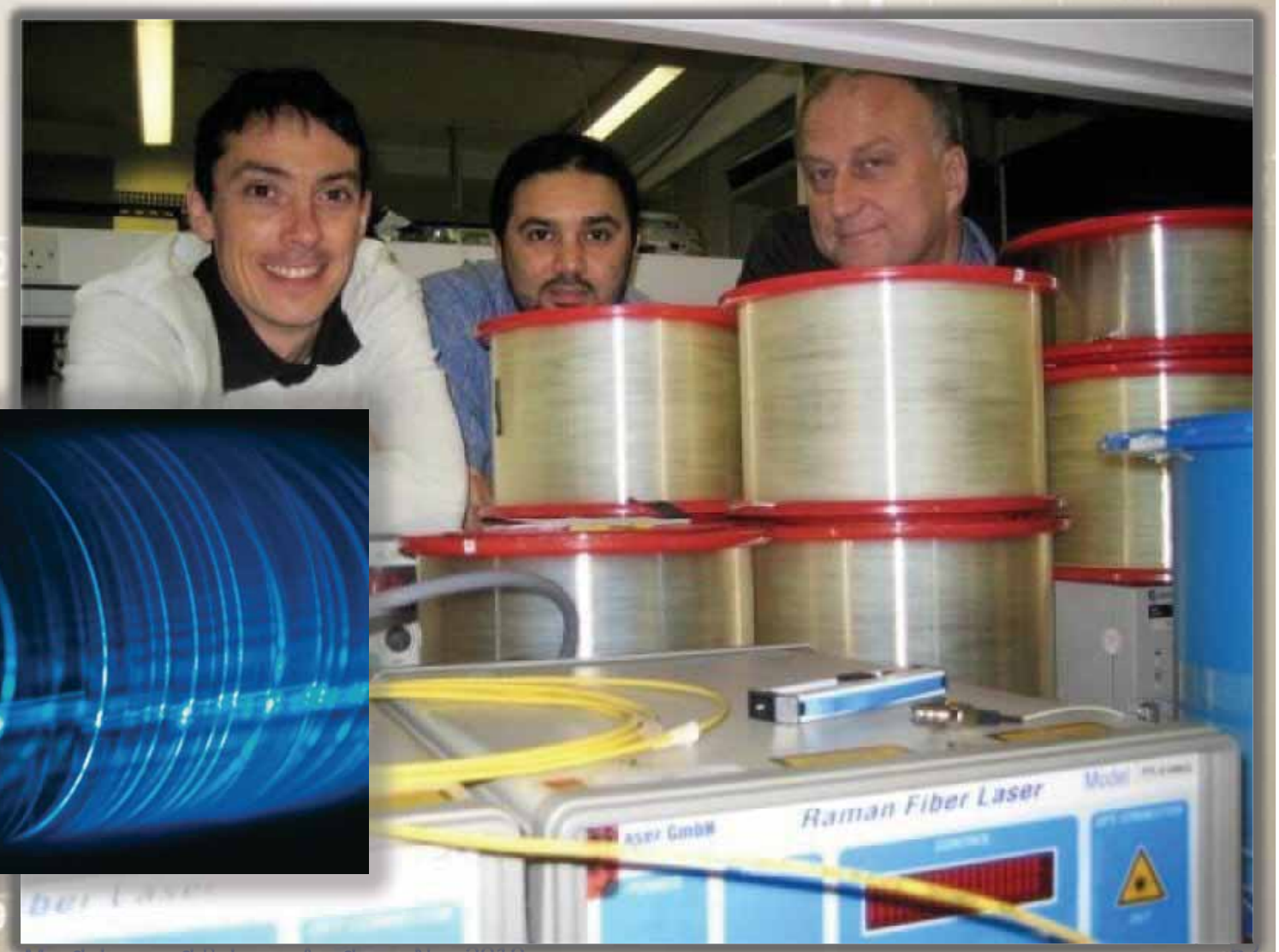
#118 JINR, LLNL

#114 Flerovium (JINR, 2012)

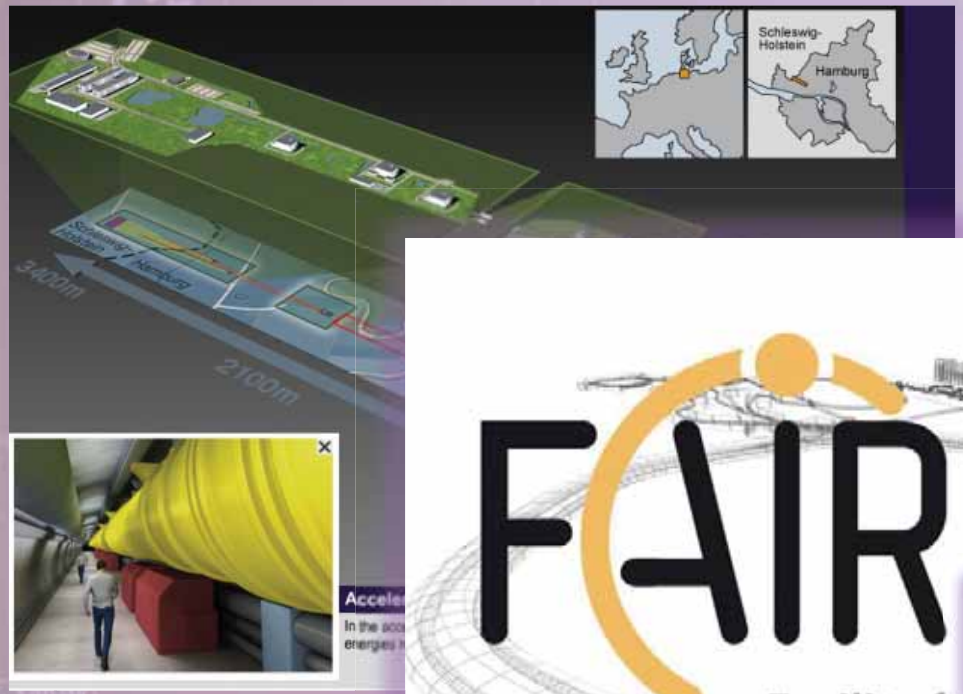
#116 Livermorium (JINR, LLNL, 2012)

WORLD'S LONGEST LASER 270 KM
NOVOSIBIRSK IAE & ASTON (UK)





RUSSIA SUPPORTS INT'L MEGASCIENCE

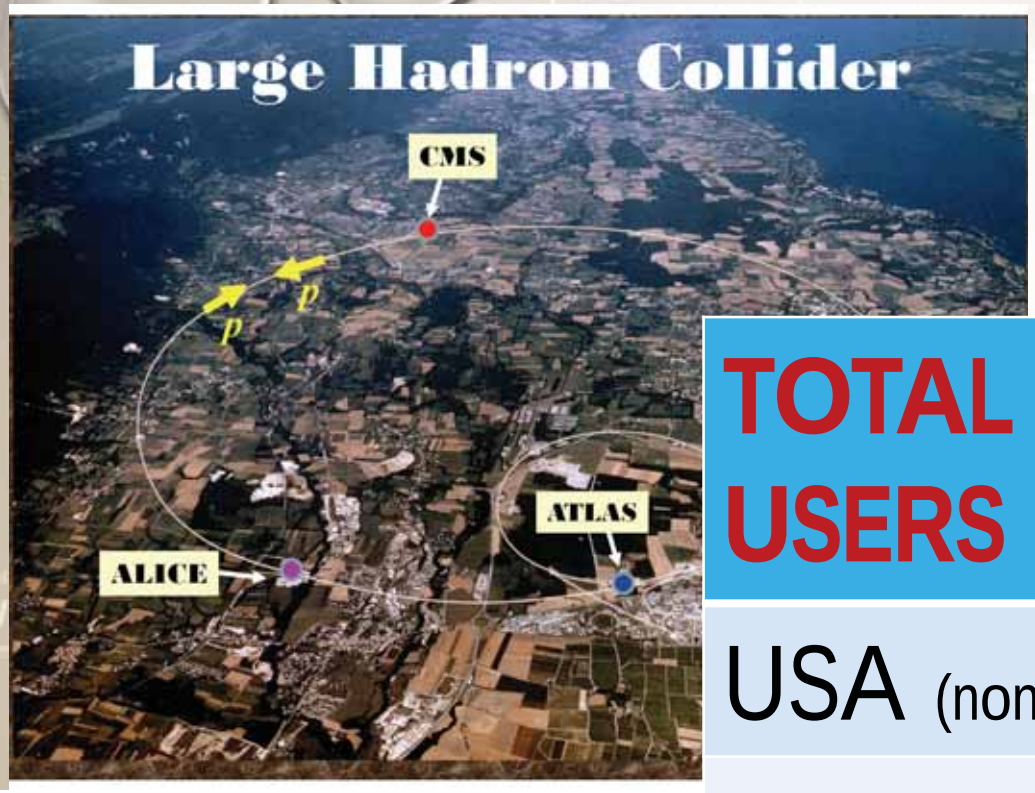


FAIR (Darmstadt) 17%

European Synchrotron Radiation Facility

Grenoble, 11%

EUROPEAN XFEL (HAMBURG) 25%



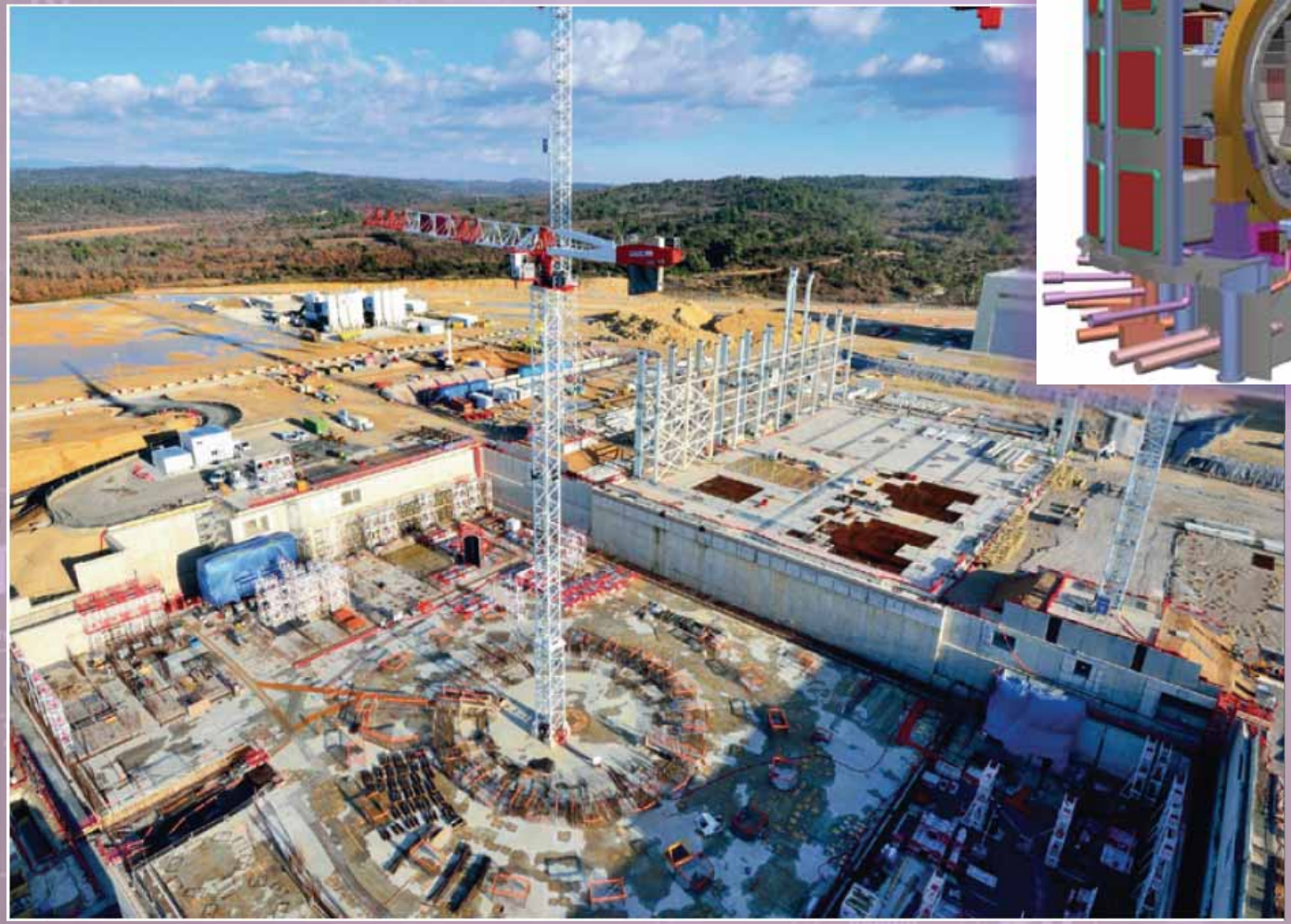
RUSSIA-CERN:

TOTAL LHC USERS	~12500
USA (non-member)	1730
ITALY	**1500**
GERMANY	1200
RUSSIA (non-member)	**920**
UK	900

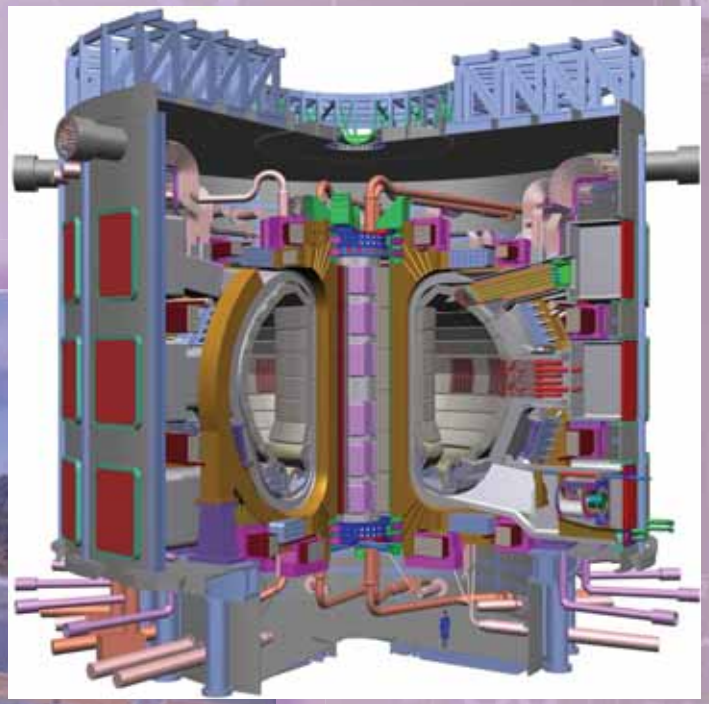
- In-kind contribution ~ 150 M$ to LHC construction (beamlines)
- Support of many groups in 4 major experiments
- Considering joining CERN as *Associate Member*

RUSSIA-ITER: 9% (2B$)

(EU & RU, US, CH, RK, IN, JP)



CONSTRUCTION AT CADARACHE, FRANCE, SITE OF THE ITER NUCLEAR-FUSION EXPERIMENT



29 m dia x 29 m
2020… -2022?

the idea of **tokamak** *(1951 - Lavrentiev, Sak-harov, Tamm)*

RUSSIA'S MEGASCIENCE: *ION-ION COLLIDER* NICA

2020
Dubna
JINR

OTHER MEGASCIENCE PROJECTS (APPROVED): *RESEARCH REACTOR PIK* (ST.PETERSBURG – UNDER CONSTR.), *THREE MODERN LIGHT SOURCES* 1, 3 AND 6 GEV AND *PULSED NEUTRON SOURCE* (PUTIN, 2019)

ALL THAT MAKES US HOP

CONNECTIONS BTW R NCE

AND BOLO MY –

STARTED GENESES AS

LO AND MENDELEEV –

ONTINUE TO STRENGTHEN

MILLE GRAZIE PER LA VOSTRA ATTENZIONE!

MENDELEEV AND ITALY

1860, 1864, 1879, 1881, 1904

Rome, Genoa, Bologna, Venice, Palermo, Catania, Naples, Aosta, Chiavenna, Menaggio, Porlezza, Ivrea, Arona, Como, Bellagio, Torino, Novara, Bergamo, Padova, Brescia, Verona, Milano, Pisa, Firenze , Civitavecchia, Albano, Anacapri, Castellammare, Sorrento, Messina, Canicatti, Caltanissetta, Agrigento, Bolzano

Prof. Petra Rudolf (Netherlands)

https://books.google.com/ngrams

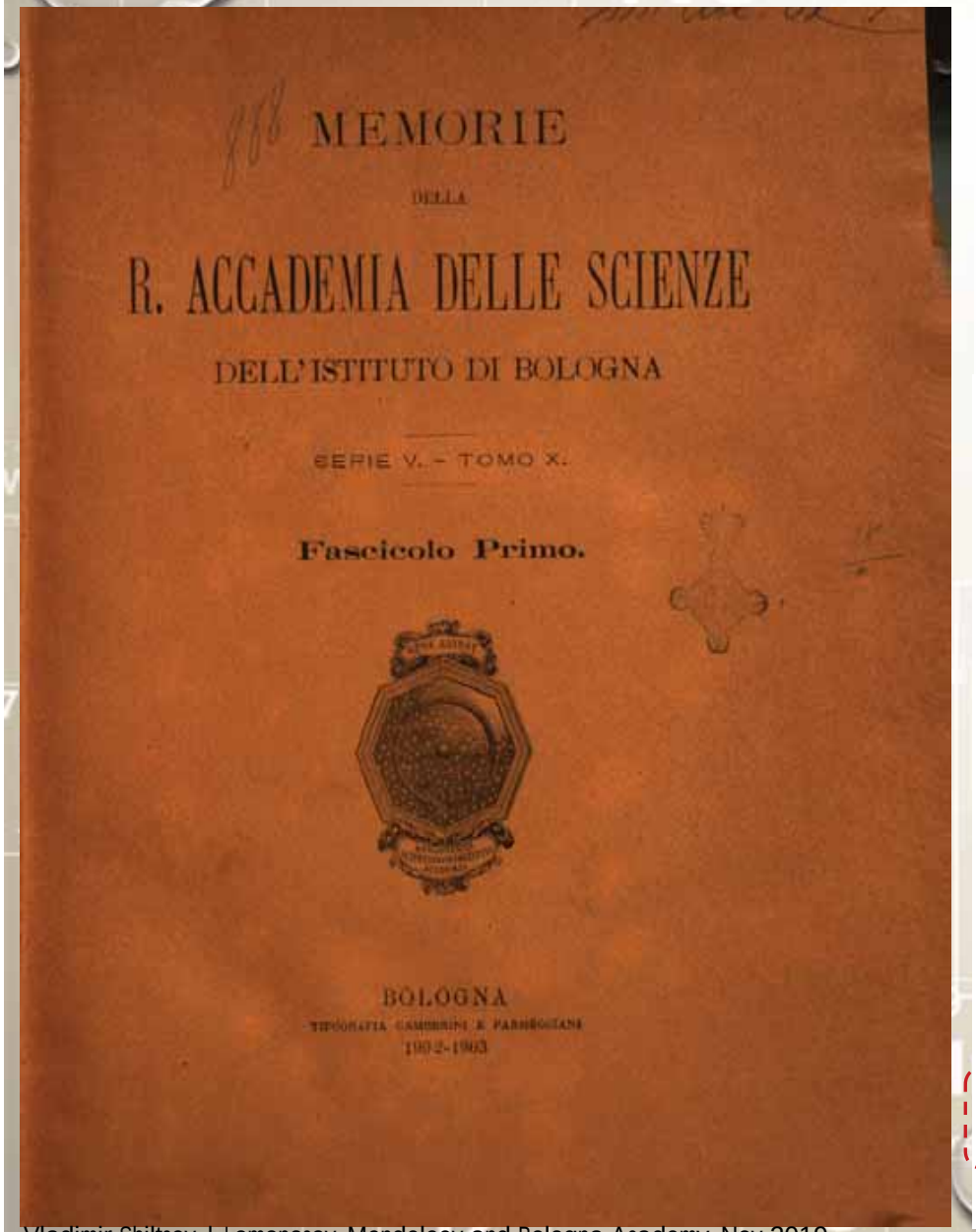
Google Books Ngram Viewer

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

LOMONOSOV: ACADEMY & BEYOND

• ODES TO EMPRESSES, POETRY REFORM	1739-1763
• ADJUNCT PROFESSOR OF PHYSICS ST.PETERSBURG ACADEMY	1742
• ACADEMICIAN (PROFESSOR) OF ST.PETERSBURG ACADEMY	1745
• ESTABLISHED FIRST RUSSIAN CHEMICAL LAB	1748
• PROOF OF LAW OF CONSERVATION OF MATTER AND MOVEMENTS	1748-1756
• MOSAIC FACTORY	1752-1765
• FORMULATED MODERN RUSSIAN GRAMMAR	1754
• THEORY OF ELECTRICITY - FIRST HELICOPTER	1753-54
• FOUNDED MOSCOW UNIVERSITY	1755
• ORIGINS OF EARTHQUAKES AND MINERALS	1757
• ACADEMY TOP SCIENTIST/MANAGER	1757-65
• DISCOVERED ATMOSPHERE OF VENUS	1761
• ARRANGED ARCTIC PATH EXPEDITION	1763-65
• COMPREHENSIVE RUSSIAN HISTORY	1765

MENDELEEV IN BOLOGNA ACADEMY



ACCADEMICI CORRISPONDENTI ESTERI

SEZIONE PRIMA

Scienze Fisiche e Matematiche.

Boltzmann Dott. **Lodovico** Prof. di Fisica nell' Università di *Vienna*; Membro dell' I. R. Accademia di scienze di Vienna; Membro onorario della R. Accademia delle scienze di Berlino, e Corrispondente della R. Accademia Svedese delle scienze, della R. Società delle scienze di Göttingen, del R. Istituto Lombardo di scienze e lettere, della R. Accademia delle

Hooker Sir **Giuseppe Dalton** Dottore *honoris causa* della Facoltà di scienze fisiche, matematiche e naturali della R. Università di Bologna; già Presidente della Società R. di Londra; Membro corrispondente della R. Accademia delle scienze di Berlino, della R. Accademia Svedese delle scienze, della R. Accademia delle scienze di Amsterdam, della R. Accademia Danese di scienze e lettere, della R. Società delle scienze di Göttingen; Membro straniero della R. Accademia Bavarese delle scienze; Socio straniero della Società Italiana delle scienze detta dei XL, della R. Accademia dei Lincei, della R. Accademia delle scienze di Torino e della R. Accademia delle scienze, lettere e belle arti di Palermo; Direttore dei *Royal Kew Gardens* - *Londra*.

Karpinsky Alessandro Petrovic Professore di Geologia nella I. Università di *S. Pietroburgo* e nel Berginstitut; Direttore del Comitato Geologico di Russia; Socio straniero della R. Accademia dei Lincei.

De Lapparent Prof. **Alberto**, Membro dell' Istituto di Francia - *Parigi*.

Leydig Dott. **Francesco** Dottore *honoris causa* della Facoltà di scienze fisiche, matematiche e naturali della R. Università di Bologna; Professore d'Anatomia comparata nella Università di *Würzburg*; Ordinario emerito dell' Università di Bonn; Membro corrispondente della R. Accademia Danese di scienze e lettere.

Mendeleeff Prof. **Demetrio** Direttore della Camera centrale dei Pesi e delle Misure dell' Impero Russo - *S. Pietroburgo*.

Pauthier G. P. Guglielmo - *Parigi*.

“The solution is Jesiutic”

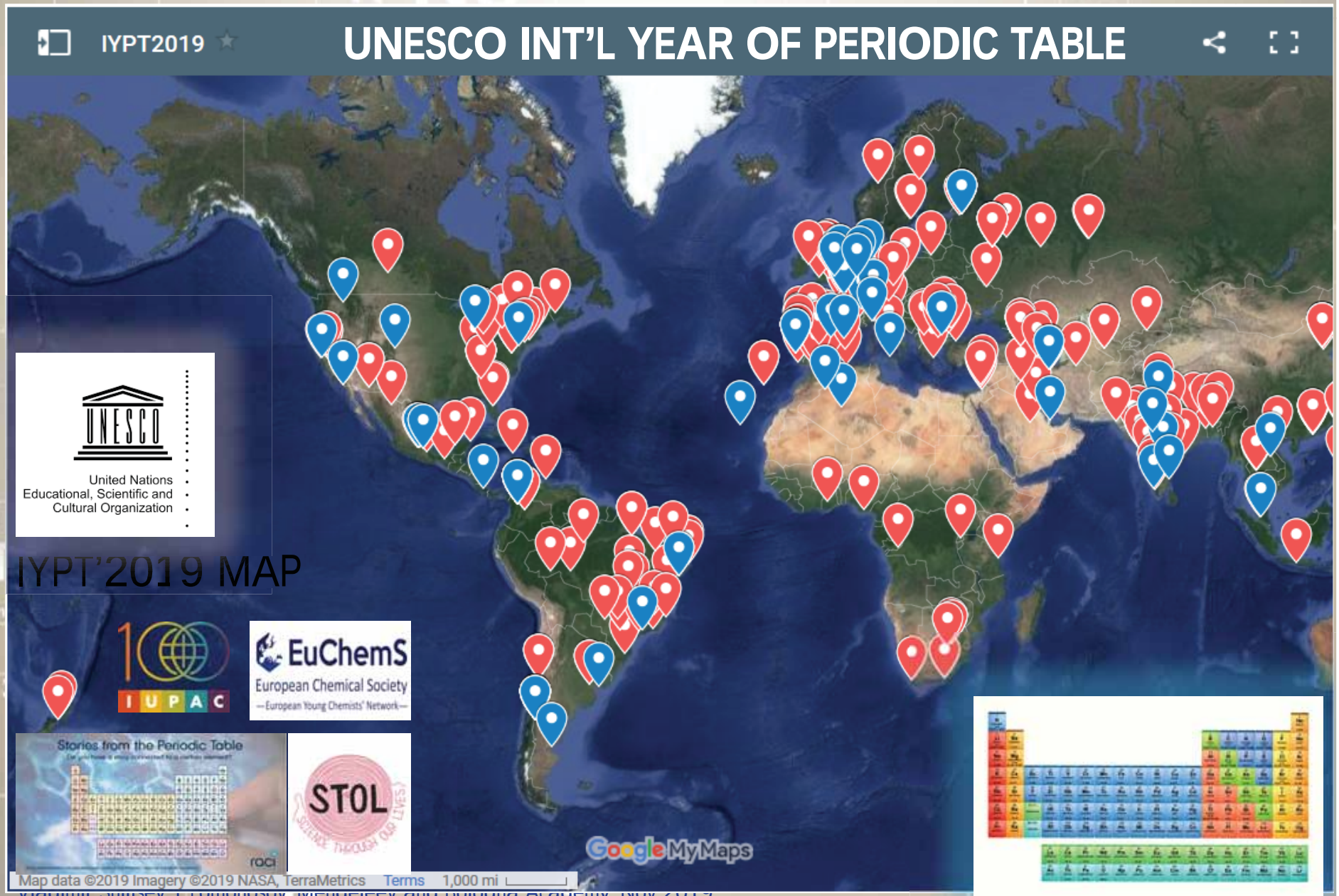
“*Un-Real History*” (TNT channel)

Lyuba Mendeleeva & Alexander Blok, m.1903.

...Вхожу я в темные храмы,
Совершаю бедный обряд.
Там жду я

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

HTTPS://WWW.IYPT2019.ORG/



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
Life and death with nitrogen
Oxygen origins
The allure of aluminium
Silicon beyond the valley
The two faces of phosphorus

FERMILAB (CHICAGO) – MAY 2019

TYUMEN (DIM BIRTHPLACE) – SEP 2019

CERN – OCTOBER 2019

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

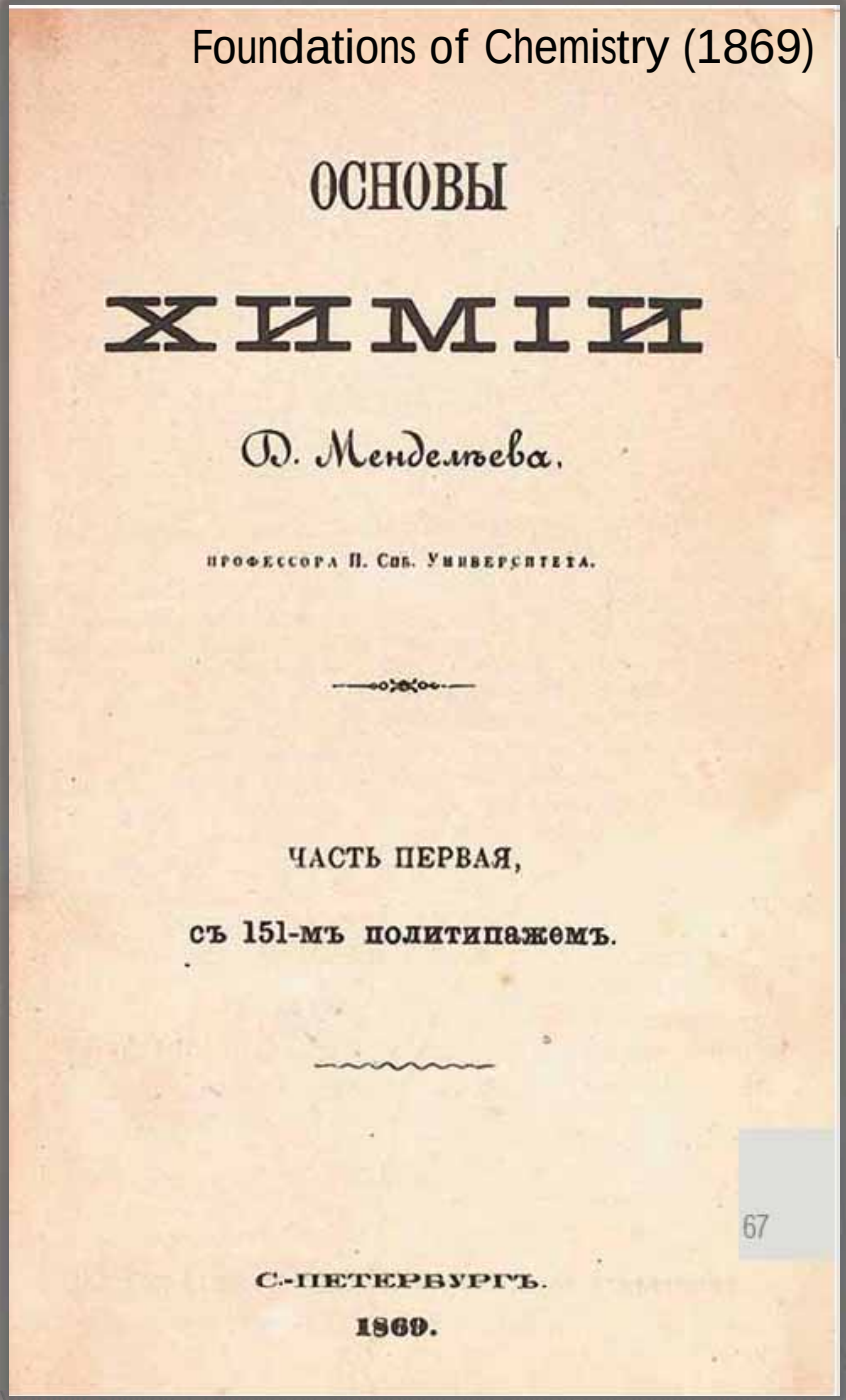
Ulrich Schubert (Vienna University, Austria)
New materials: where chemistry and materials sciences meet

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

Foundations of Chemistry (1869)



ОСНОВЫ

ХИМІИ

Д. Менделѣева,

ПРОФЕССОРА П. СПБ. УНИВЕРСИТЕТА.

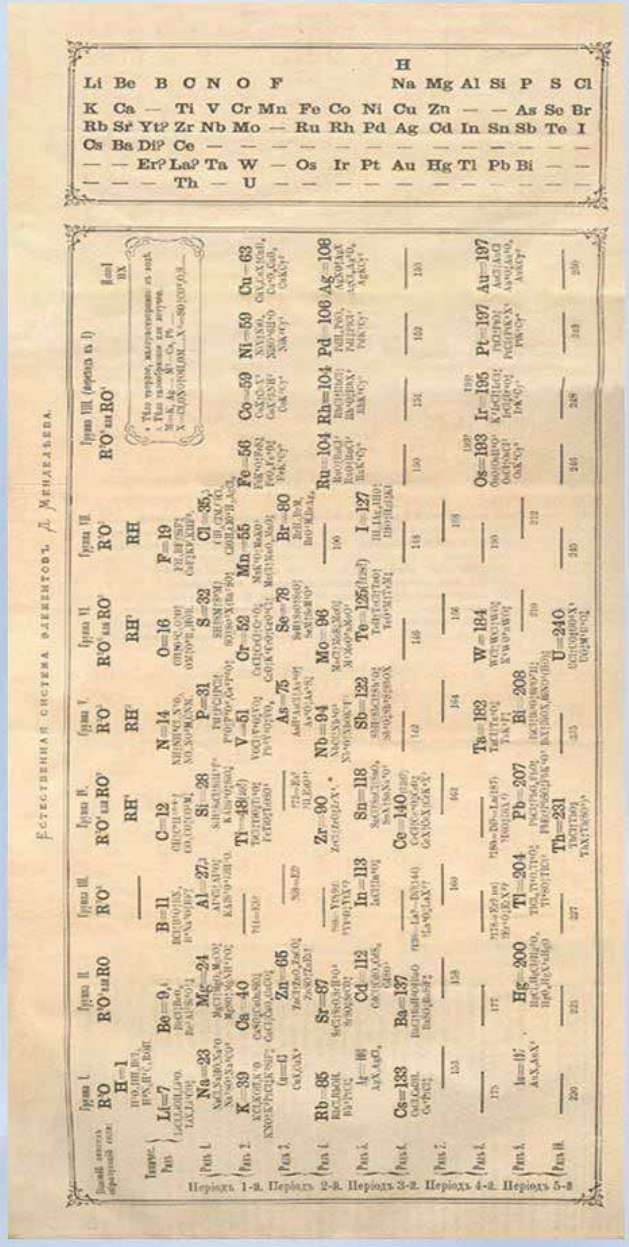
ЧАСТЬ ПЕРВАЯ,

съ 151-мъ политипажемъ.

С.-ПЕТЕРБУРГЪ.

1869.

… IN REALITY



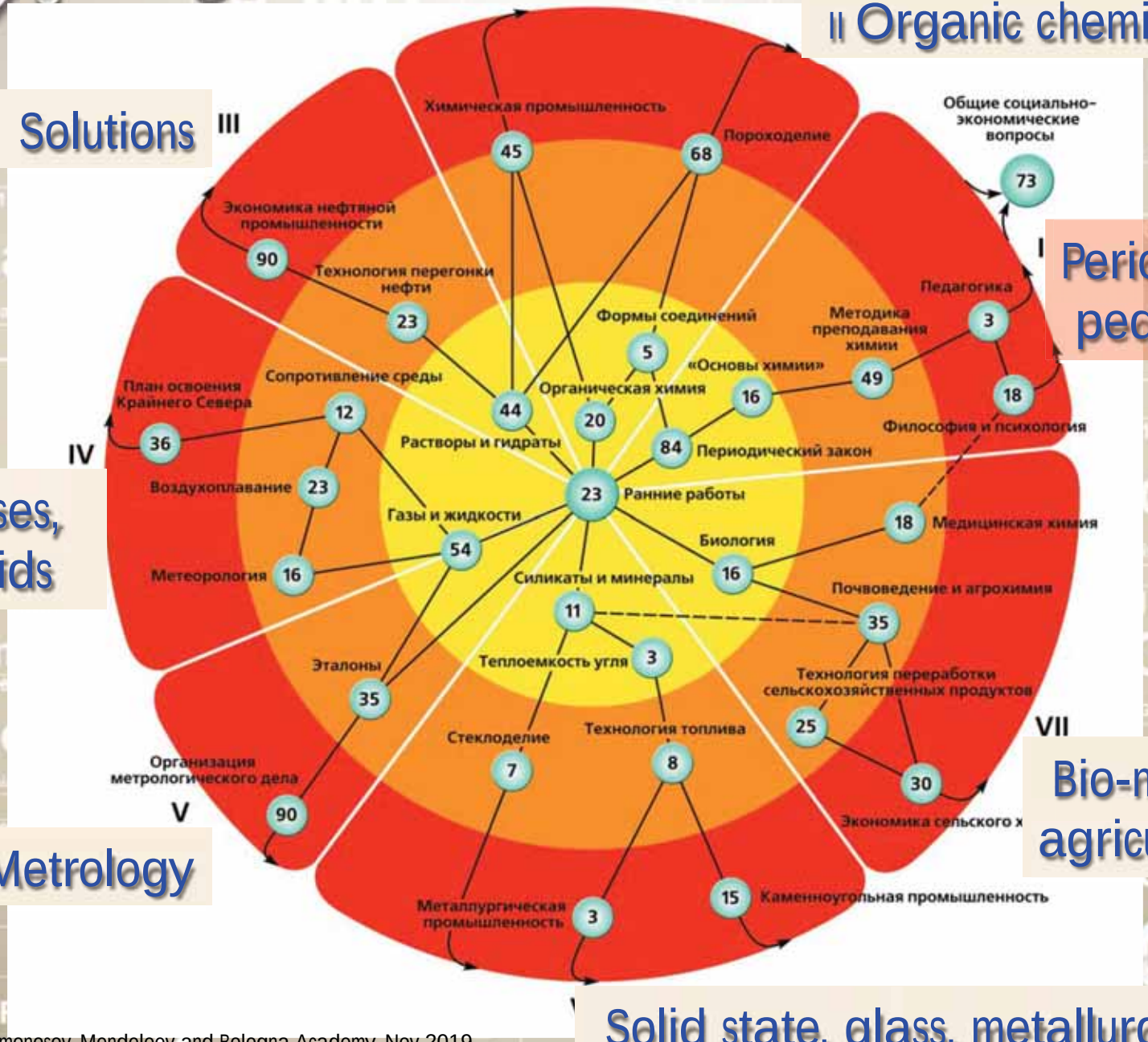
Mendeleev's "System of Elements" in short form
Published in Part 2 of "Foundations of Chemistry" (1871)

DM “COMPLETE WORKS” (1937-1954)

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

Р.Б.Добротин, Н.Г.Карпило, Л.С.Керова, Д.Н.Трифонов. Летопись жизни и деятельности Д.И.Менделеева. Л.,



Solutions

Organic chemistry

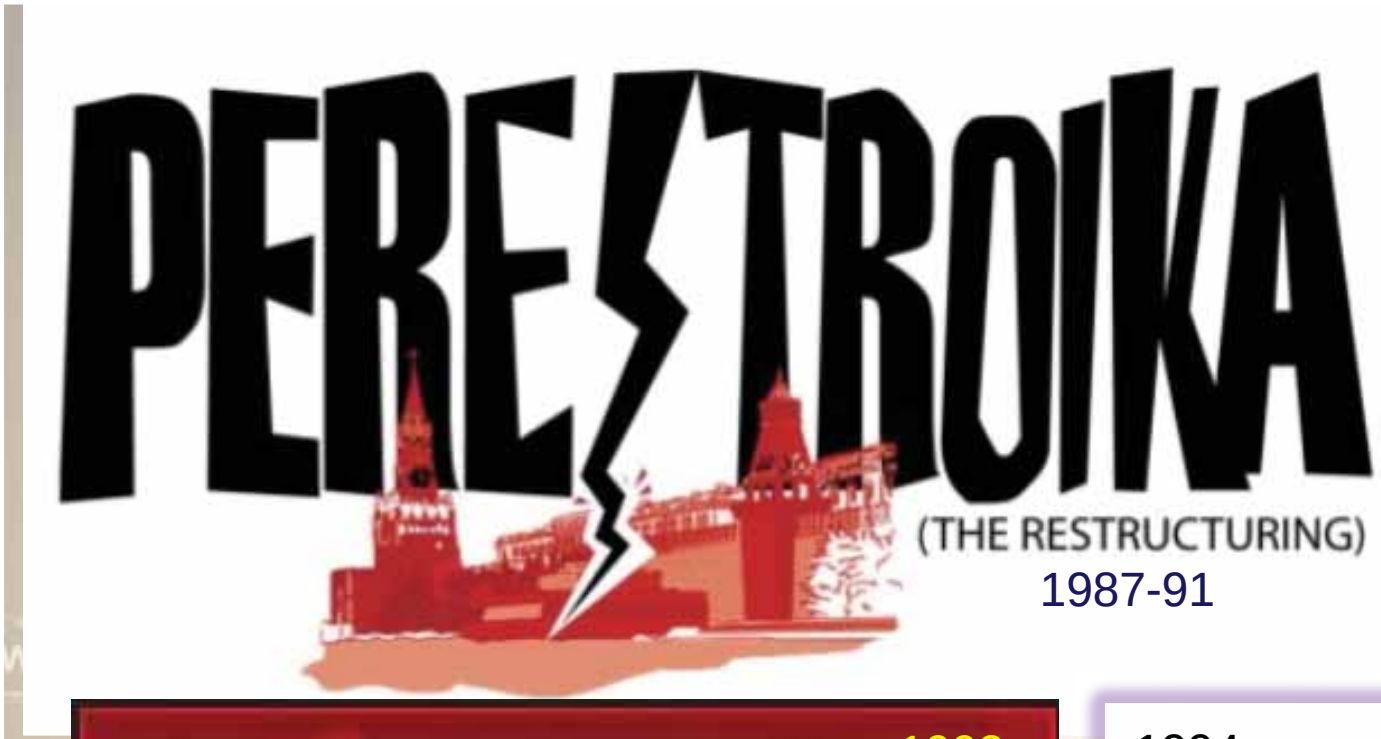
Periodic law, pedagogy

Gases, liquids

Metrology

Bio-med, agriculture

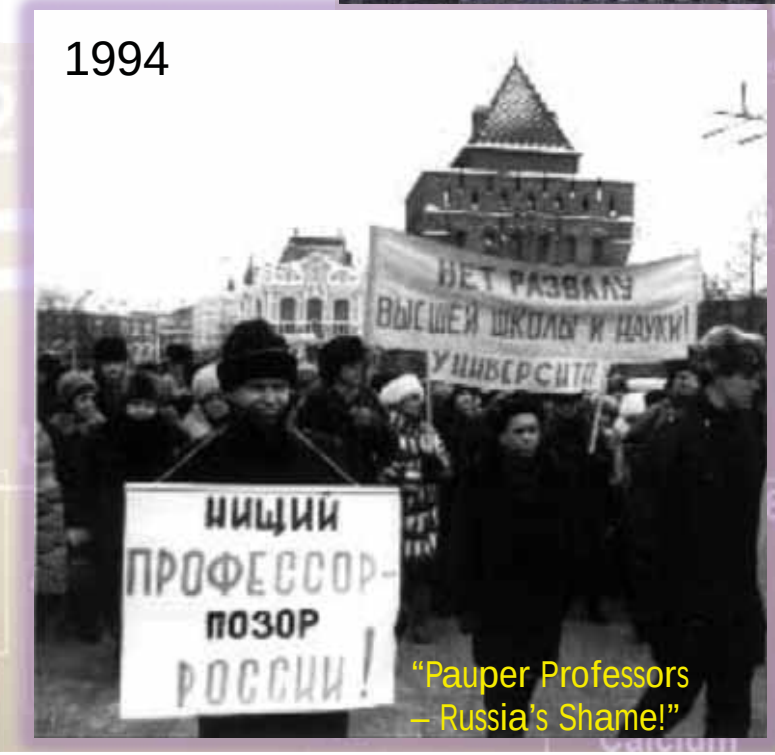
Solid state, glass, metallurgy



1987-91

A.Sakharov 1989

1993



1994

"Pauper Professors – Russia's Shame!"

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)

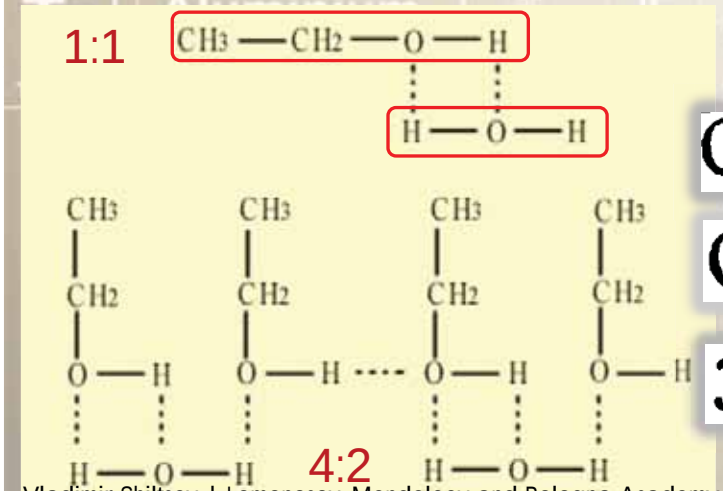
POPULAR MYTHS ABOUT VODKA

- "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

PHD THESIS (1865)

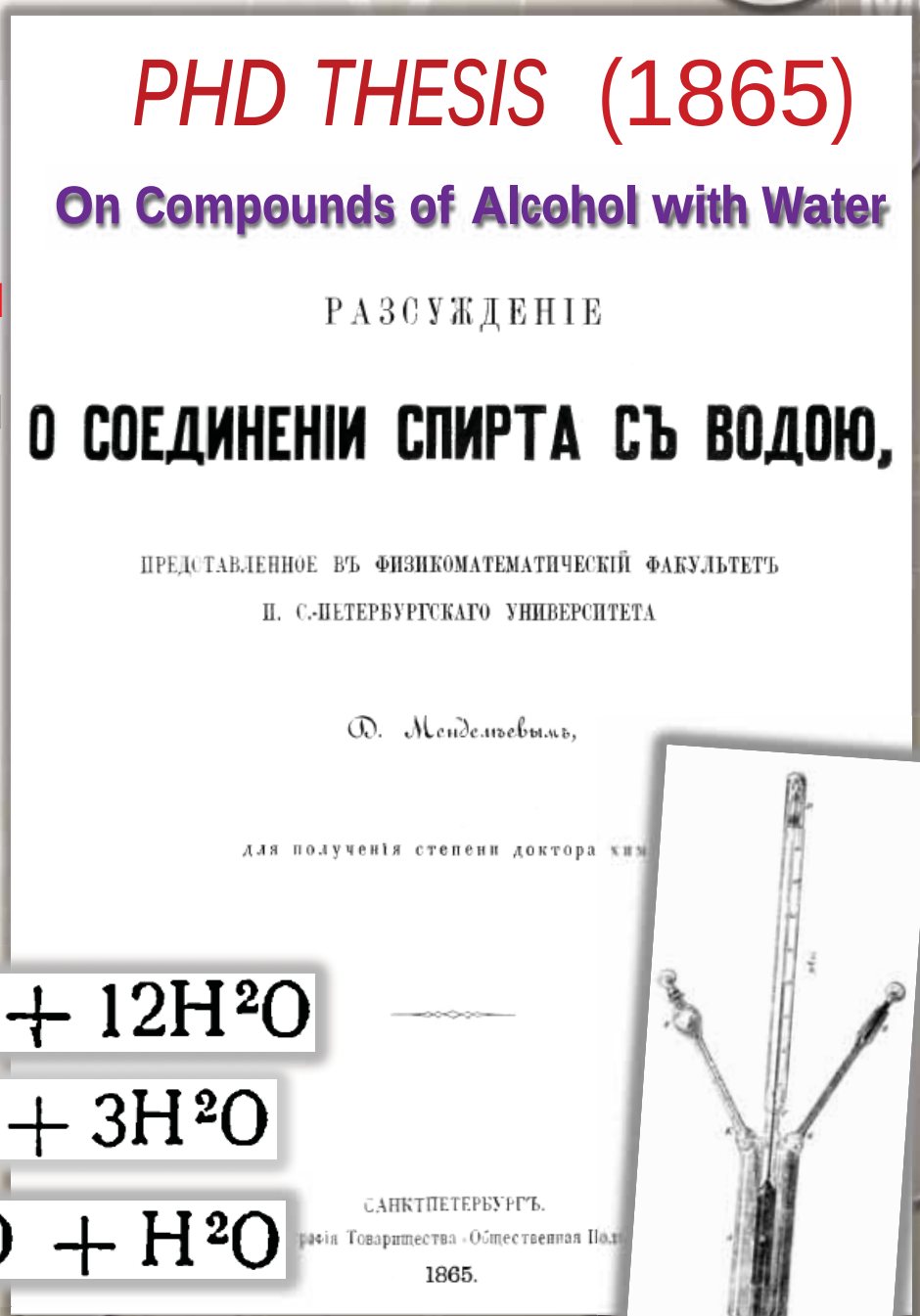
- **Seminal scientific** study of solutions of alcohol C_2H_5OH in water:
  - Temperature control *dT~ 0.02°C*, new method to get record pure 99.99% ethyl alcohol, took into account air weight and air pressure, precise calibration of *P* and *T*, glass expansion, etc etc...
  - VERY thorough error analysis
  - 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



$C^2H^6O + 12H^2O$

$C^2H^6O + 3H^2O$

$3C^2H^6O + H^2O$



On Compounds of Alcohol with Water

РАЗСУЖДЕНІЕ

О СОЕДИНЕНІИ СПИРТА СЪ ВОДОЮ,

ПРЕДСТАВЛЕННОЕ ВЪ ФИЗИКОМАТЕМАТИЧЕСКІЙ ФАКУЛЬТЕТЪ

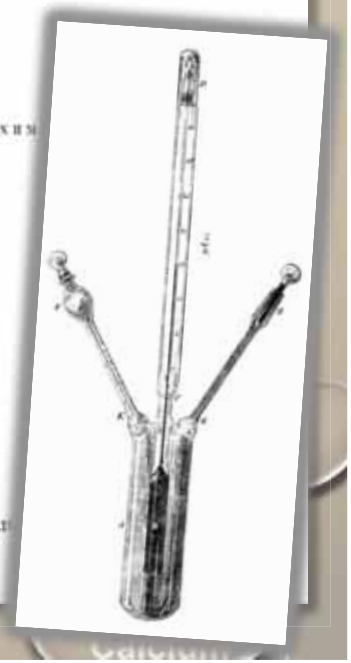
И. С.-ПЕТЕРБУРГСКАГО УНИВЕРСИТЕТА

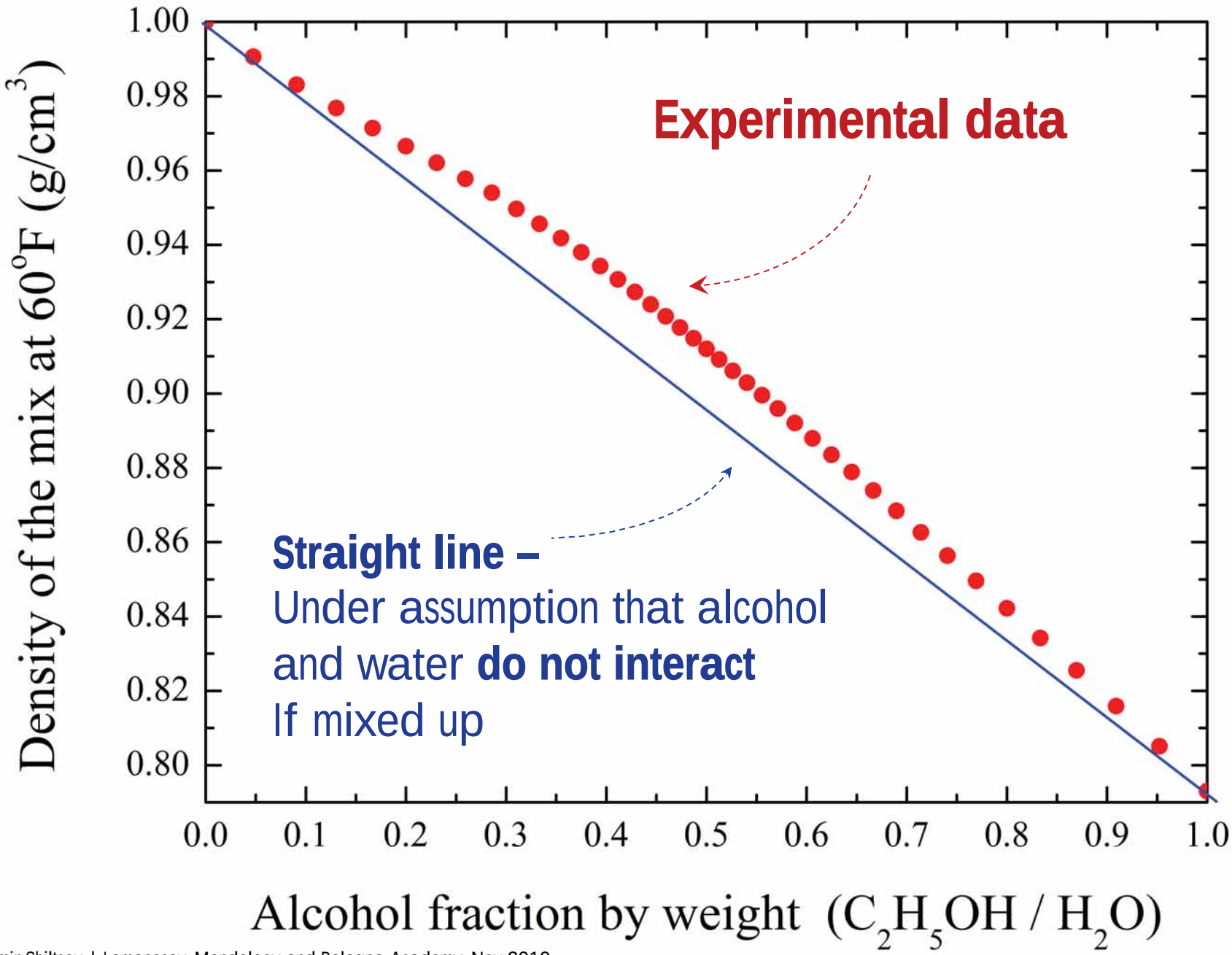
Д. Менделѣевымъ,

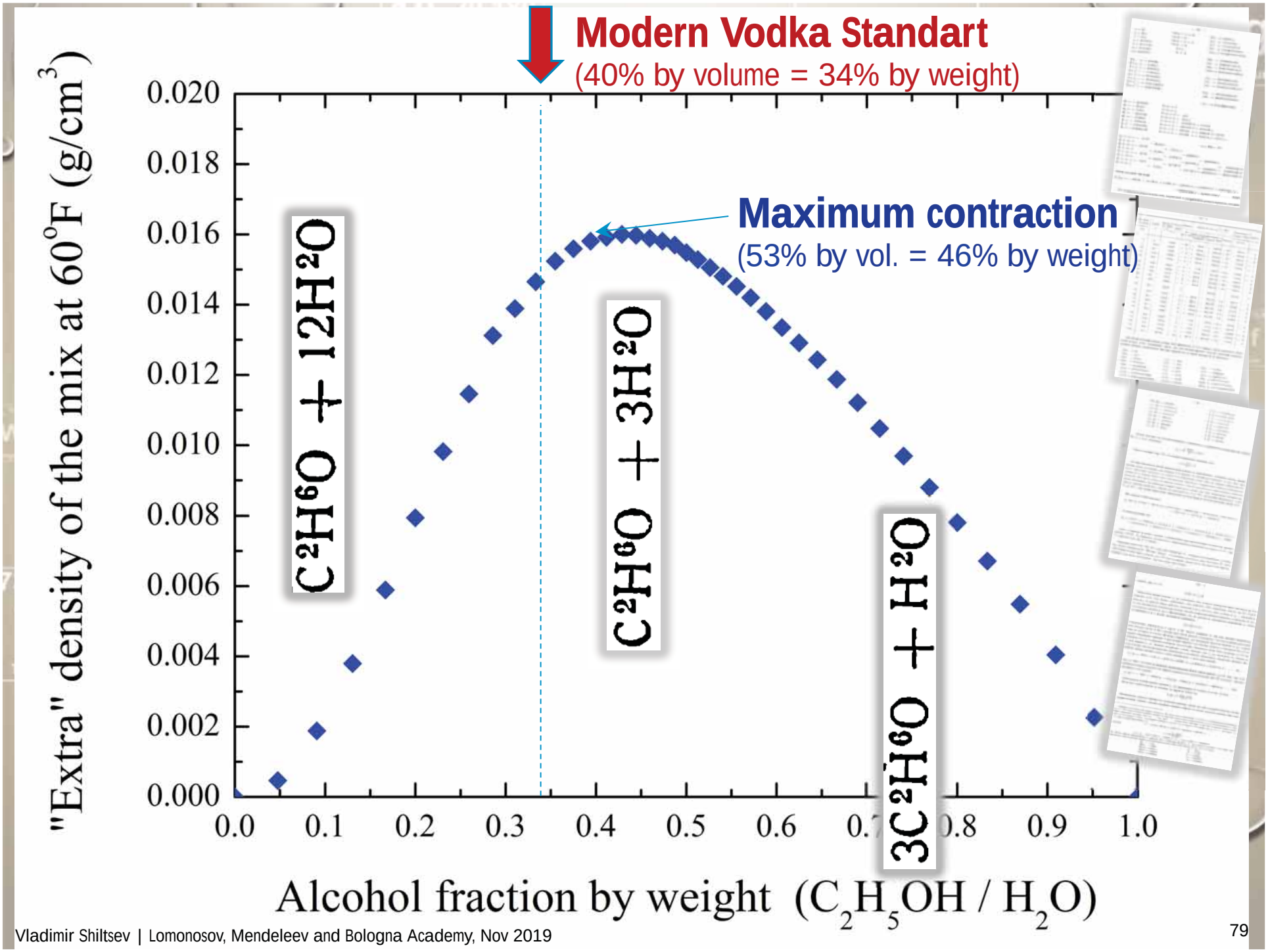
для полученія степени доктора хим

САНКТПЕТЕРБУРГЪ.

1865.




Density of the mix at 60°F (g/cm³)
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Alcohol fraction by weight (C2H5OH / H2O)
Experimental data
Straight line –
Under assumption that alcohol
and water do not interact
If mixed up


Modern Vodka Standart
(40% by volume = 34% by weight)
Maximum contraction
(53% by vol. = 46% by weight)
C2H6O + 12H2O
C2H6O + 3H2O
3C2H6O + H2O
"Extra" density of the mix at 60°F (g/cm3)
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Alcohol fraction by weight (C2H5OH / H2O)

WHY PEAK AT 46% ALCOHOL?

C_2H_5OH AND 3 (H_2O)

12X2 + 5 +16 + 1	3 X (2+16)
46	**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")

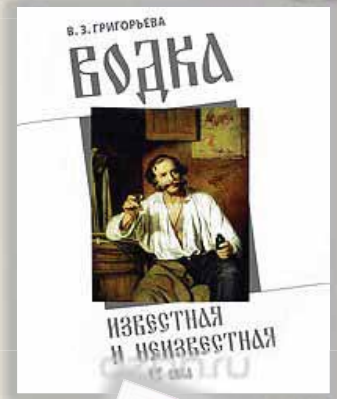
- Hydrogen bond strength depends not only on ethanol concentration but also on impurities / foreign substances
- Consequently, the taste is strongly dependent on them, too

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

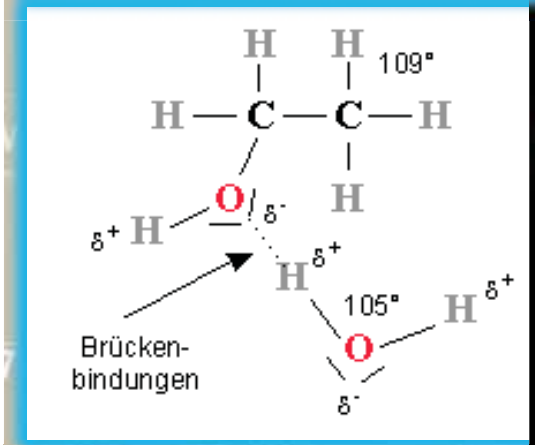
- Comparative analysis of health effects of vodka, gin, beer, whiskey

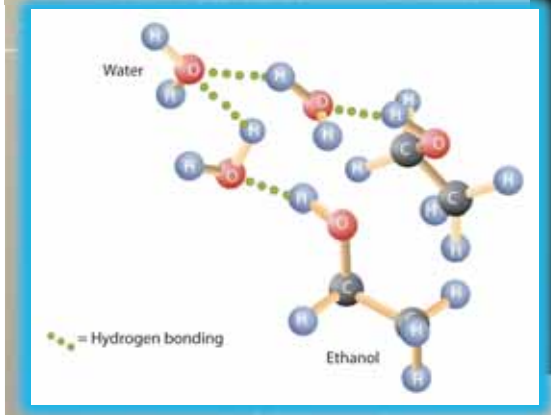
Drs. S.Patsaeva and T.Dolenko (Moscow State University)

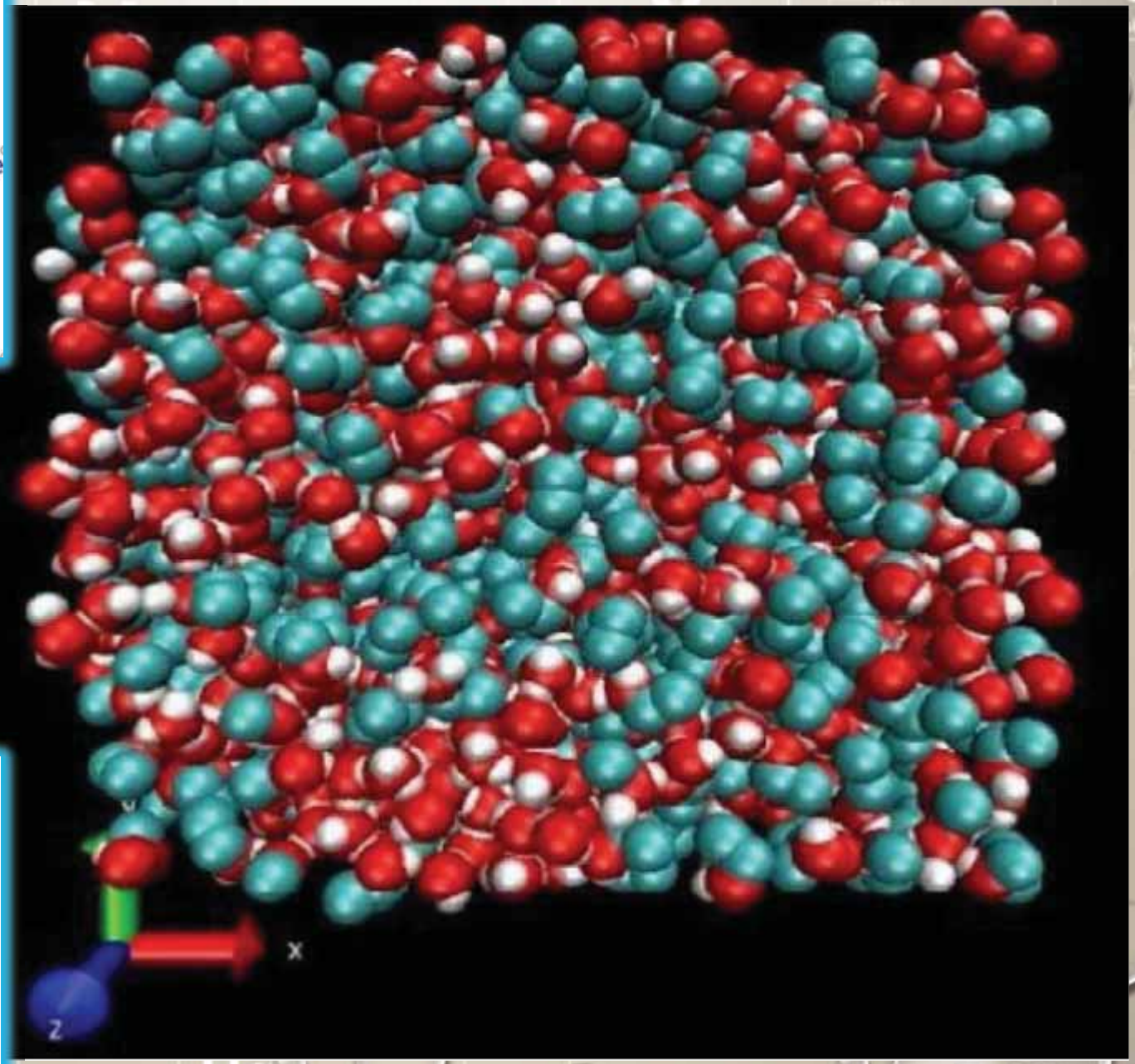
- Successfully applied Raman scattering for precise determination of the ethanol concertation and detail analysis of impurities



Strongly
Approachable
EtOH


H
H
109°
H — C — C — H
H
O
δ-
δ+ H
H δ+
105°
H δ+
O
δ-
Brücken-
bindungen


Water
= Hydrogen bonding
Ethanol


X
Z

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. [illegible] prise move after the speech, [illegible] vited Attorney General Chris[illegible] to stand right next to him at [illegible] um to field questions. "Hi[illegible] for Christie this time," twee[illegible] News Channel reporter Meg[illegible] who was covering the speec[illegible] sports bar near Rockefeller C[illegible] cause she has been placed on [illegible] House blacklist.

Although Trump reitera[illegible] promise to eject some 11.3 mil[illegible] gal workers on a twoyear tim[illegible] "So fast that your head will s[illegible]

Markets sink as trade war looms

UNCERTAINTY STOCKS

HOME / BUSINESS / TECHNOLOGY

ASK DR. KNOWLEDGE

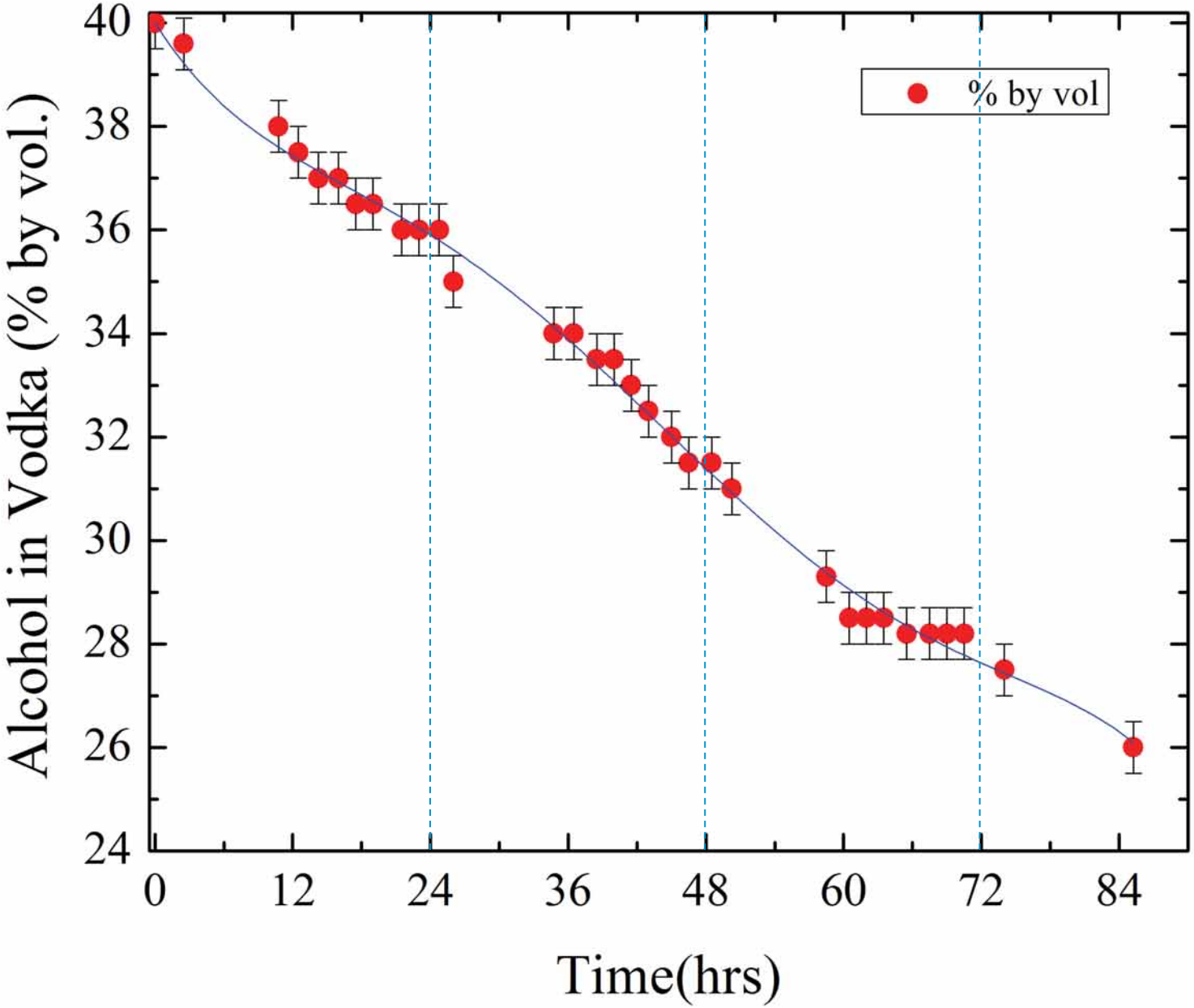
Why is vodka 40 percent alcohol?

November 22, 2010

E-mail | Print | Reprints | Text size − +

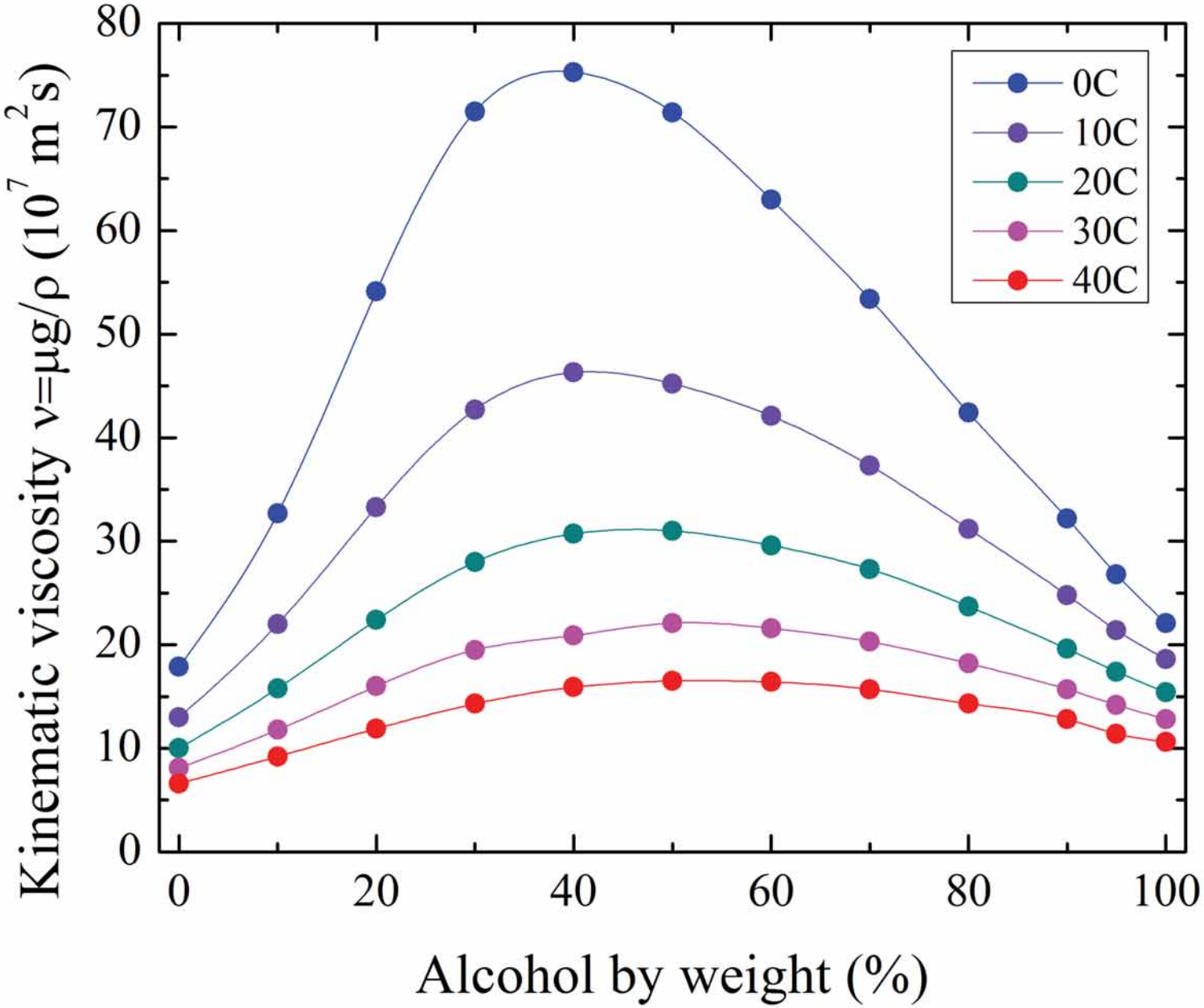
Why is vodka 40 percent alcohol? Is this arbitrary? No — and the reasons are linked to the specific properties of alcohol and water. All of them rather amazingly lead to the "40 percent alcohol by volume" label we know so well.

“STRENGTH LOSS IN TIME”

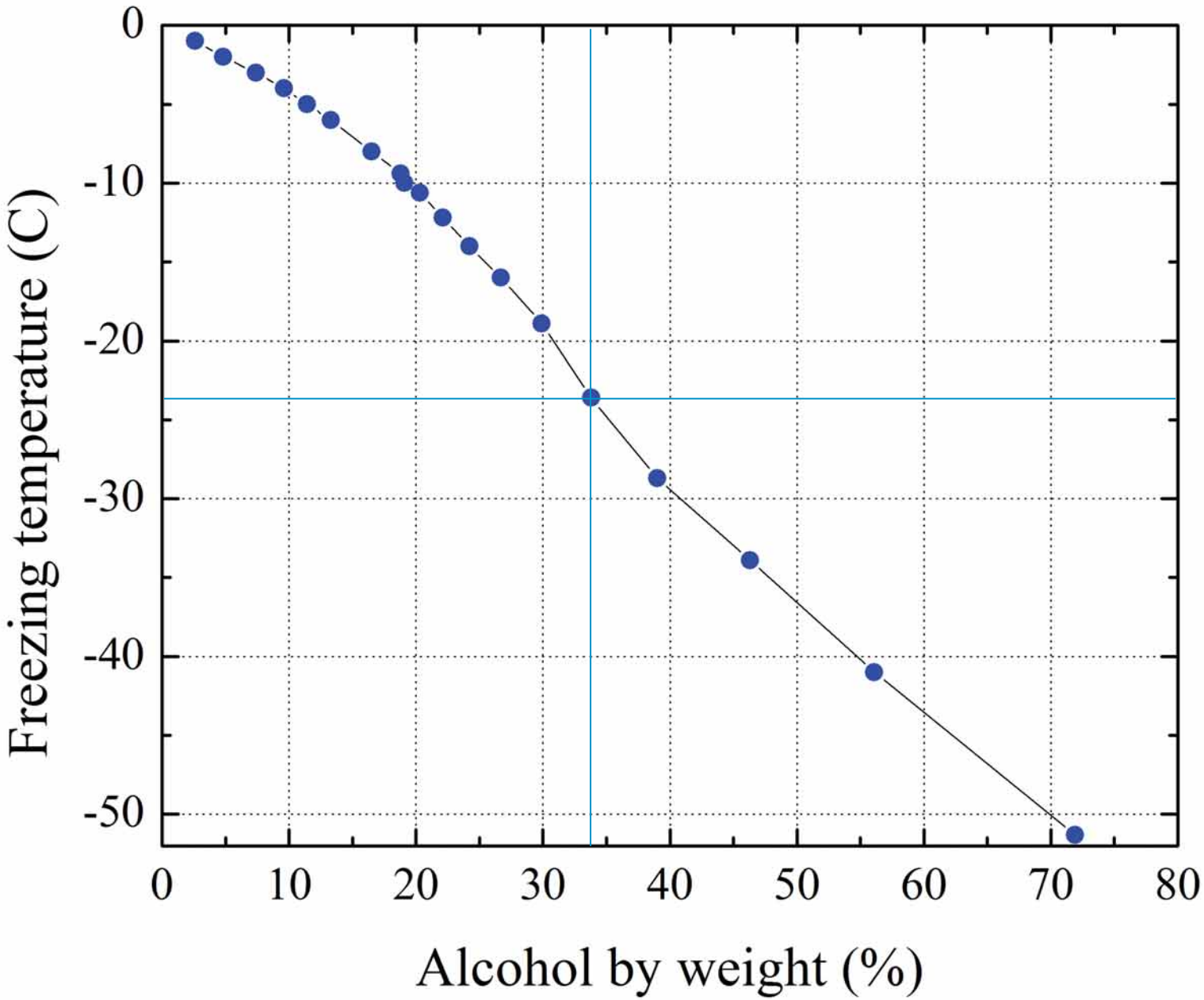


DOES VODKA CATCH FIRE AND BURN ?

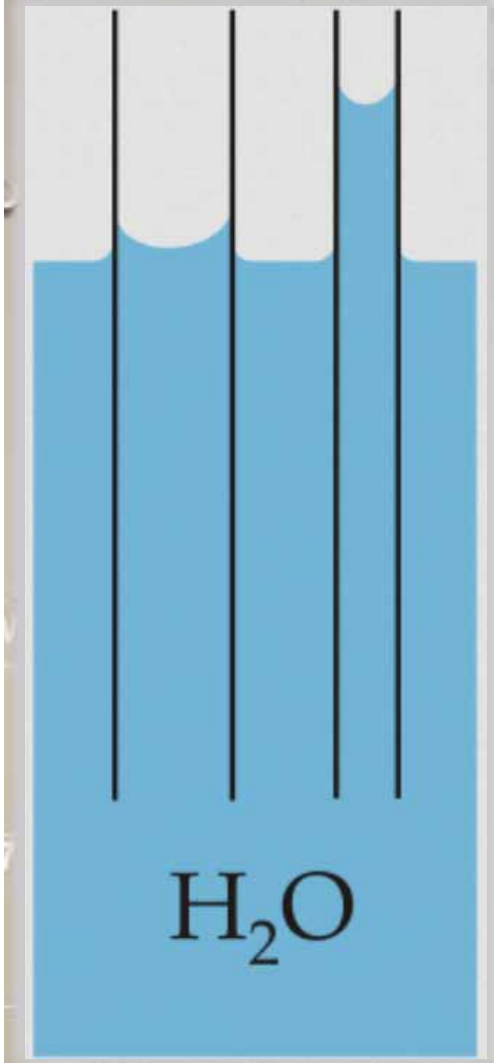
VISCOSITY - "DRINK WHEN COLD"



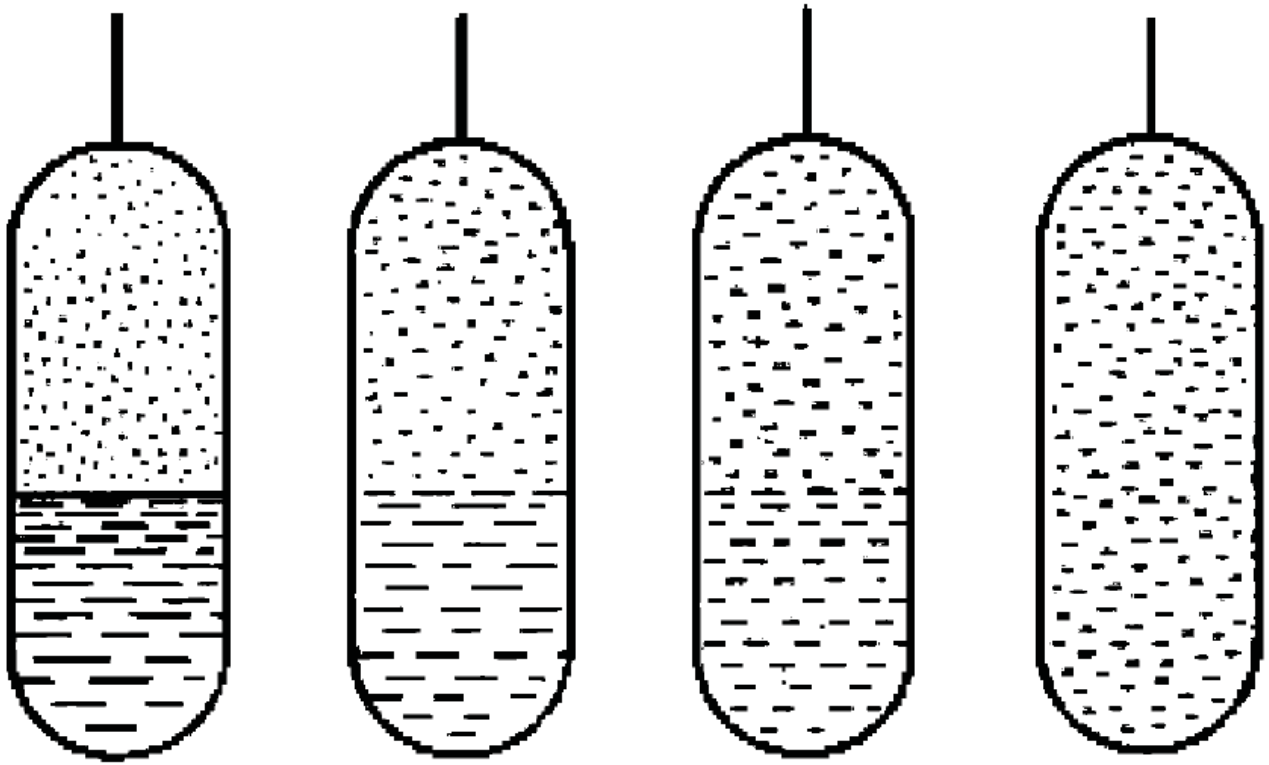
VODKA - ANTIFREEZE



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 Каньяр-де ла Тур (Ch. Cagniard de la Tour, 1822), Фарадей [3], Франкенгейм (1835), и современники Менделеева (Бруннер и Вольф (1857–1858), Дрион (1859), см. ссыл-



DM AND GASES
TEXTBOOK EQUATIONS

- R. BOYLE (1662) AND E. MARIOTTE (1676)

$$PV = CONST$$

- J. CHARLES(1787) AND J. GAY-LUSSAC (1802)
  - AT CONSTANT PRESSURE, *T* IN KELVIN

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- A. AVOGADRO (1811)
  - IN MOLES, UNDER SAME *P*, *T*

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

- B.P.E. CLAPEYRON (1834)
  - *B* DEPENDS ON GAS

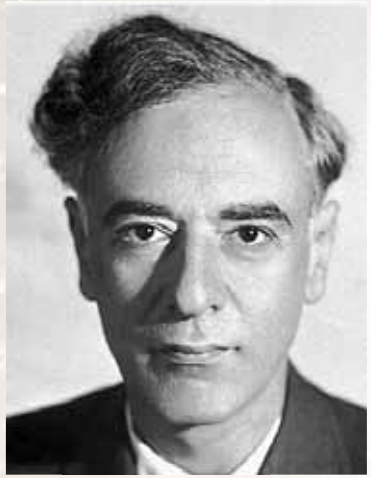
$$PV = BT$$

- D. MENDELEEV (1874)
  - *R* IS THE UNIVERSAL GAS CONSTANT (*R* = 8.314 J/MOLE K)
  - HIS OWN DATA *T=273.09+T(°C)…* NOW *273.16*

$$PV = (M/\mu)RT$$

Clapeyron-Medeleev equation

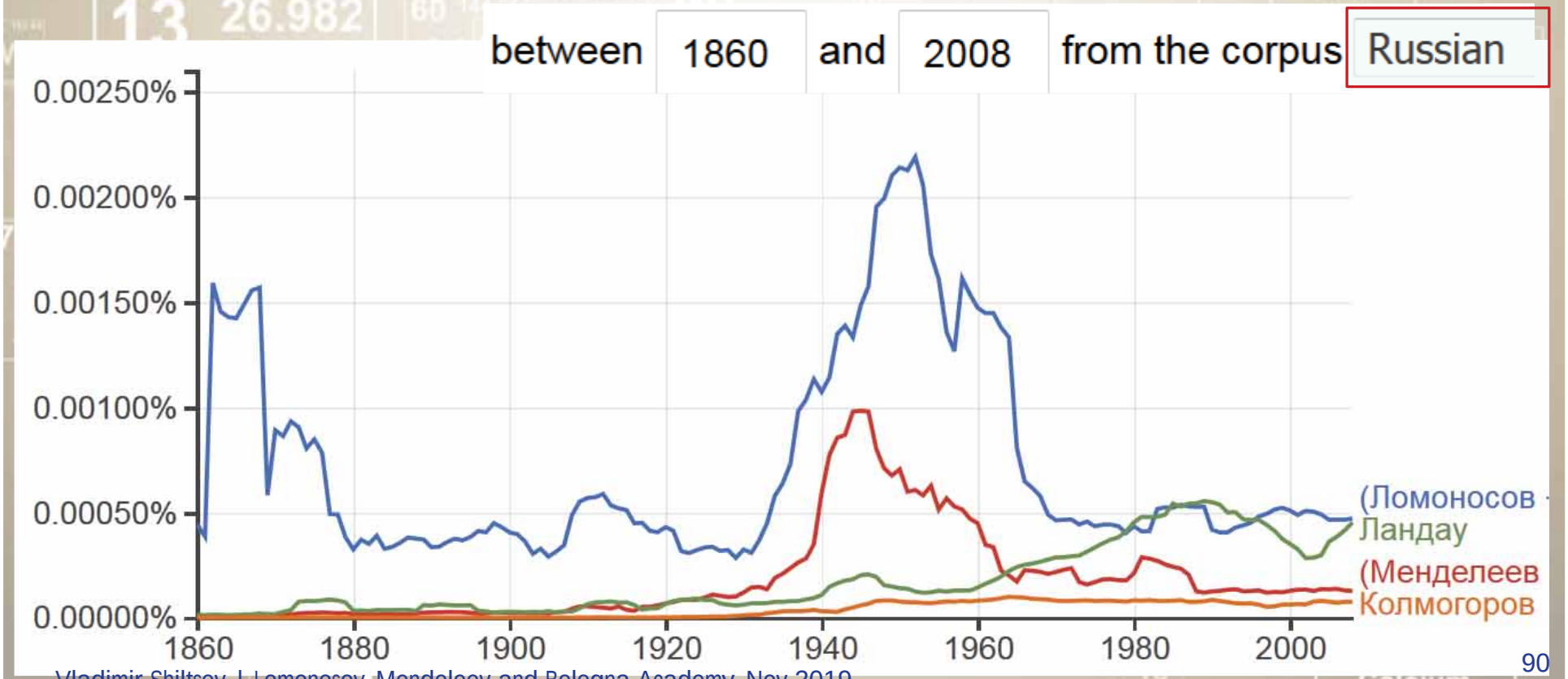
Lomonosov



Landau

Mendeleev

Kolmogorov



DM NATURE, **15** (1877), P.499

There are three laws for gases: that of Boyle and Marriotte, $pv = \text{const.}$; that of Gay Lussac, $v_t = v_0 (1 + \alpha t)$; and that of Ampère and Gerland $\frac{av}{m} = \text{const.}$ (a being the molecular weight, and m the mass). Their *ensemble* is expressed for all gases in general by the equation—

$$\boxed{apv = 845 (273 + t) m,}$$

where a is the atomic weight ($H = 1$), p the pressure in kilograms per square metre, v the volume in cubic metres, m the weight in kilograms, t the centigrade temperature. This is, however, only a first approximation. In the second member of the equation there must be additional terms which express a function of p and of a, very small for the ordinary mean values of p, and which become of a sensible magnitude only when p is very small or very great. To find this function is a question of the future, and

RUSSIAN PHYSICS NOW:

78 RESEARCH INSTITUTES DOING FUNDAMENTAL (49) AND APPLIED PHYSICS RESEARCH (29) - SOME 35,000 STAFF

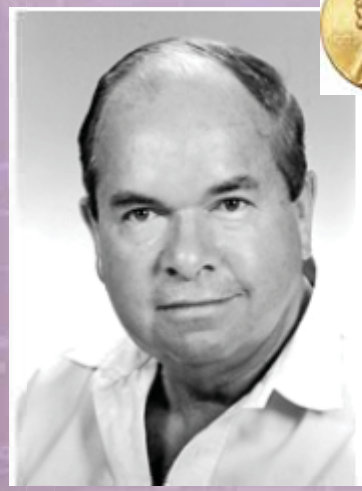
1958 Cherenkov, Tamm and Frank
Cherenkov radiation

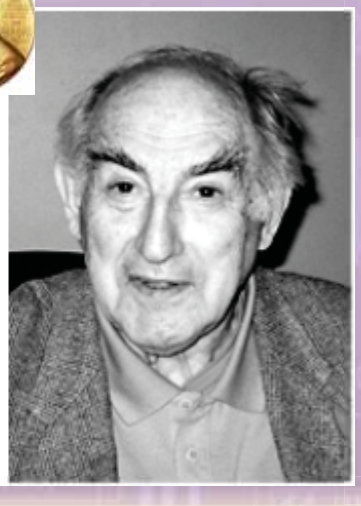
1962 Landau
Superfluid He theory

1964 Basov, Prokhorov
Laser

1978 Kaptsa
Superfluid He

2000 Alferov
Semiconductor laser





2003 Abrikosov, Ginzburg
Theory of superconductors

2010 Geim, Novoselov
Graphene