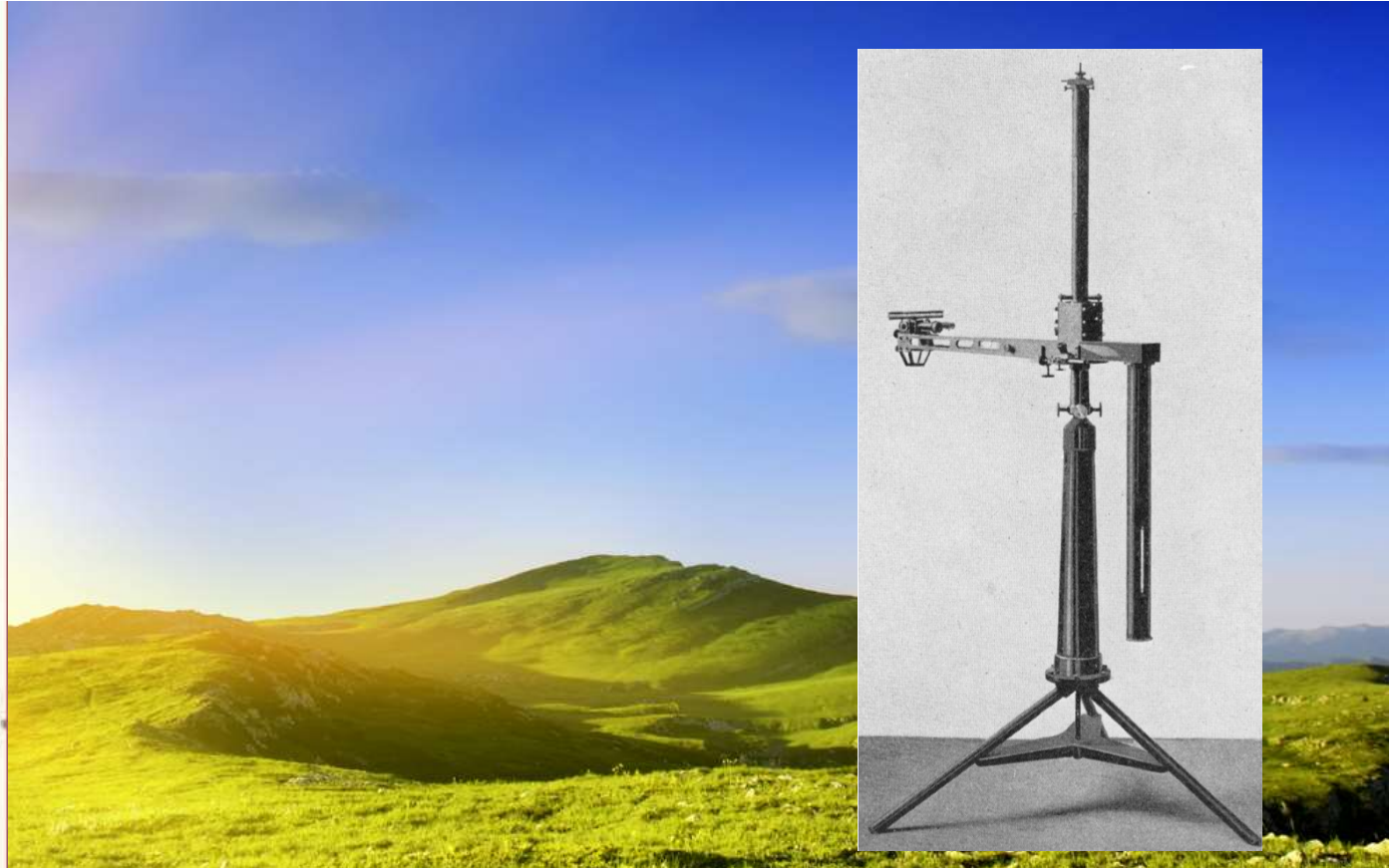




·DR·EÖTVÖS·LÓRÁND·BARÓ

1891-92



# Loránd (Roland) Eötvös (1848-1919)

Zsolt Vidovenyecz – Hungary  
CLGE General Assembly – Sofia, 2019

## Sources:

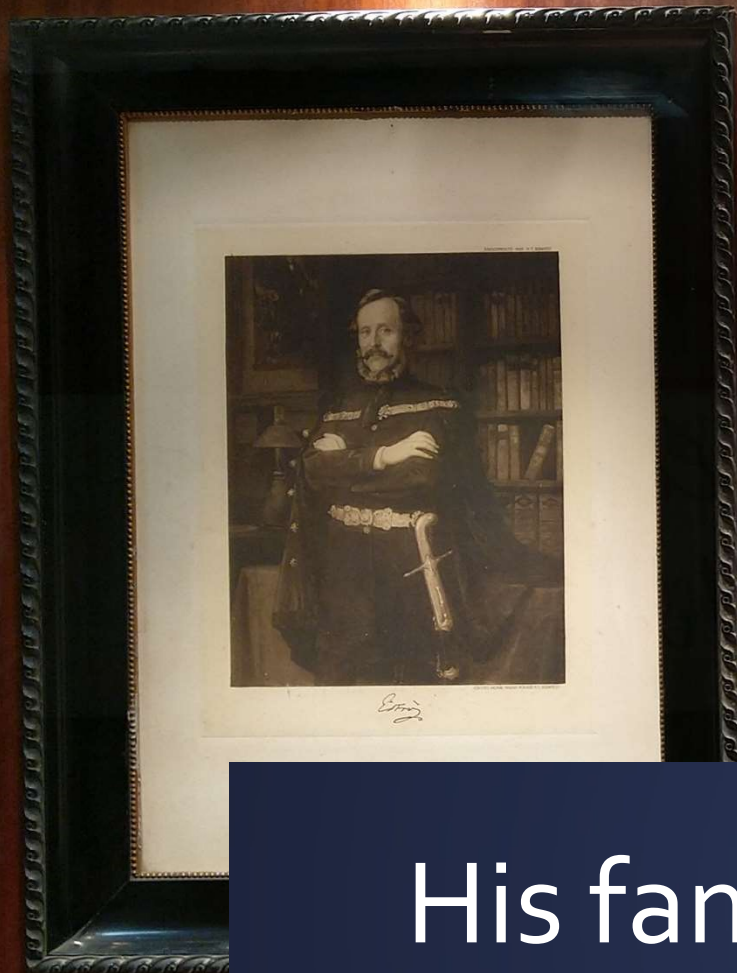
- The Illustrated History of the Eötvös Loránd University, Budapest (ELTE)  
[https://www.elte.hu/file/ELTE\\_tortenete\\_SzogiL.pdf](https://www.elte.hu/file/ELTE_tortenete_SzogiL.pdf)
- József Cserti: József Eötvös, the Physician  
[http://eotvos100.info/mediagyujtemeny/evt\\_20190114/eotvos\\_lorand\\_a\\_fizikus\\_2019\\_01\\_14.pdf](http://eotvos100.info/mediagyujtemeny/evt_20190114/eotvos_lorand_a_fizikus_2019_01_14.pdf)
- Zoltán Szabó: The history of the 125 year old Eötvös torsion balance  
<https://core.ac.uk/download/pdf/83549242.pdf>
- dr. Pernecky László: Eötvös Loránd, a fotográfus nyomában a Dolomitokban  
[http://eotvos100.info/mediagyujtemeny/evt\\_20190114/eotvosdolomit.pdf](http://eotvos100.info/mediagyujtemeny/evt_20190114/eotvosdolomit.pdf)
- Wesztergom Viktor: Loránd Eötvös and the Foundations of Geophysics  
[http://eotvos100.info/mediagyujtemeny/evt\\_20190114/wesztergom-viktor-lorand-eotvoes-and-the-foundations-of-geophysics.pdf](http://eotvos100.info/mediagyujtemeny/evt_20190114/wesztergom-viktor-lorand-eotvoes-and-the-foundations-of-geophysics.pdf)

- Many pictures taken at:
- Loránd Eötvös Memorial Collection
- Mining and Geological Service of Hungary  
H-1145 Budapest,  
Columbus str. 17-23.
- Thanks to:  
Dr. Klára Palotás –  
Head of the Collection





# His family and background



Az apa: báró Eötvös József (1813–1871) író, költő és államférfi. A magyar kritikai realizmus első nagy alakja, aki rajongott a nemzeti és szabadelvű törekvésekért és harcolt az ország liberális átalakulásáért, a polgári reformokért. 1848-ban az első magyar kormány vallás- és közoktatásügyi minisztere. 1867-ben, a kiegyezés után ismét betölti ezt a tisztséget. Nevéhez fűződik az általános és kötelező népoktatásról, valamint a zsidók emancipációjáról szóló törvény.

Eötvös József fiához írt leveléből: "...én azzal vigasztalom magamat, hogy te majd folytatni fogod műveimet, és így a magyar kultúrának és tudományosságának megalapítása, ha nem is az én, legalább a kettőnk nevéhez lesz köve. Kollektív dicsőségünk."

\*\*\*

The father: Baron József Eötvös (1813–1871) author, poet and statesman. The first eminent figure of Hungarian critical realism, he had a passion for national and liberal aspirations and fought for bourgeois and liberal reforms. In 1848, in the first Hungarian government, became minister of religion and education; after the compromise between the





# The Eötvös family



Miklós  
cs. kir. tábornok.

I. Ignác báró  
szül. 1763. † 1838.  
főpohárnok.  
(b. Szepessy Mária)

Gábor  
cs. kir. kam.  
s kincstári tan.

II. Ignác báró  
főtárnok-mester.  
(b. Lilien Anna  
csillagker. és palota-hölgy  
† 1858. kora 72.)

József  
szül. 1813.  
m. akad. elnök.  
(Rosty Ágnes)

Dienes  
szül. 1817.

Julia  
(gr. Vieregg Károly)


Ilona Jolán Loránt Mária

# The Eötvös family

- József (Joseph) Eötvös (1694-1742), rich land owner in Szatmar county
- Miklós (Nicolaus) Eötvös (1716-1783), baron (1768-), general, head of the administration in Szatmar county
- Ignac (Ignatius) Eötvös (1763-1838), baron, lawyer, Member of the Parliament, head of the administration in many counties, Advisor of the Treasury





  
**HUNGARIE** *hujus nominis* **QUINTUS**  
**BOHEMIE**  
 DALMATIÆ, CROATIAE, SLAVONIAE, GALLI-  
 CIAE ET LODOMERIAE, REX APOSTOLICUS;  
 ARCHIDUX AUSTRIÆ, DUX LOTHARINGIAE,  
 SALISBURGI, VIRCEBURGI ET IN FRANCO-  
 NIA; MAGNUS DUX CRACOVIAE; MAGNUS  
 PRINCEPS TRANSYLVANIAE; DUX STYRIÆ,  
 CARINTHIAE ET CARNIOLIAE, SUPERIORIS  
 ET INFERIORIS SILESIAE; PRINCEPS BERCH-  
 TOLDSGADENÆ ET MERGENTHEMI;  
 COMES HABSPURGI ETC:  
  
**MEMORIAE**  
  
 comendamus TENORE PRESENTIUM significantes,  
 QUIBUS EXPEDIT UNIVERSIS:

  
**QUOD** *NOBIS* **IN CON-**  
*signam et clementissimam reflexionem sumptis vultu  
 gerrima fide, constantique fidelitate, ac conspicuis  
 fidelium juxta, ac periculum servitorum meritis*  
**FIDELIS NOSTRI, NORIS HINCERE DILECTI,**  
**MAGNIFICI-**  
**LIBERTBARONIS**  
**IGNATIUS EÖTVÖS**  
*DE*  
**VASÁRÓD - VÁSÁRNYI**  
**AVIARIARI** *et Actualistitumi Status* **CONSILIARI**  
**NOSTRI,**  
**PRO-CANCELLARI**  
**NOSTRI REGII HÉRICO AULICI,**  
*nec non Collis sacrosiensis*  
**SUPREMI COMITIS.**



Ferencz császár Eötvös Ignác részére kiadott oklevele

7. br. Lilién Ádám (1753-1828), anyai nagypapa, osztrák koronakapitány, nádor  
 8. Diszputa, Lilién báró ajándéka vejének, Eötvös Ádáméknak



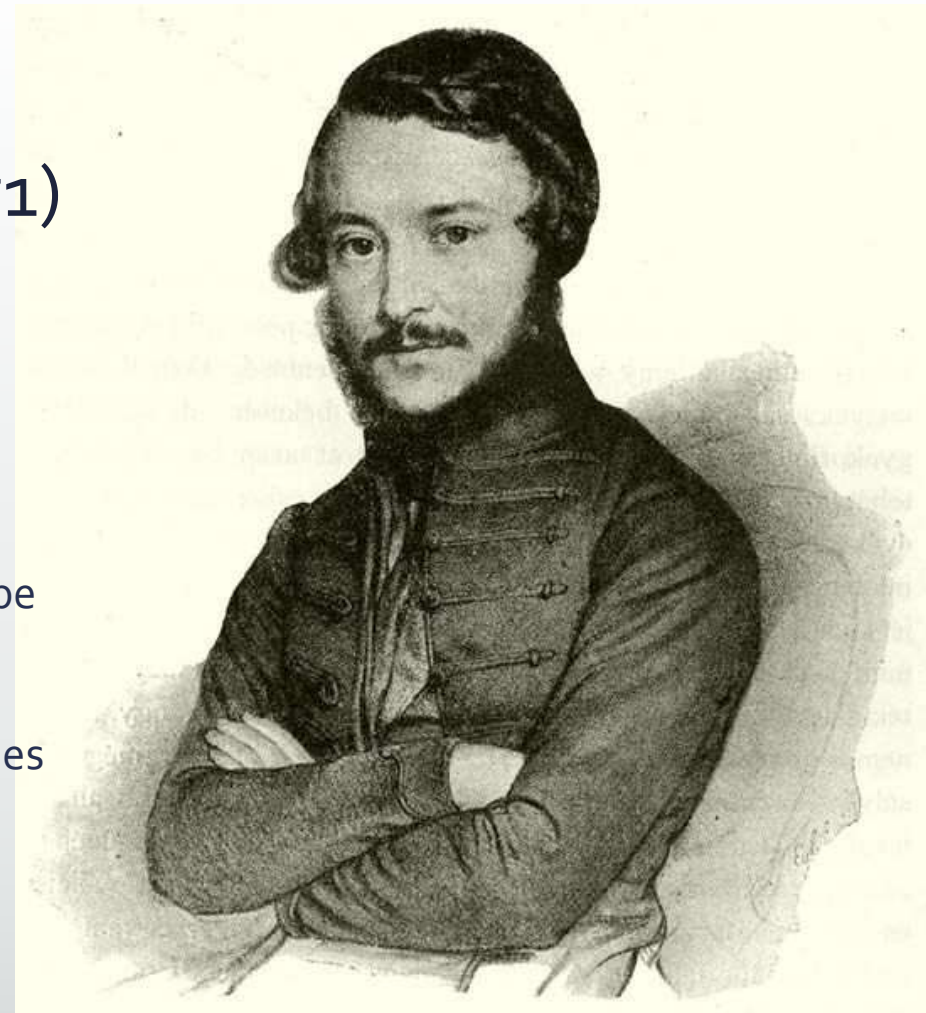
# Age of Eötvös

- 1848-1849: Revolution and independence war (against the Habsburg-dynasty)
- 1849-1867: from the revenge to the ‚Austro-Hungarian Compromise‘
- 1867-1918: Austro-Hungarian Monarchy
  - Emperor Franz-Joseph I. of Austria – King of Hungary
  - Partial independence of Hungarian State
  - Most of the 1848 (revolutionary) reform laws were restored
- The 1867 Compromise contract opened unknown dimensions of the economic growth
  - Agriculture, Industry, science, welfare



## báró Eötvös József – Baron Joseph von Eotvos (1813-1871)

- Father of Loránd Eötvös
- Writer, statesman
- Excellent education – spent many years in Western Europe
  - Germany, Switzerland, France, England
- Progressive political ideas – influential writings and articles



# báró Eötvös József – Baron Joseph von Eotvos (1813-1871)

- Main book:  
„Notary of the village’
- A novel about an  
imaginary Hungarian village  
it’s people and their  
(political) problems

## A' FALU' JEGYZŐJE.

REGÉNY

IRTA

B. EÖTVÖS JÓZSEF.

1845

I. KÖTET.

PESTEN.

HARTLEBEN KONR. ADOLF TULAJDONA.

1845.

Der Karthäuser  
von  
Baron Joseph Eötvös.  
Erster Band.



PEST 1842

Verlag von Gustav Heckenroth.



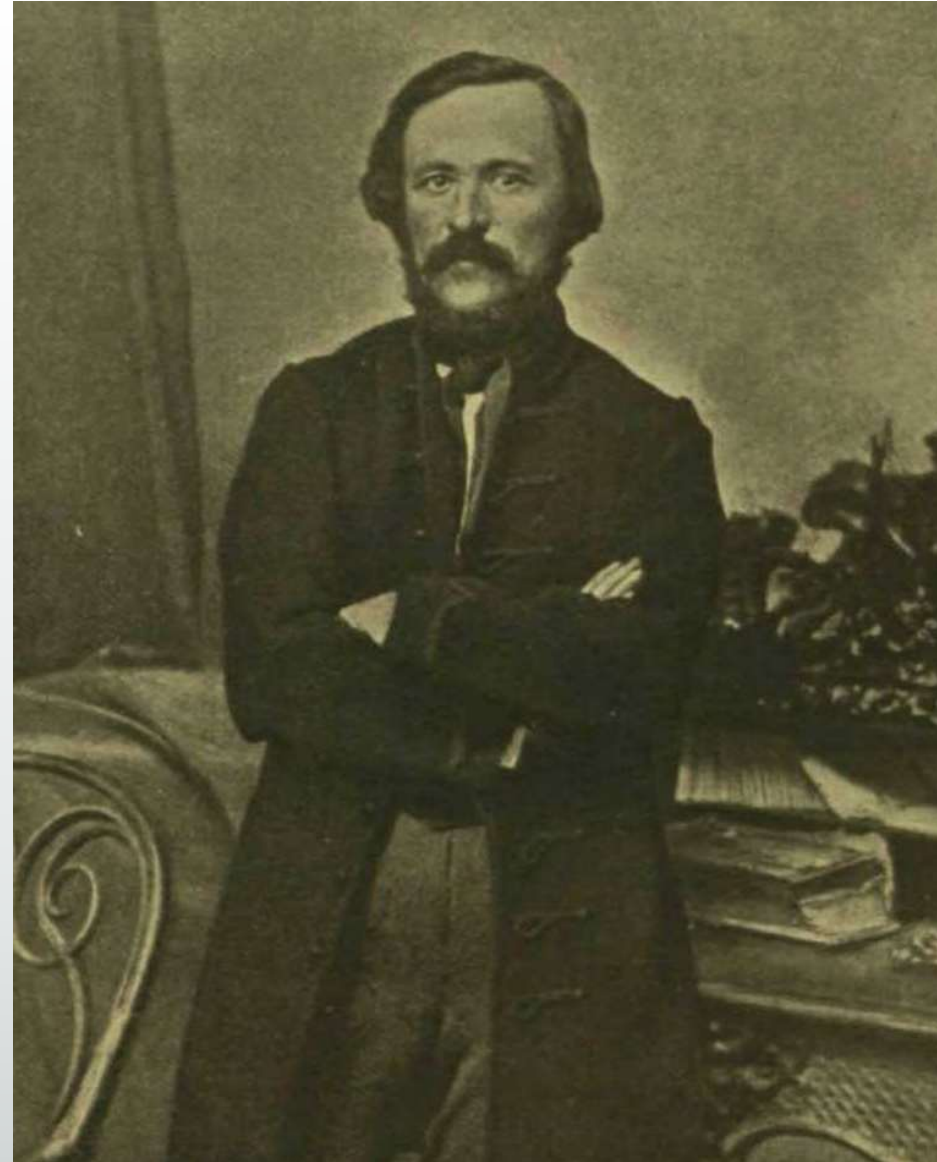
# Baron Joseph von Eotvos (1813-1871)

- Minister of Religion and Education of Hungary (during the Revolution of 1848)



# báró Eötvös József – Baron Joseph von Eotvos

- Main thesis: ‚The Guarantees of the Power and Unity of Austria‘ (1859)
- President of the Hungarian Academy (1866-)
- Minister of Religion and Education of Hungary (1867-1871)
  - Emancipation of Jews – many successful factory owners after this law
  - Liberty of religions
  - National Schools Act – a huge step in the Hungarian education system





# Loránd (Roland) Eötvös



1874-1875-ig  
Budapesti Állami Egyetem  
1874-1875-ig (1874-1875)



4



5



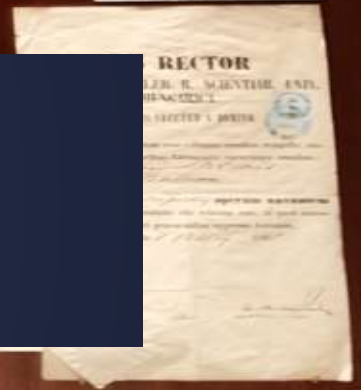
1848-1849-ig



1848-1849-ig



1848-1849-ig



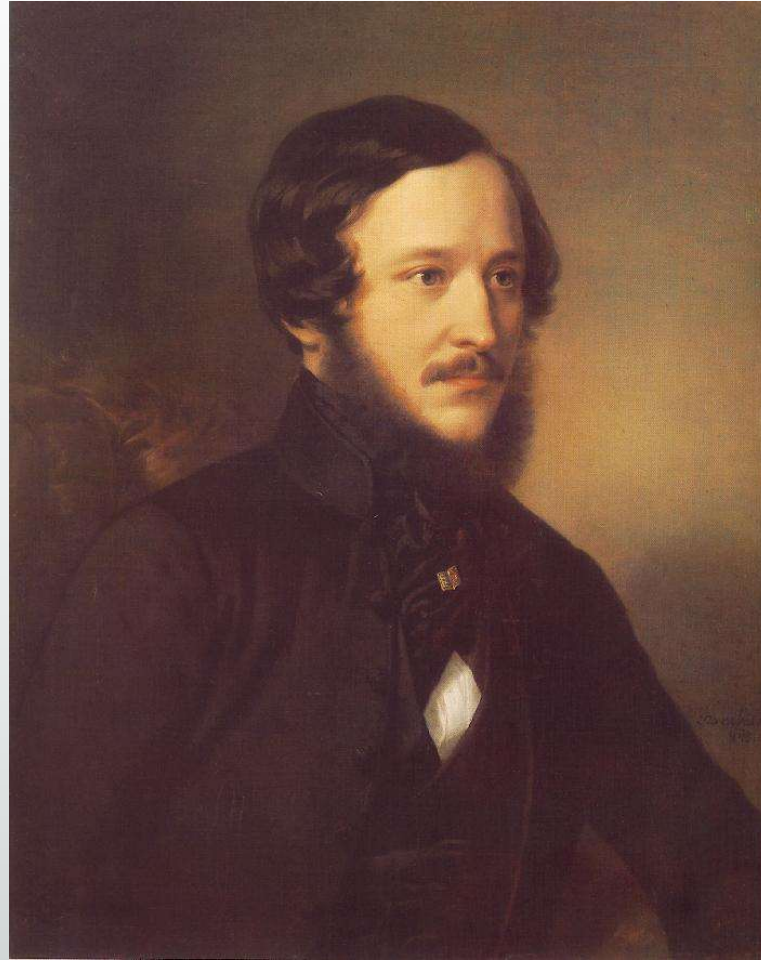
1848-1849-ig





## His parents

- Baron József Eötvös
- Ágnes Rosty



1848

- 27 July 1848 – Loránd Eötvös was born

	Loránd	P. M.
	Agoston	Mellősig. Dava
5.	Ignác	Eötvös József
születés	Albert	ei
Julius	József	Rosty Agnes
24. évi	Törvényes.	P. M.
	Julius	Reigl, Antal,





# Loránd Eötvös - Early years

- 1865-67 University of (Buda)Pest - He completed his law studies , but he wasn't interested in it
- *„I was born with ambition and a sense of duty not only to one nation but towards the whole humanity. In order to satisfy these urges and retain my own individual independence, my aim in life will be best achieved, as far as I can see at present, if I follow a carrier in science.“*

Letter to his father (1866)

# Loránd Eötvös - Early years

Per semestre <sup>7</sup> anni 18<sup>65</sup>/<sub>66</sub>  
 in C. R. Universitate has lectiones se frequentaturum professus est.

Index scholarum et nomina magistrorum.	Quot per hebdom. horas scholae habitae sint.	Receptum nomen testatur quaestor	Receptum nomen testatur magister	Quotus fortasse in auditorio locus assignatus sit.	Didactrum solutum aut immunitatem legitime comprobata testantur quaestor.	Scholas frequentatas testantur magistri.	Adnotat
Rimai jog. Dr. Hoffmann	8		Hoffmann				Storgelium
Rimai alkotmány közelet Dr. Hoffmann	3		Hoffmann				
Művelőtan Dr. Pászti	1		Faulstich				
Jogtudomány Dr. Wenzel	5		Wenzel				Storgelium, tel. jelsz. sziget adta.
Magyarország története Dr. Károlyi	4		Károlyi				Storgelium.
Egyetemi könyvtár Dr. Petróczy	5		Petróczy				Storgelium, tel. jelsz. sziget adta.
Fizika Dr. Károlyi	2		Károlyi				Storgelium.
Történet magyarságra Dr. Károlyi	2		Károlyi				Storgelium, tel. jelsz. sziget adta.

## NOS RECTOR IN ALMA AC CELEB. R. SCIENTIAR. UNIV. HUNGARICA

LECTURIS SALUTEM A DOMINO.



Notum et manifestum esse volumus omnibus et sigillis, omnium Facultatum Doctoribus, Licenciatis, caeterisque omnibus:

**Dominum:** *Loránd L. Eötvös*  
*Badensensem*

**studiis juridico politico operam navantem**  
 in album Universitatis rite relatam esse, id quod manu-  
 propria et sigillo minori praesentibus appresso testamur.

Pestini in Hungaria, die 1. Octobris 1865

*Dr. Gu. Wenzel*  
 Rector

*Dr. Theodor Faulstich*  
 Decanus



# Loránd Eötvös in Heidelberg

- 1867-1870 Heidelberg University – Physics, mathematics and chemistry
  - his teachers were: Kirchhoff, Bunsen and Helmholtz
  - Summa cum laude



 UNIVERSITÄT HEIDELBERG | ZUKUNFT SEIT 1386

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INSTITUT  
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- Aktuelles
- Kontakt
- Forschung
- Personen
- Veranstaltungen
- Öffentlichkeit**
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## 5. Loránd Eötvös und Agost Heller in Heidelberg

**Loránd Eötvös** (1848 – 1919) wünschte sich nach Abschluß eines Jurastudiums in Budapest, das er auf Wunsch seines Vaters absolvierte, ein naturwissenschaftliches Studium bei hervorragenden Professoren. Dafür kam in erster Linie Heidelberg in Frage. Hier lehrte neben Gustav Kirchhoff und Robert Bunsen auch Hermann Helmholtz. Kirchhoff und Bunsen hatten kurz zuvor mit ihren Arbeiten zur Spektralanalyse Aufsehen erregt.



In Heidelberg angelangt stürzte Eötvös sich mit Begeisterung in das ersehnte naturwissenschaftliche Studium. In einem Brief vom 24. Oktober 1867 an seine Schwester Ilona schreibt er, daß er frühmorgens um 8 Uhr sein Zimmer verläßt, erst abends um 6 zurückkehrt und dann noch die Vorlesungen ausarbeitet. Er hörte in der Woche 22 Stunden Vorlesungen, und zwar täglich „Experimentalchemie“ bei Bunsen von 9 bis 10 Uhr und von 11 bis 12 Uhr „Experimentalphysik“ bei Kirchhoff. Außerdem arbeitete er im Labor bei Bunsen, hörte einige Mathematikvorlesungen und bei Helmholtz „Allgemeine Resultate der Naturwissenschaften“.

Eötvös schrieb, das bereite ihm alles sehr viel Arbeit, aber noch mehr Freude. Am anstrengendsten war ihm das abendliche Ausarbeiten der Vorlesungen, auf das er aber sehr viel Mühe verwandte. Diesem Studieneifer verdanken wir unsere ausführlichen Kenntnisse der Kirchhoffschen Vorlesungen. Da Eötvös zunächst an ein Chemiestudium bei Bunsen dachte, hat er im Wintersemester 1867/68 die Vorlesung Bunsens viel detaillierter ausgearbeitet als Kirchhoffs Experimentalphysik. Aber die Persönlichkeit Kirchhoffs und dessen Vorlesung beeindruckten ihn so sehr, daß die Physik zu seinem Hauptinteressengebiet wurde. Mit Ausnahme des Sommersemesters 1868, das er auf Anraten Kirchhoffs bei Neumann in Königsberg verbrachte, blieb er in Heidelberg und schloß sein Studium im Sommer 1870 mit der Promotion ab.



**KIRCHHOFFS HEIDELBERGER  
VORLESUNGEN**

1. Gustav Kirchhoff als Lehrer
2. Kirchhoffs Weg nach Heidelberg
3. Kirchhoffs Heidelberger Lehrveranstaltungen
4. Skripte zu Kirchhoffs Vorlesungen
5. Loránd Eötvös und Agost Heller in Heidelberg
6. Die Vorlesungen über Experimentalphysik
7. Die Übungen im Physikalischen Praktikum
8. Die Vorlesungen über

PRORECTORE. ACADEMIÆ. MAGNIFICO

VIRO. AMPLISSIMO. ILLUSTRISSIMO

JOAN. CASP. BLUNTSCHLI

UTRUSQUE JURIS. DOCTORE. PROFESSORE. PUBLICO. ORDINARIO. MAGNO. DUCI. BAVARUM. A. CONSILII. INTIMIS. ORDINIS. DE. LEONE. ZARINGIE. PRAEFECTO. ORDINIS. A. MAXIMILIANO. II. BAVARIE. REGE. IN. HONOREM. SCIENTIÆ. CONDITI. EQUITE. ORDINIS. BORUSSICI. DE. CORONA. RUSSICI. SANCTE. ANNE. SAXONICI. ALBERTINENSIS. PRAEFECTO. ORDINIS. BAVARICI. DE. S. MICHAELE. EQUITE. ACADEMIÆ. IMPERIALIS. FRANCORUM. SOCIO. HONORARIO. COLLEGIO. DOCTORUM. UNIVERSITATIS. VIENNENSIS. ADSRIPTO. ETC.

NOS. DECANUS. SENIOR. CETERIQUE. PROFESSORES

ORDINIS. PHILOSOPHORUM

IN. LITTERARUM. UNIVERSITATE. RUPERTO-CAROLA

IN. VIRUM. DOCTISSIMUM. ET. CLARISSIMUM

BARONEM. ROLANDUM. ECETVÆS

BUDENSEM

POST. COMPROBATAM. EXAMINE. RIGOROSO. PRÆCIPUE. IN. PHYSICA  
SUMMA. CUM. LAUDE. SUPERATO. DOCTRINAM

JURA. ET. PRIVILEGIA

DOCTORIS. PHILOSOPHIÆ. ET. MAGISTRI. LIBERALIUM. ARTIUM

RITE. CONTULIMUS. ET. HOC. DIPLOMATE. SIGILLO. ORDINIS. NOSTRI. MUNITO. TESTATI. SUMUS.

P. P. HEIDELBERGAE. IN. UNIVERSITATE. LITTERARIA. RUPERTO-CAROLA.

D. VIII. MENSIS. JULII. MDCCCLXX.



TYPIB. J. A. WOLFF.

*Urschick  
h. t. Bismarck*

**Bedingter Polizeistrafbefehl.**

*1867*

Name, Stand und Wohnort des Verurtheilten:

*Roland von Ectovs aus Pflaff, ad.*

Bezeichnung der demselben zur Last gelegten That:

*Daselbst stiehlt in dem Wirthshaus auf d. Markt  
1 Mpf. Wein und 1 Mpf. Bier auf dem Hauptplatze  
des württemberg. Hofes*

Bezeichnung der hierauf anzuwendenden polizeilichen Strafbestimmung:

*§ 13 d. P.M.G. Maßregeln der Einsperre*

Bezeichnung der hierauf verurtheilten Strafe:

*3 wöchentl. Gefängnis*

Die dem Verurtheilten zur Last gelegte That wird als jugendlichen angesehen und die hierauf verurtheilte Strafe in Vollzug gesetzt werden, wenn derselbe nicht binnen 8 Tagen Einsprache erhebt.

Heidelberg, den 7. ten September 1867

Gr. Bezirksamt.

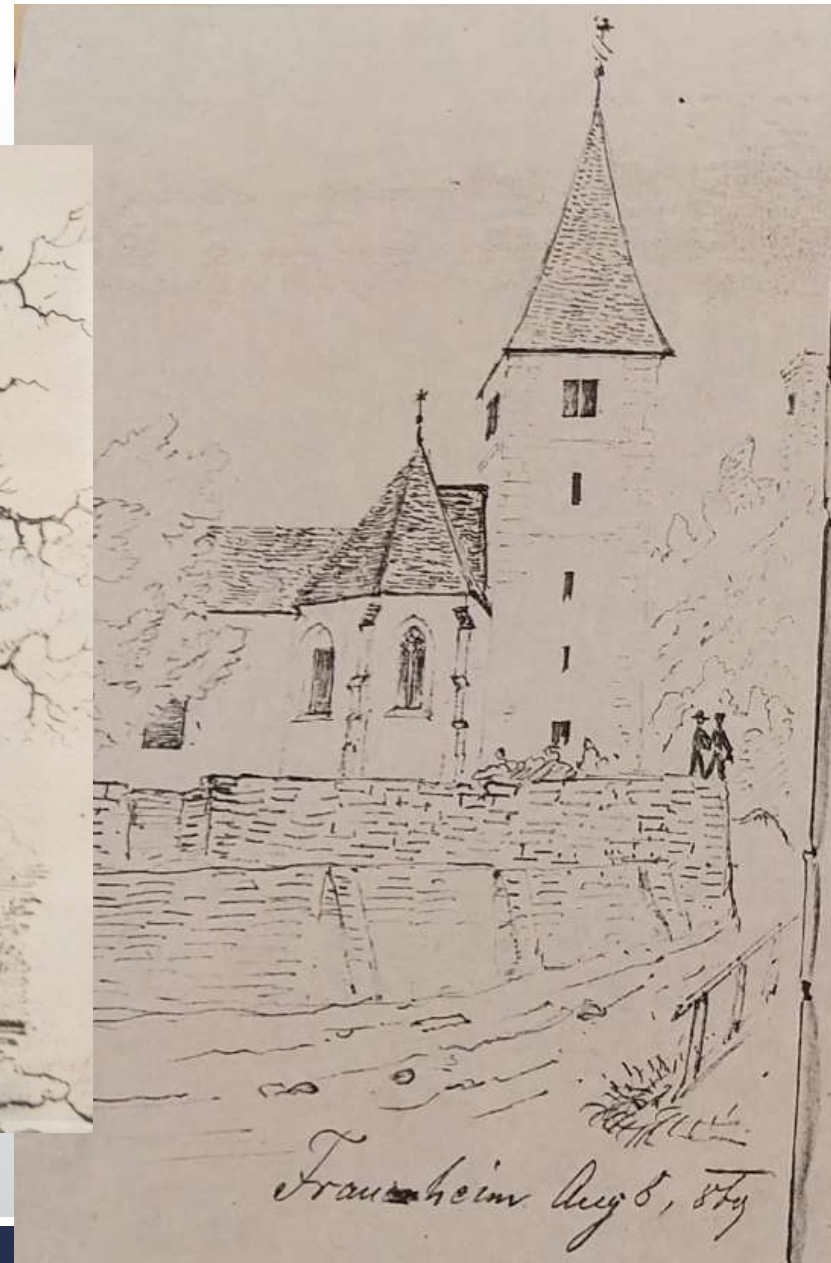
Ingeheft dem *R. v. Ectovs* am 11. ten September 1867

*M. C. Schönbauer*

**Beachtungen.**

- 1) Der Strafbefehl wird dem Verurtheilten in 3 Exemplaren zugestellt werden.
- 2) Ein Exemplar desselben überreicht man dem Verurtheilten, ein zweites dem Richter, ein drittes dem Staatsanwalt.
- 3) Ein Exemplar desselben kann dem Verurtheilten in 3 Exemplaren in gleichem Sinne, 2) zugewandt werden.
- 4) Einsprache gegen das Urtheil der Justiz ist innerhalb 8 Tagen nach dem Strafbefehl zu erheben.
- 5) Einsprache, Revision, Berufung, Revisionsbeschwerden sind bei dem Staatsanwalt gegen das Urtheil zu erheben.

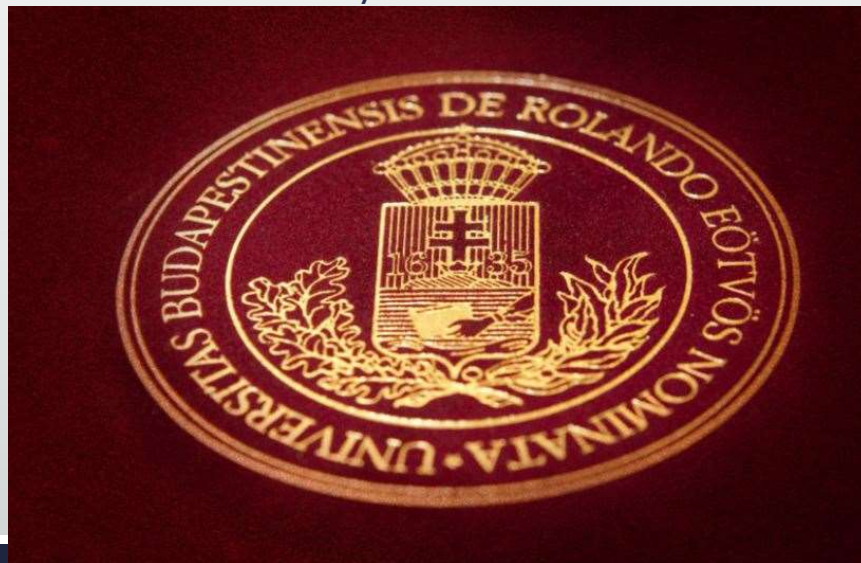




Frauenheim Aug 8, 87

# First years at the University

- 1871: His father passed away
- 1871: Theoretical Physics Lecturer at the Pest University  
(later: this University bears his name)
- 1872: Appointed professor of Theoretical Physics





# His career

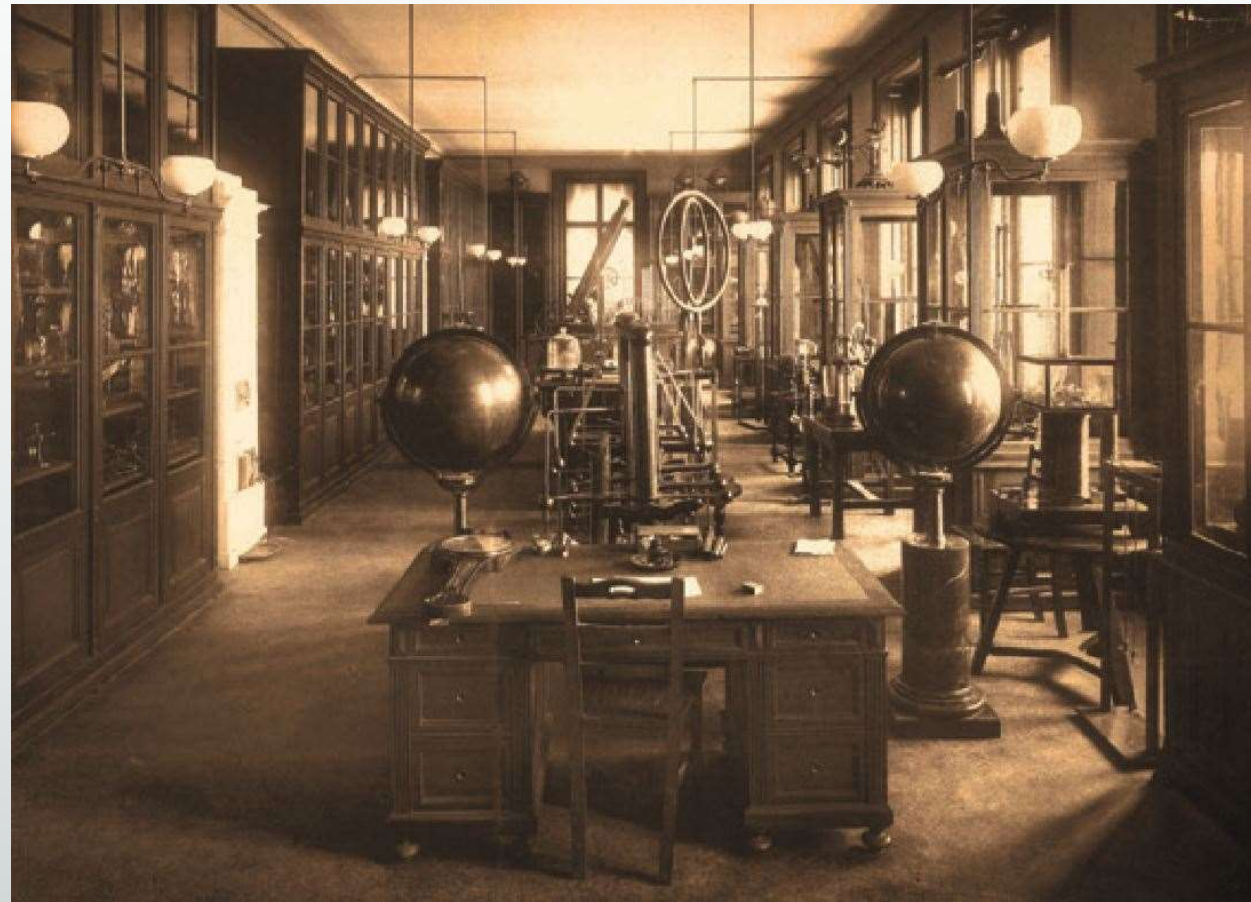
- 1873: Associate Member of the Hungarian Academy of Sciences (Age 25)

*"On Laws of Distant Effects as Implied by Oscillation Theory"*



# His career

- 1878: Director of the Institute of Physics
- 1881: International Electricity Congress (Paris)
- 1883: Elected member of the Academy (age 35)





## Scientific achievements



·DR·EÖTVÖS·LÓRÁND·BÁRÓ·

1891-92

# Honours

- The French government decorated him with the Cross of the Legion of Honour
- Saint Sava award – King of Serbia
- Franz Josef award – King of Hungary





# Honours

- Prussian Royal Academy of Sciences (Berlin) – honorary member
- Jagello University (Cracow) – honorary doctorates
- Norwegian Royal Frederick University (Christiania/Oslo) – honorary doctorates

- 1911, 1914, 1917:  
Nominated for **Nobel-prize**



# His career

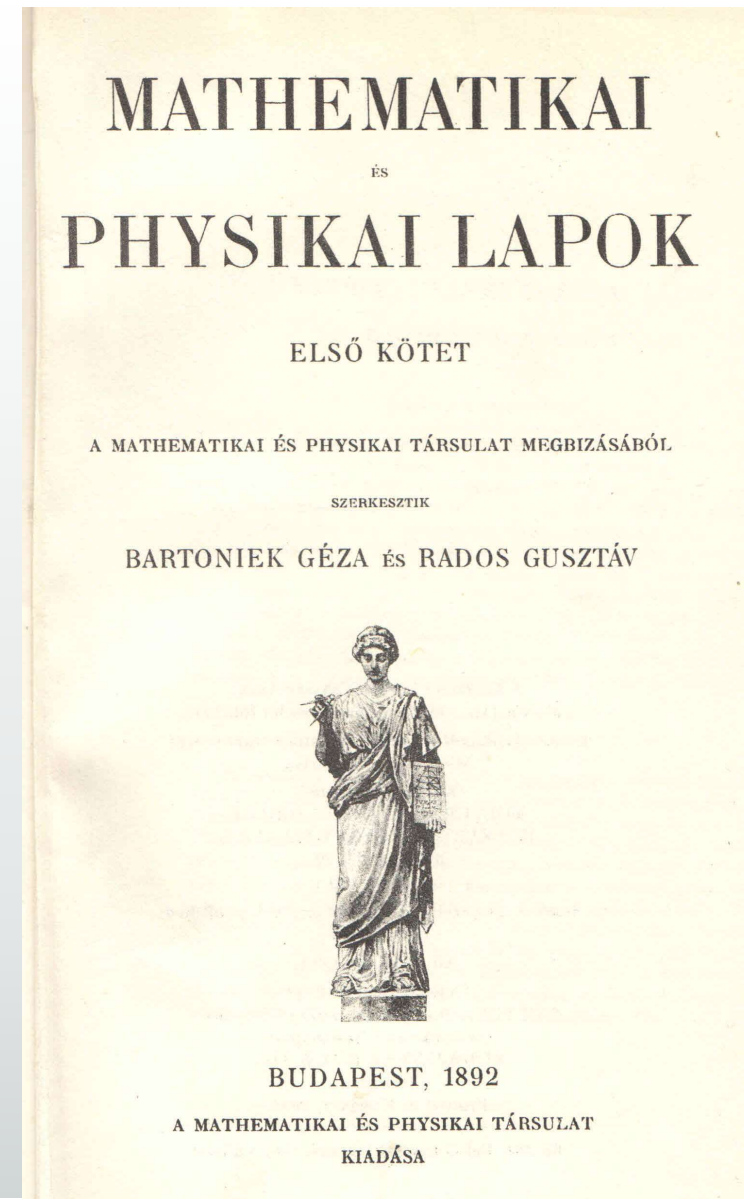
- 1889: President of the Academy (for 16 years)
  - Reforms: Open the Academy to the Public
  - Discussions, scientific presentations to the public





## His career

- 1891: Organized the Mathematical and Physical Society
  - Started the Mathematical and Physical Papers – 1892
- June 1894 – January 1895: Minister of religion and education
  - Law of freedom of religions
  - Founded the Joseph Eötvös College for poor teacher's



## His life

- 1896 Studies in the Field of Gravity and Magnetism (review)
- 1905: Resign of the Presidential position of the Hungarian Academy of Sciences to spend more time on research





# The Eötvös-College

- The new building of the Baron Eötvös József College (1911)

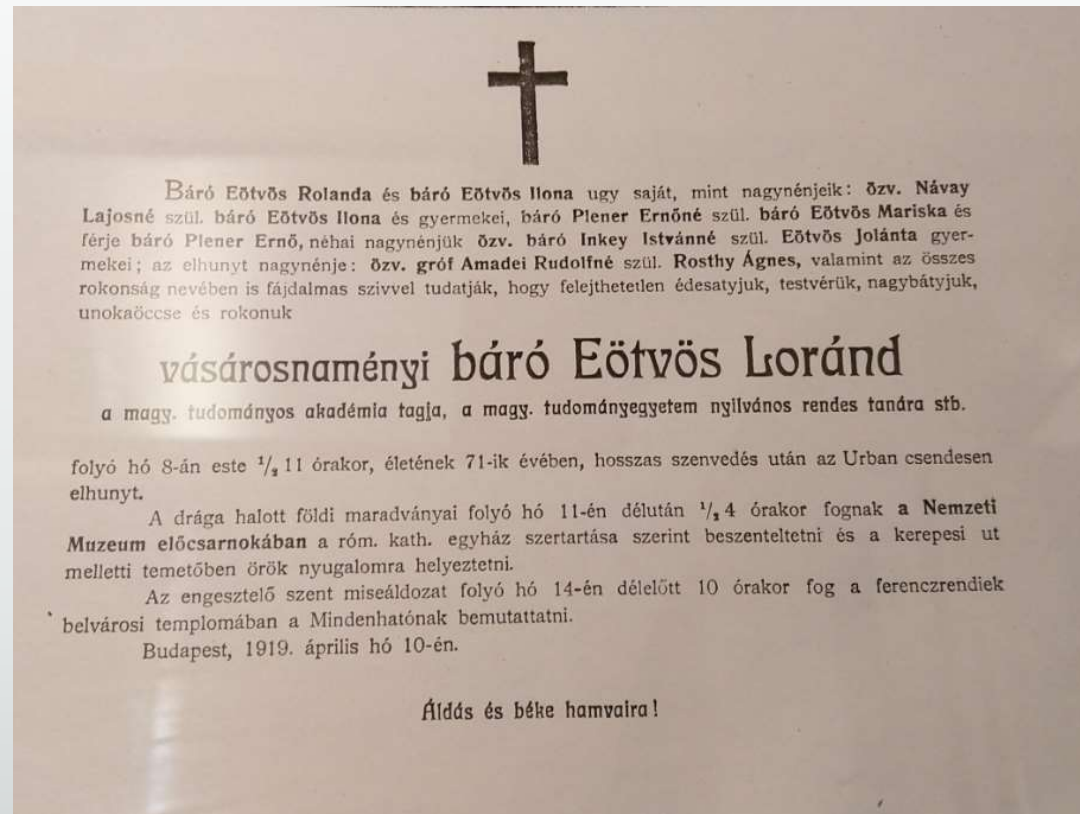


## 1919 – Final days

- 8 April 1919

„...a prince of classic physics has died”

(Albert Einstein)



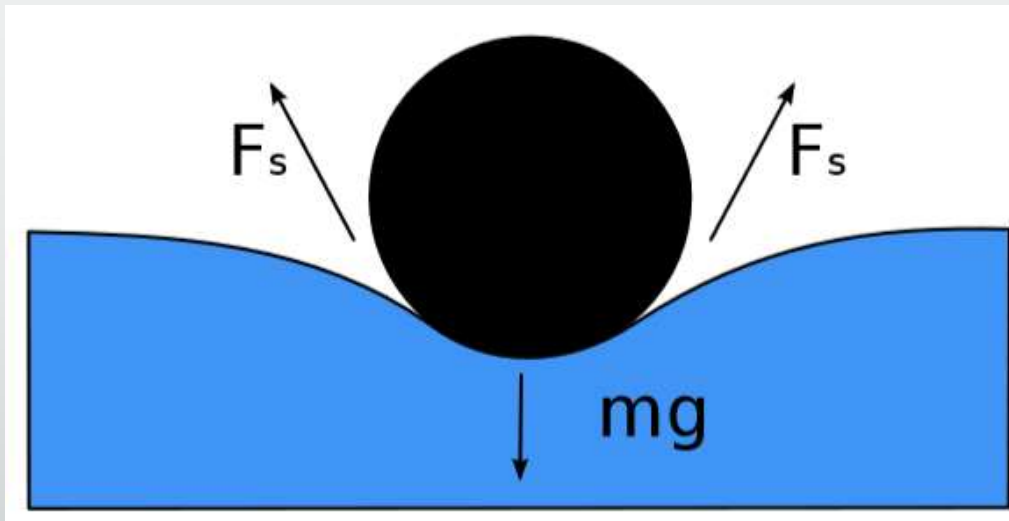




# Scientific achievements

# Eötvös in Physics

- 1875-1885: Studies in the field of capillarity:
- Reflexion method to determine the capillary constant





# Eötvös in Physics

- **The Eötvös-rule:** With increasing temperature, the surface tension of a liquid decreases until - at the critical temperature - it becomes zero.



Surface tension

The Eötvös-constant  $k = 2.1 \times 10^7 \text{ J}/(\text{K} \cdot \text{mol}^{2/3})$

$$\gamma v^{2/3} = k(T_k - T)$$

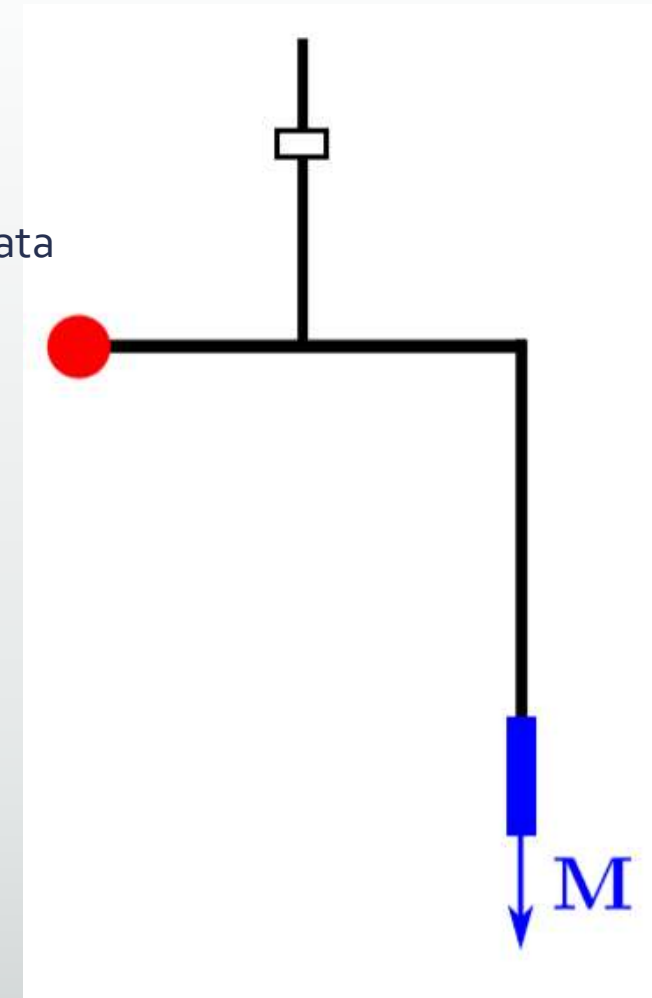
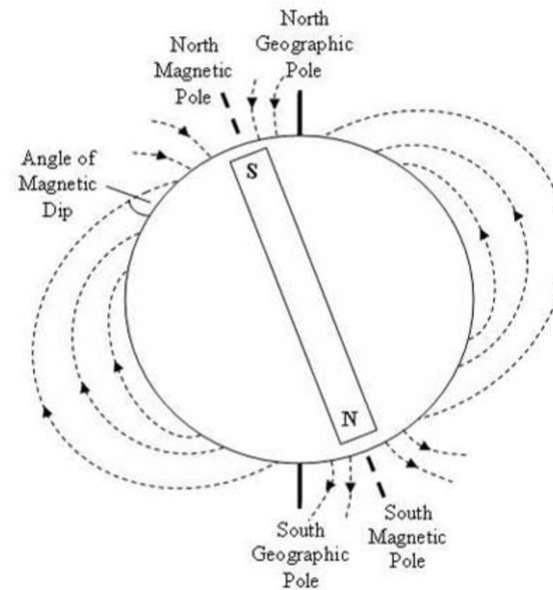
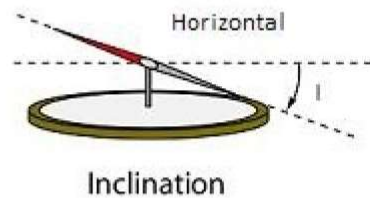
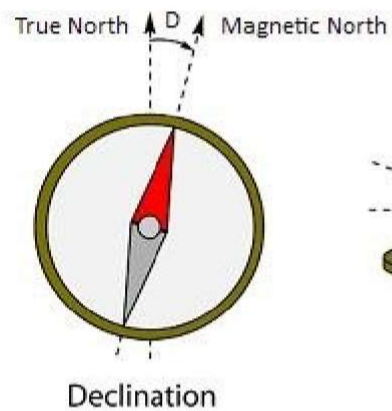
Temperature

The molar volume  
of the liquids

Critical temperature

# Eötvös in Physics

- **Magnetic translatometer by Eötvös**
- Very sensitive tool to determine the magnetic momentum of strata
- Similar to the Eötvös balance





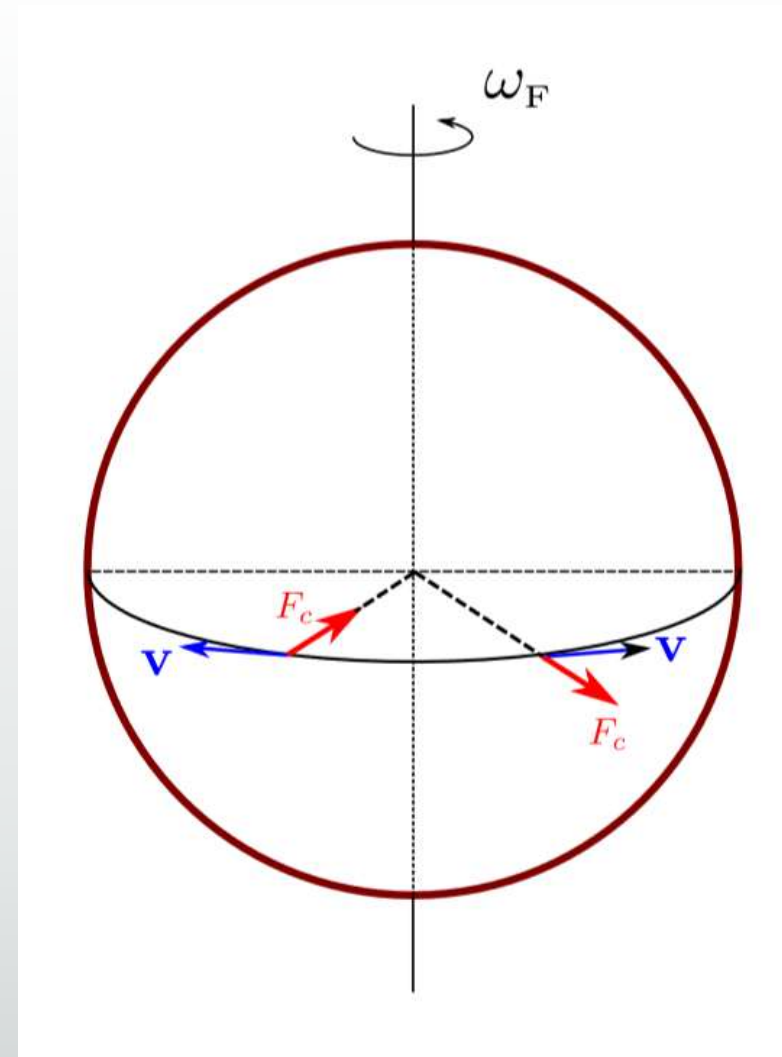
# Eötvös in Physics

- Precision tools to measure the magnetic Declination and the Inclination



# Eötvös in Physics

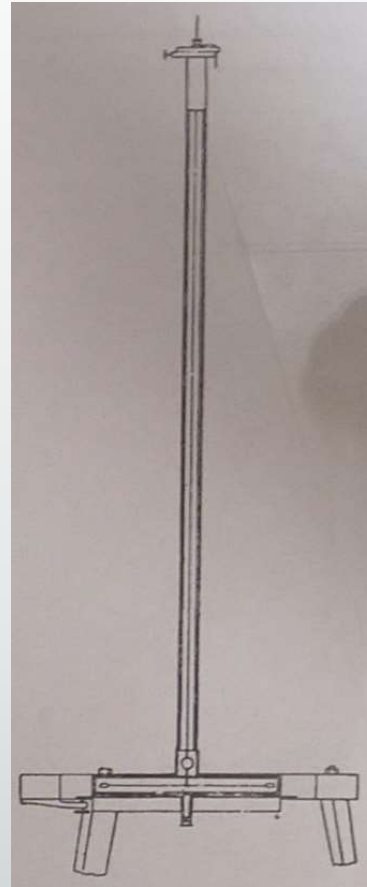
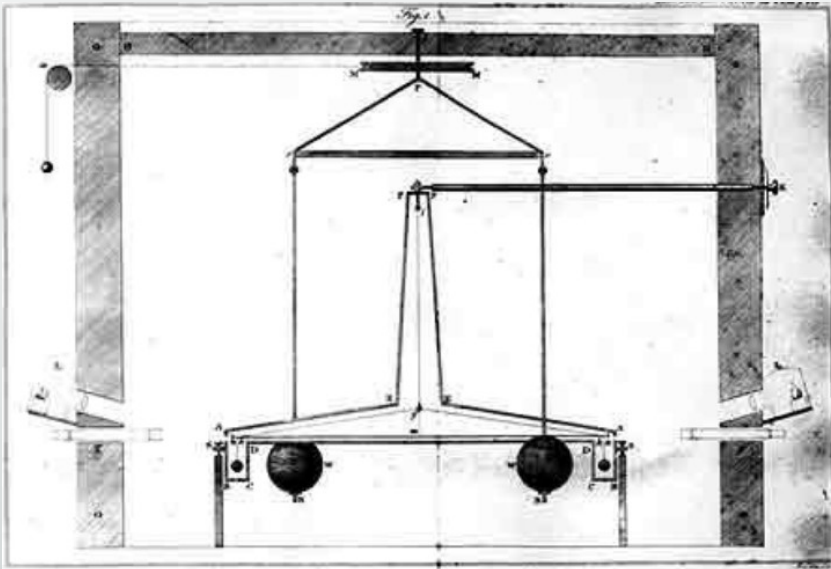
- The Eötvös-effect:
- The vertical Coriolis-force lift up the things going to East
- In Budapest 100 kg man walks by 1 m/s to East
- He's weight is less by 1,5 g





# Curvature Variometer (1890)

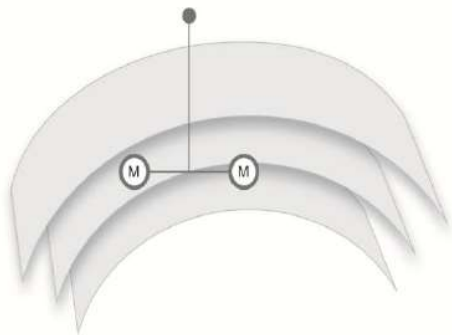
- Similar to a Coulomb-balance
- To measure the direction of the gravity field
- The masses were at the same level



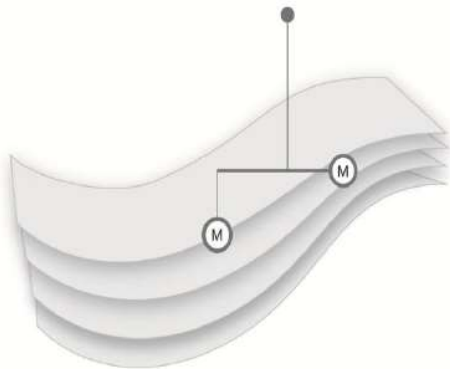
# Eötvös Torsion Balance – Horizontal Variometer (1891)

- One of the masses was at lower level than the other
- This makes the instrument sensitive to the horizontal gradient of the gravitational field

Coulomb torsion balance



Eötvös torsion balance



0,01–0,02 mm thick platina-, or wolfram-wire

aluminium arm

mirror

50-60 cm

25-40 cm

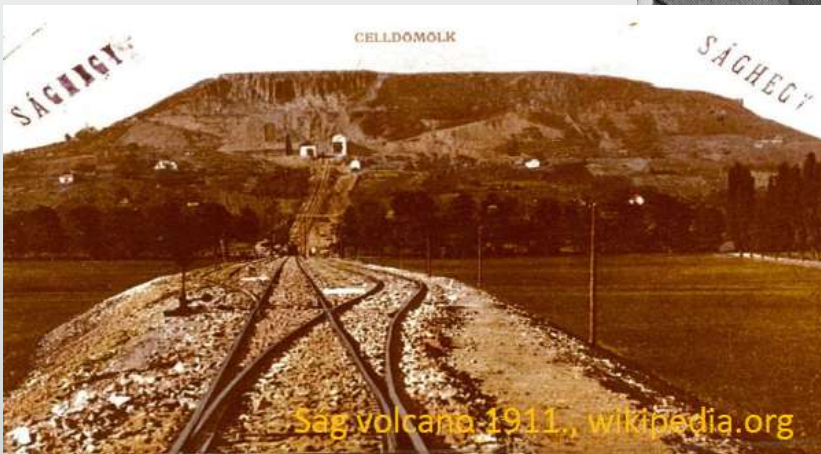
platina masses  
( $m \approx 15-20$  g)





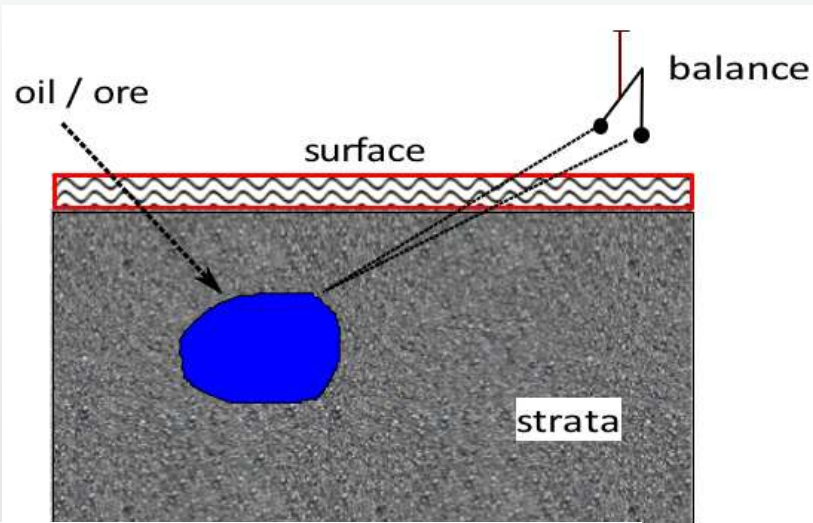
# Eötvös Torsion Balance

- 1891: First measurements – Ság-hill, Celldömök, Hungary
- Smaller volcanic hill
- Truncated cone shape
- Easy to calculate its mass



# Eötvös Torsion Balance

- The Eötvös Torsion Balance is the perfect and very precise tool to measure the local variances of the gravitational field



- The unit of this was named as ,Eötvös'

$$1 \text{ E} = 10^{-7} \frac{\text{Gal}}{\text{m}} = 0,1 \frac{\text{mGal}}{\text{km}} = 10^{-9} \frac{1}{\text{s}^2}$$

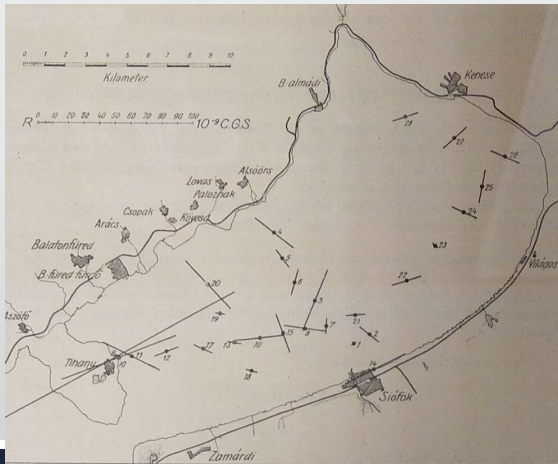






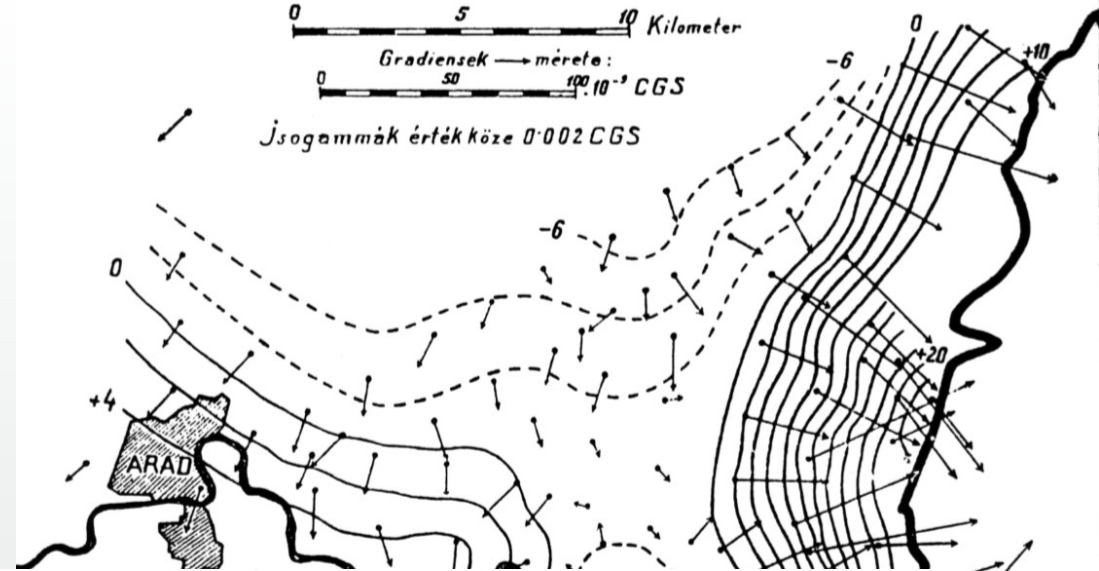


- 1901: Measurements on the frozen lake Balaton
- a 70km long lake in Hungary – ideal to measure on its surface
- (Almost) perfect geoid shape
- Discovered an underground tectonic line

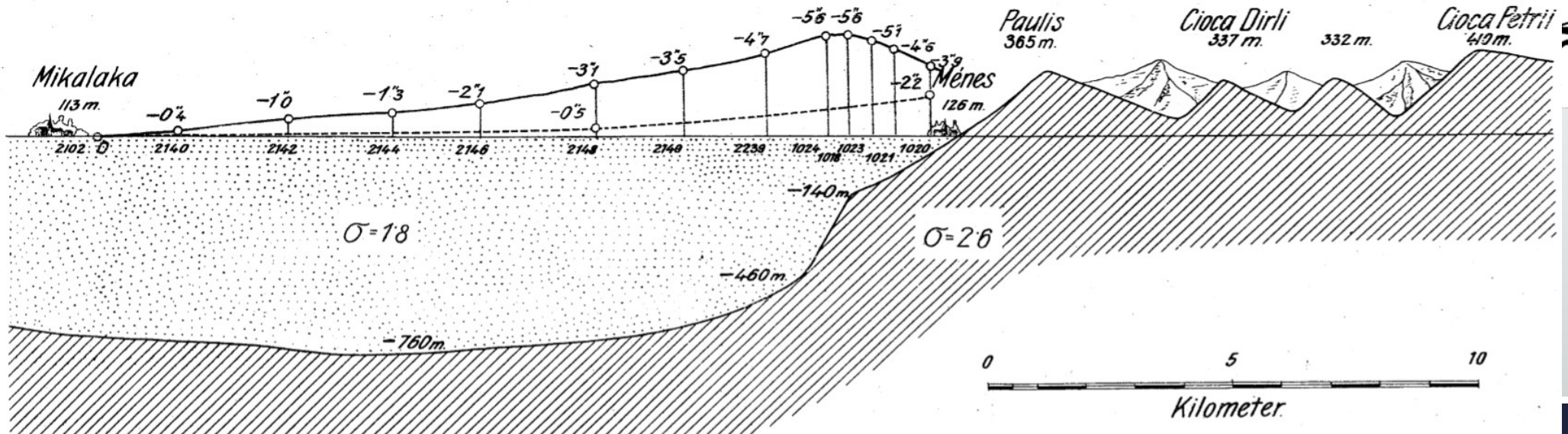


# Measurements – Arad, 1906

- The first geophysical map
- The mountains continued under the Hungarian Great Plain



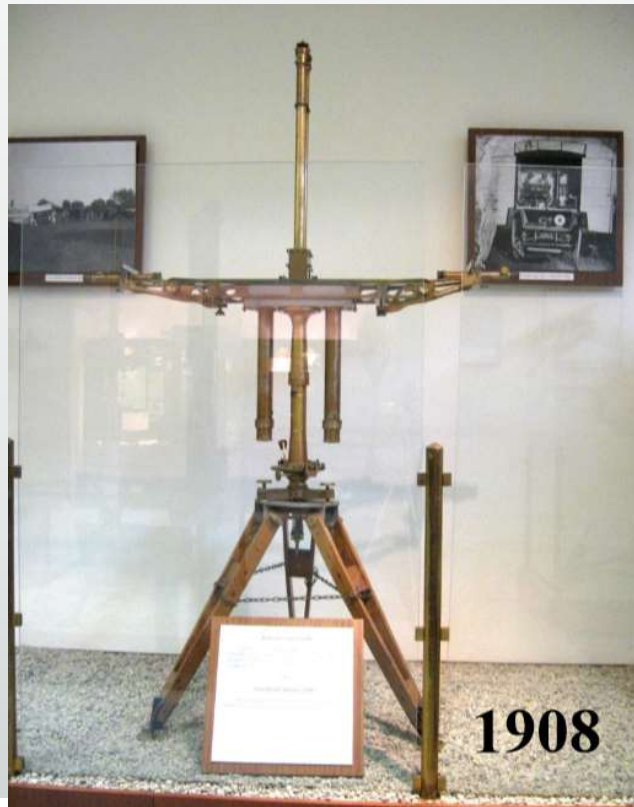
Lotabweichungen nach Osten längs des Breitenkreises von Ménes ( $\varphi = 46^\circ 8'$ ).





# Double Balance, 1902

- Two balances, rotated by  $180^\circ$
- The time of 1 measurement reduced from 100 mins to 60 mins.
- Double Small balance, 1908





- The equipment somewhere in the Hungarian Great-plane

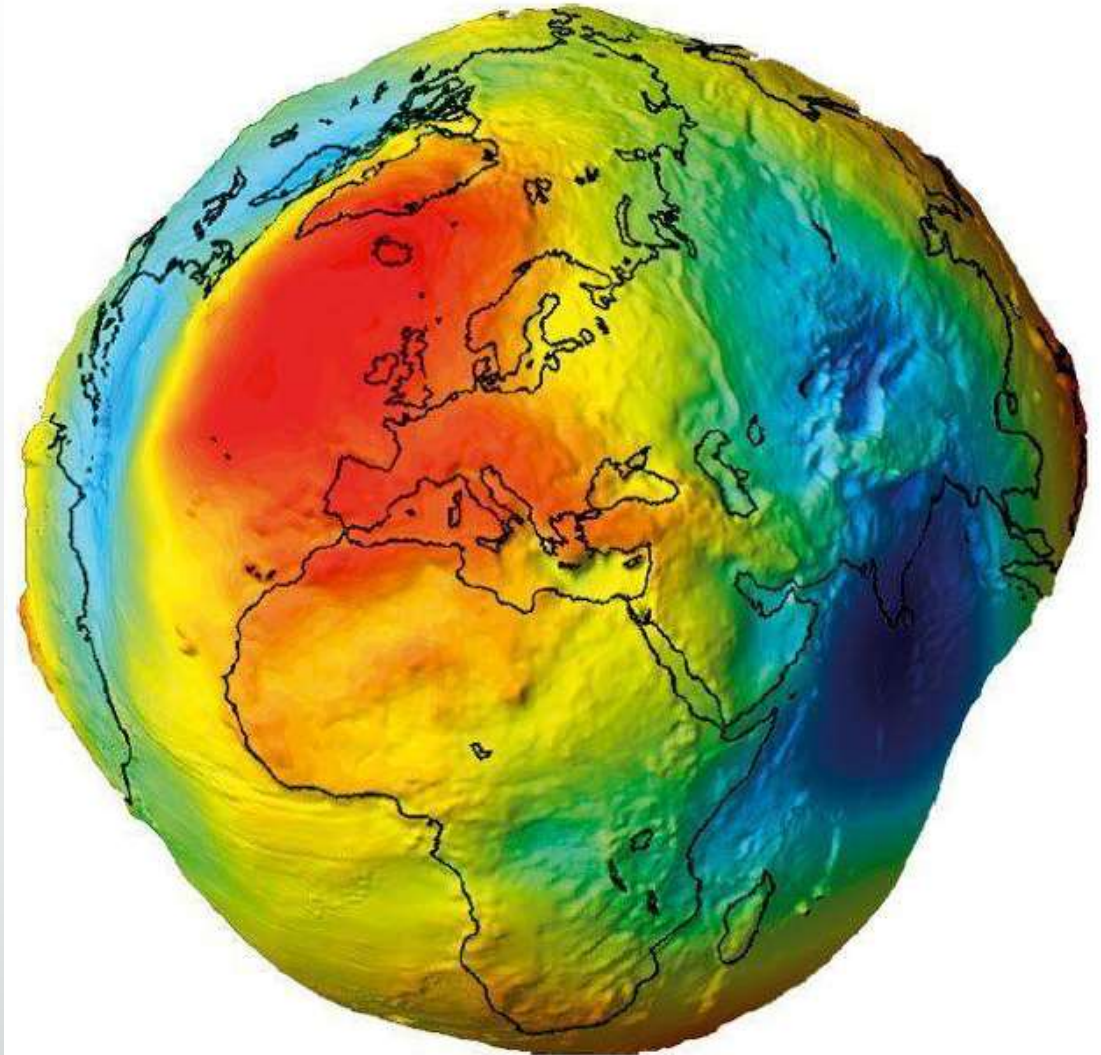






# Shape of Geoid

- His method was fundamental until the 1950's
- The Eötvös Balance is an effective tool for detection of underground geological formations, deposits, reservoirs or simply of buried objects
- Its perfect knowledge is inevitable in the determination of the irregular equipotential surface of the planet which is called geoid. Precise geodetic height positioning is based on the geoid modelling, and the accuracy of the GNSS positioning strongly depends on the reference frame.





# Gravimeter, 1901

- To measure the gravity of the Earth, he created a gravimeter
- He was far ahead in technology, but he wasn't satisfied with the field results of the experiments
- He didn't published his achievements
- It was the essential tool for oil-searchers until the 1940's
- „It was good enough for the industry, but not good enough for the science“



# The geophysicist

- 1906: IUGG XV.  
Conference in Budapest
- He presented his Balance
- 1907: The 1st Geophysical Institute of the World was founded in Budapest, lead by Eötvös

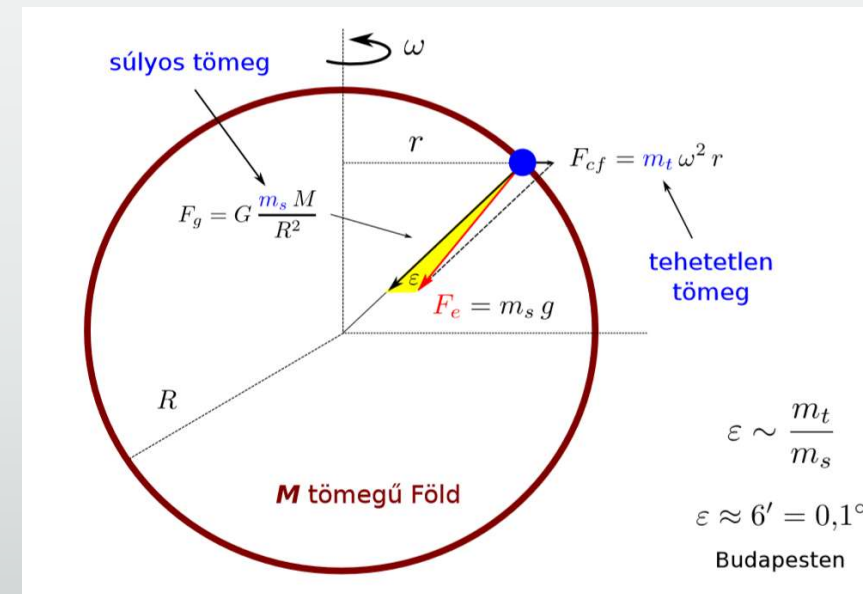


# Benecke award - 1909

- Proportionality of the inertial and the gravitational masses?
- University of Göttingen 1906 – connected to the Newton-rule
- Newton's precision (1686):  $10^{-2}$
- Bessel's precision (1832):  $10^{-5}$
- Eötvös's precision, 1889:  $10^{-8}$       1909:  $10^{-9}$
- Roll, Krotkov and Dicke (1964):  $10^{-11}$
- It was fundamental for Einstein's theory of the general relativity

$$F = m_t a$$

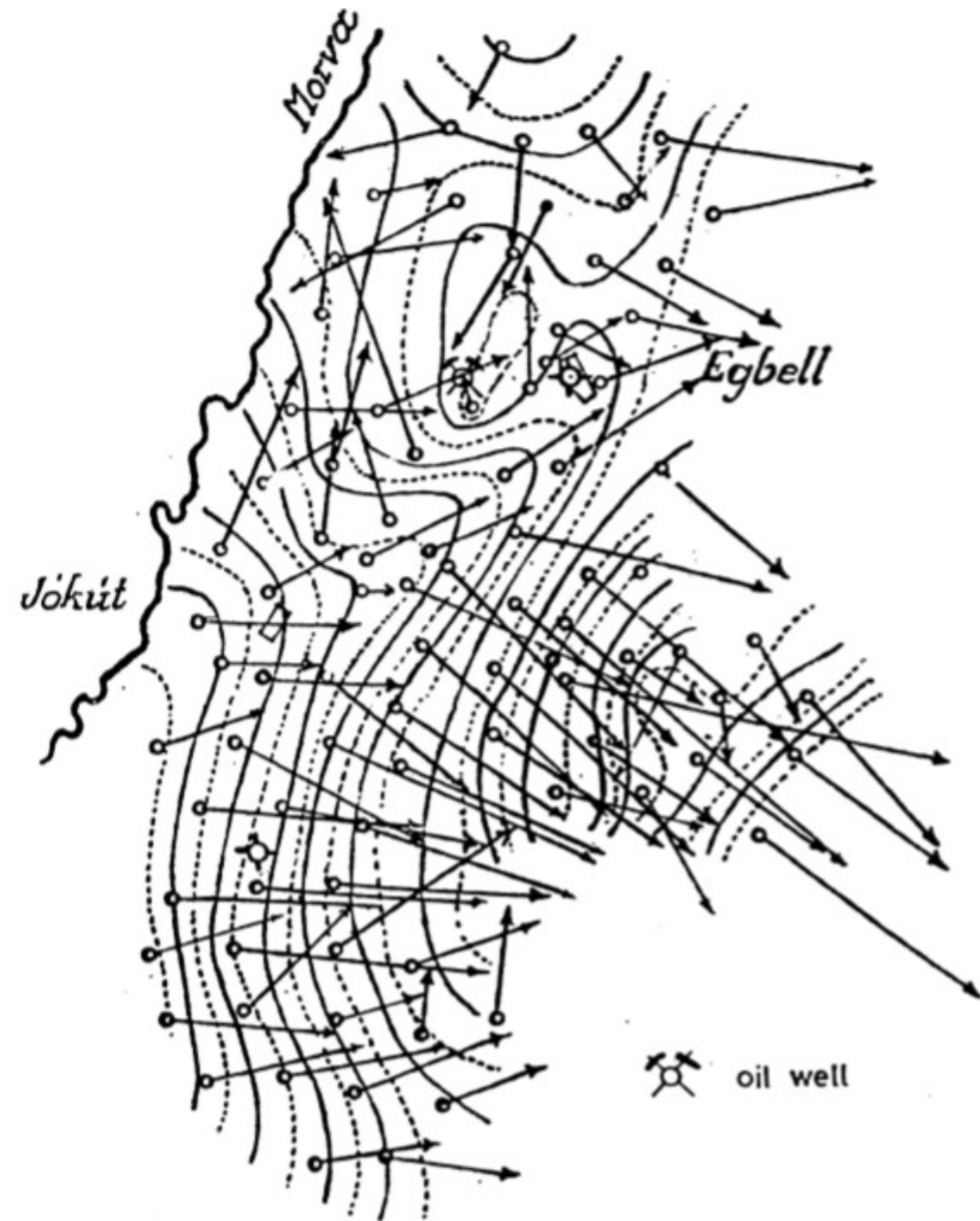
$$F = G \frac{m_s M}{r^2}$$





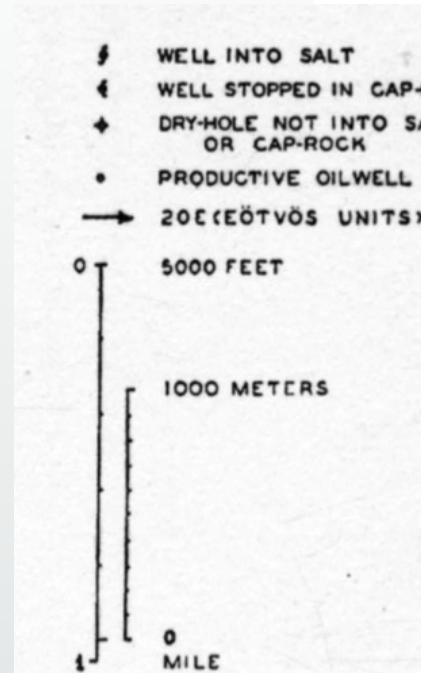
# Scientific achievements

- 1913: The 1st deep-drills in Transylvania by Eötvös' measurements
- 1915 Rotating balance – to demonstrate the Eötvös effect
- 1916 The Egbell-survey – the birth of petroleum-geophysics



# Triumph of the Eötvös Balance

- The Balance was not patented, he didn't invent it for the money and fame
- First tests in Germany (1917), in Egypt (1921), in Texas (1924)
- „By the 1920s the Eötvös Institute had become a virtual Mecca of the oil industry”.
- At the beginning of the 1930's more than 125 torsion balances were in use in the USA



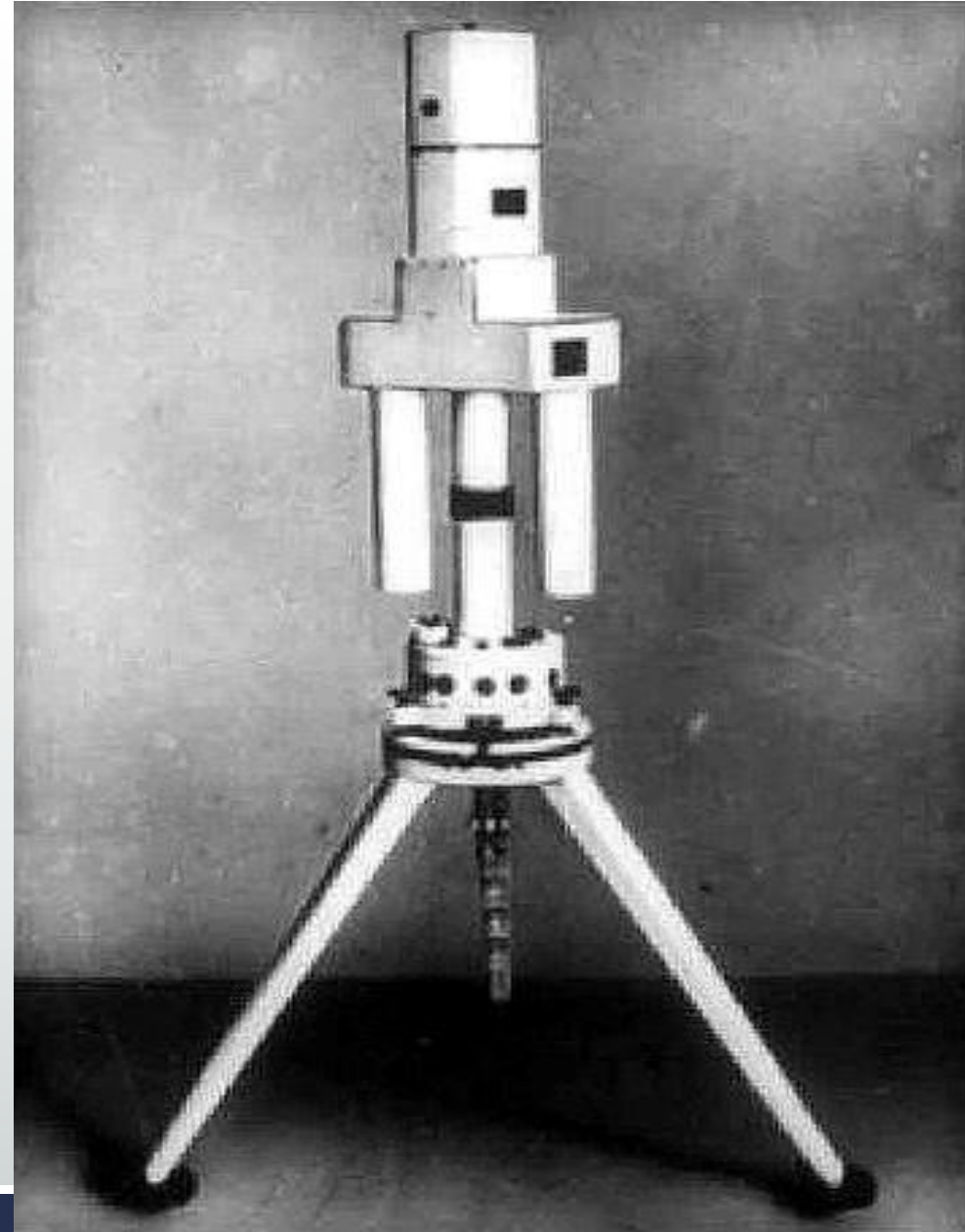
- India (1926)
- 1926-1938:  
300+ Torsion Balances  
to all over the World
- 159 Oil fields  
discovered





## The 2nd Golden Era

- After the WW2, Eastern countries had no rights to buy modern gravimeters.
- The ELGI (Eötvös Loránd Geophysical Institute) developed a modernised, easier instrument and sold more than a 100 of that around the World.
- E54 Balance: Gran prix Brussel Expo, 1958
- 1958-59: Hungarian-Chinese test in China
- 1969: the Last Eötvös Balance
- 60.000+ stations (measurements) in Hungary so far



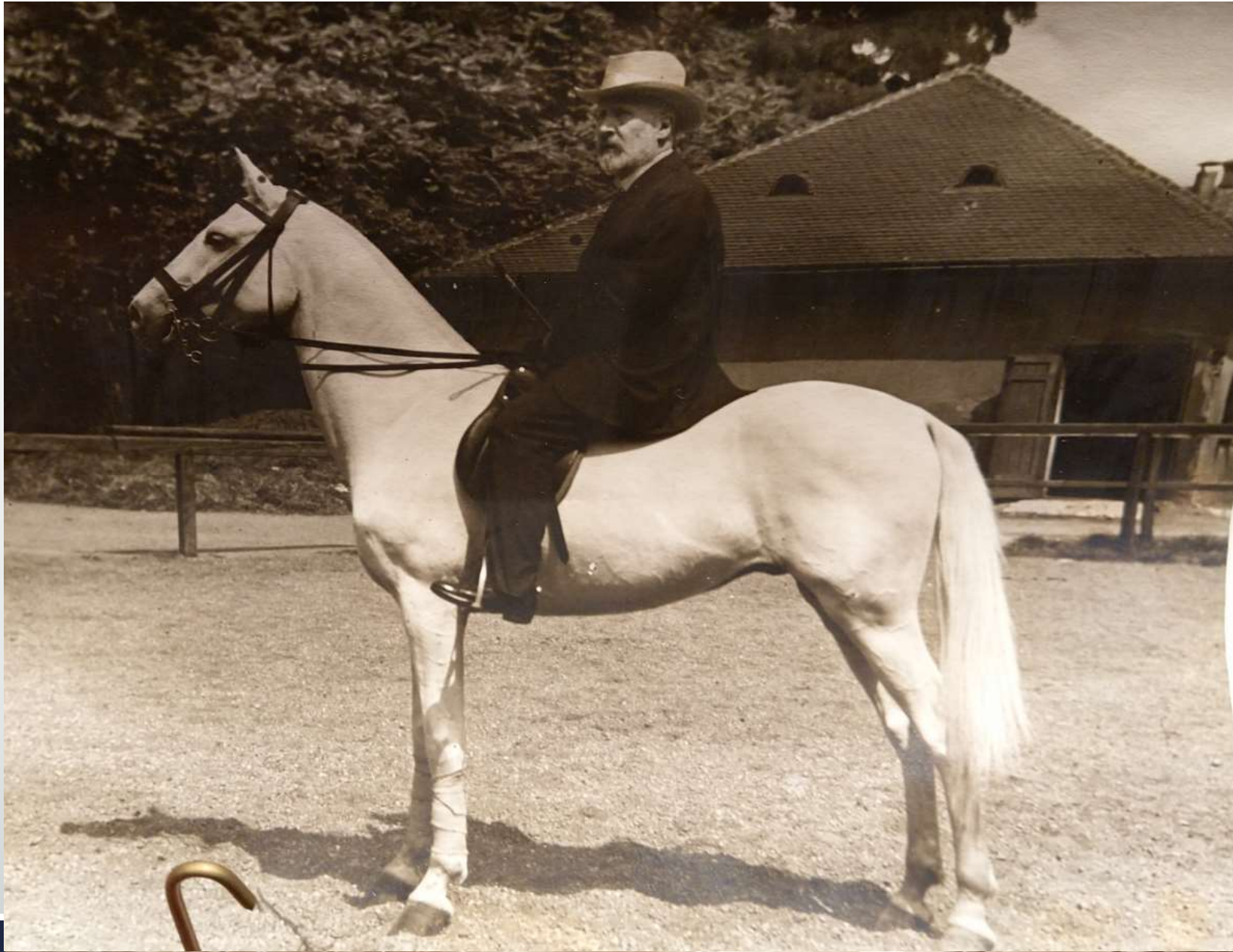




# Eötvös - the Sportsman

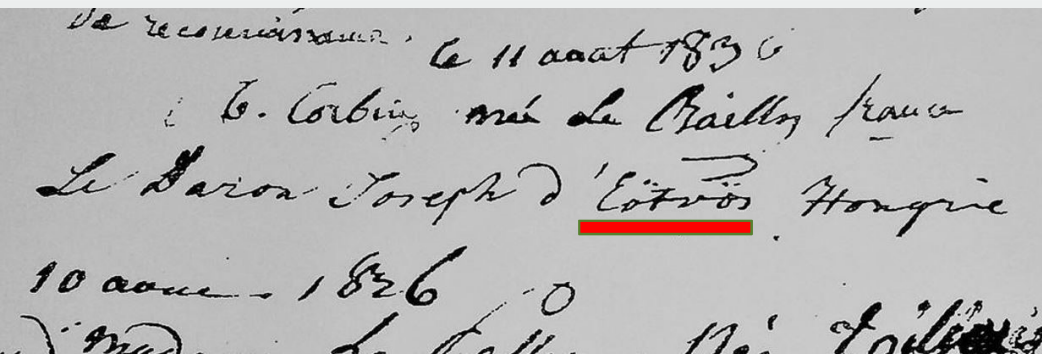
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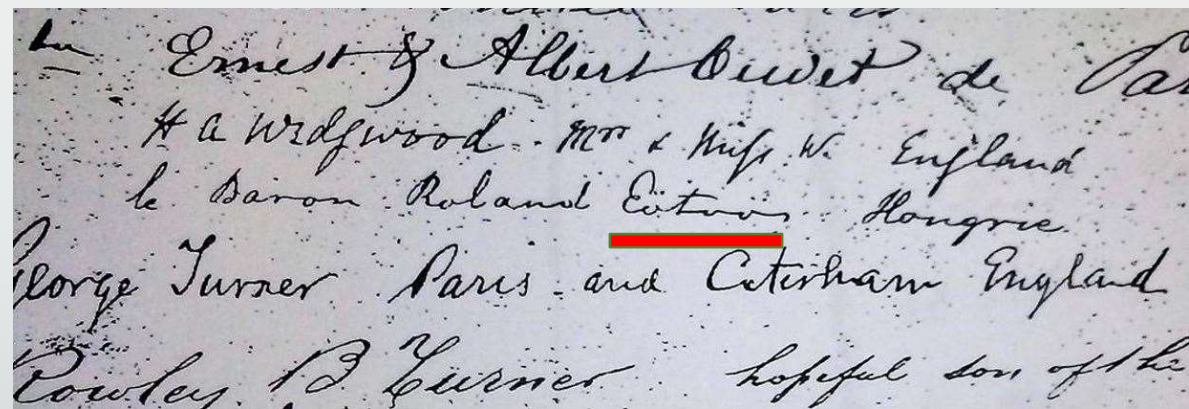
# Eötvös - the Sportsman

- 1864: First hiking trip to Austria (age 16)
- 1866: Switzerland, Italy, Austria, Germany, France 2 month-trip (age 18)
- Monte-Rosa - climbed the Duffour-peak
- Hospice St-Bernard - He found his father's sign in the Register



de reconnaissance le 11 août 1836  
G. Corbin, maréchal de Baille, France  
Le Baron Joseph Eötvös Hongrie  
10 août 1836  
M. de Baille, M. de Baille

1836



Ernest & Albert Oudet de Paris  
# a Widdowood - Mrs & Miss W. England  
le Baron Roland Eötvös Hongrie  
George Turner Paris and Caterham England  
Cowley B Turner hopeful son of the

1866



# Eötvös - the Sportsman

- First Chairman of the Hungarian Hiker's Club (Magyar Turista Egyesület) 1891-1899
- Chairman of the Hungarian Carpathian Club – Budapest Division (Magyarországi Kárpát Egyesület)
- 1898. Dobogókő (peak close to Budapest):  
Eötvös Lóránd House for Hikers
- BEAC 1st Chairman, founder (Budapest University Athletic Club)







  
**B E M T**  
 BUDAPESTI ÉRŐSÍTŐ  
 császári és királyi főhercegrőné  
 mint a Magyarországi Képzési-Égyetemi Budapesti Oktatási  
 első amatőr-fotográfiai kiállításának voltnéke  
**Baró Eötvös Terézia**  
 főrendiházi tanácsjegyző tanács-úrának  
 a fotográfia terén elért kiváló eredmények jutalmazásául  
**A M A T**  
 (VERMEILL)  
 adományoztam.  
 Budapest, 1890. *Mária Terézia Főhercegné*



  
 Schickelschicht (Catharin, Ochsensack) Hänge, über Föhnwind  
 und heftigen Nebel sehr unruhig. Es soll begünstigt  
 werden. (1890)

Blau Lőrincz Lantist  
  
**TURISTA**  
**INDULÓ**  
 TOURISTEN MARSCH  
**KOVÁCS FERENCZ**  
 KAPMESTER



## Eötvös - the Sportsman

- 1877. Piz Popena , 3152 m - Gruppo c
- 1877. Cima Cadin di San Lucano, 283
- 1878. Cima Dodici (Zwölferkofel), 30
- 1878.07.19. **Croda dei Rondoï (Schw**
- 1878.07.20. **Croda Rossa di Popera (**
- 1879.07.25. Cima Undici (Elferkofler)
- 1879. **Cima Bulla Nord, 2837 m - he**
- 1879.07.26. **Cima Una (Einserkofel),**
- 1884.07.19. **Croda da Lago Norther**
- 1892.07.10. **Cristallino, 2786 m - he**
  
- With his daughters:
  - 1896.08.31. **Cima Cadin di Misurina**
  - 1896.09.23. **Croda Liscia, 2570 m - 1**
  - 1900.08.30. Cima Cadin della Neve (
  - 1902.08.02. **Campanile Antonio-Gio**



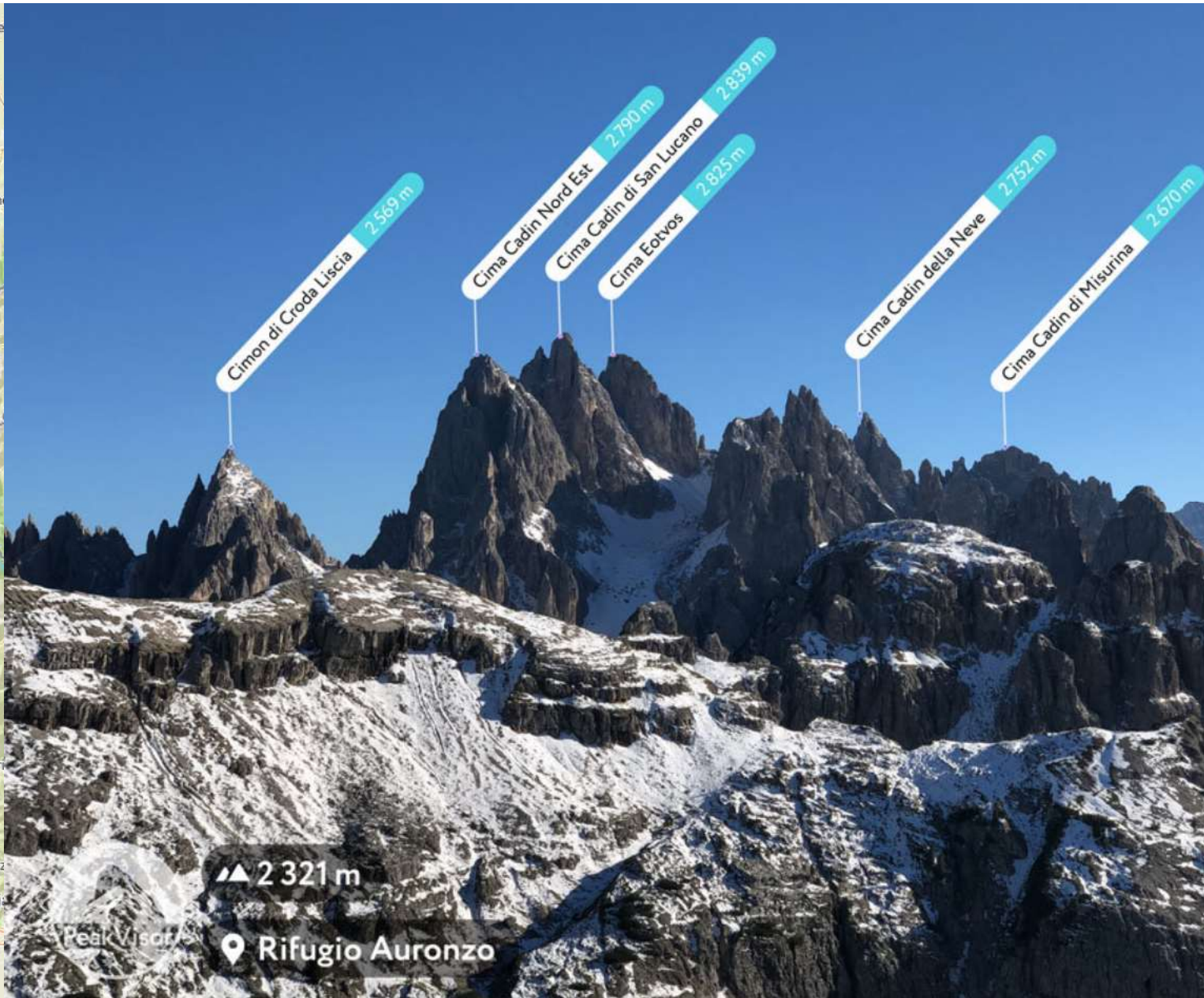








# Eötvös-peak







# GRUPPO CADINI

Cadin di S. Lucano  
m. 2839

Cima Cadin N-E  
m. 2553

Cima Eötvös  
m. 2837

Cima Cadin N-O  
m. 2725

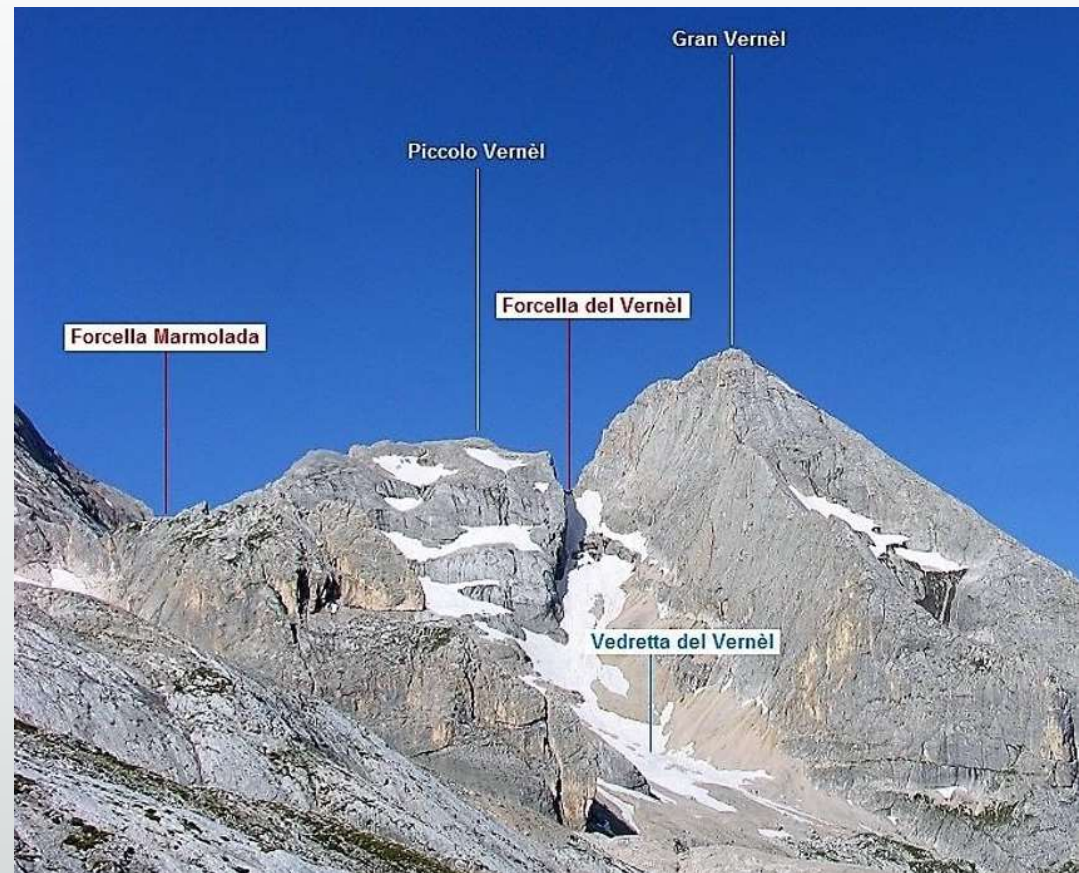
Cadini

Dolomiti

Dolomiten 



- Gran Vernel – then and now









- Lake Misurina
- Becco di Mezzodi
- View in Cortina  
Croda da Lago



- Climbing with his daughters
- On a rock
- On the top





- Tofana
- Sleeping under a tent
- Climbing





- Pragser Wildsee
- Drinking at the top
- Visegrád, King's castle (ruins)





- ,Rock gate'  
at Stracena



- ,Ice cave'  
at Dobsina







# Eötvös – 3D photos

# 3D ,Twin'-Photographs

- The following pictures from the presentation of Zsolt Regály
- Original stereoscopic pictures
- Made on glasses

