



1EOTVOS
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Roland Eötvös (1848-1919): the scientist and the man

László SZARKA

Chair, Eötvös 100 Coordination Team

Novi Sad /Újvidék, October 30, 2019

Eötvös Loránd
1848 – 1919



United Nations
Educational, Scientific and
Cultural Organization
Egyesült Nemzetek
Nevelésügyi, Tudományos és
Kulturális Szervezete

100th anniversary of Roland Eötvös
(1848-1919), physicist, geophysicist,
and innovator of higher education
Commemorated in association with UNESCO
**Eötvös Loránd (1848-1919) fizikus,
geofizikus és a felsőoktatás
megújítójának 100. évfordulója**
Az UNESCO-val közösen emlékezve

EÖTVÖS Loránd: his Hungarian name
Roland EÖTVÖS: his international author's name

1. Serbian-Hungarian connections in the time of Eötvös
2. Family background and CV
3. Achievements: concepts and terms named after Roland Eötvös
4. The Eötvös 100 Commemorative Year

Báró Eötvös Loránd (1848–1919, Baron Roland von Eötvös) was contemporary – among others – of the following earth scientists:

the Austrian Eduard Suess (1831–1914), the Croatian Andrija Mohorovičić (1857–1936),
and the Serbian Milutin Milanković (1879–1958).



MILUTIN MILANKOVICS

szerb geofizikus és csillagász

az első világháború alatti internálását (1914–1918)
kutatómunkával töltette az MTA Könyvtárban.

Itt alapozta meg a Földet elérő napenergiát befolyásoló csillagászati tényezők
és az éghajlat hosszú távú változása közötti kapcsolatról szóló elméletet.

Serbian geophysicist and astronomer

MILUTIN MILANKOVIĆ

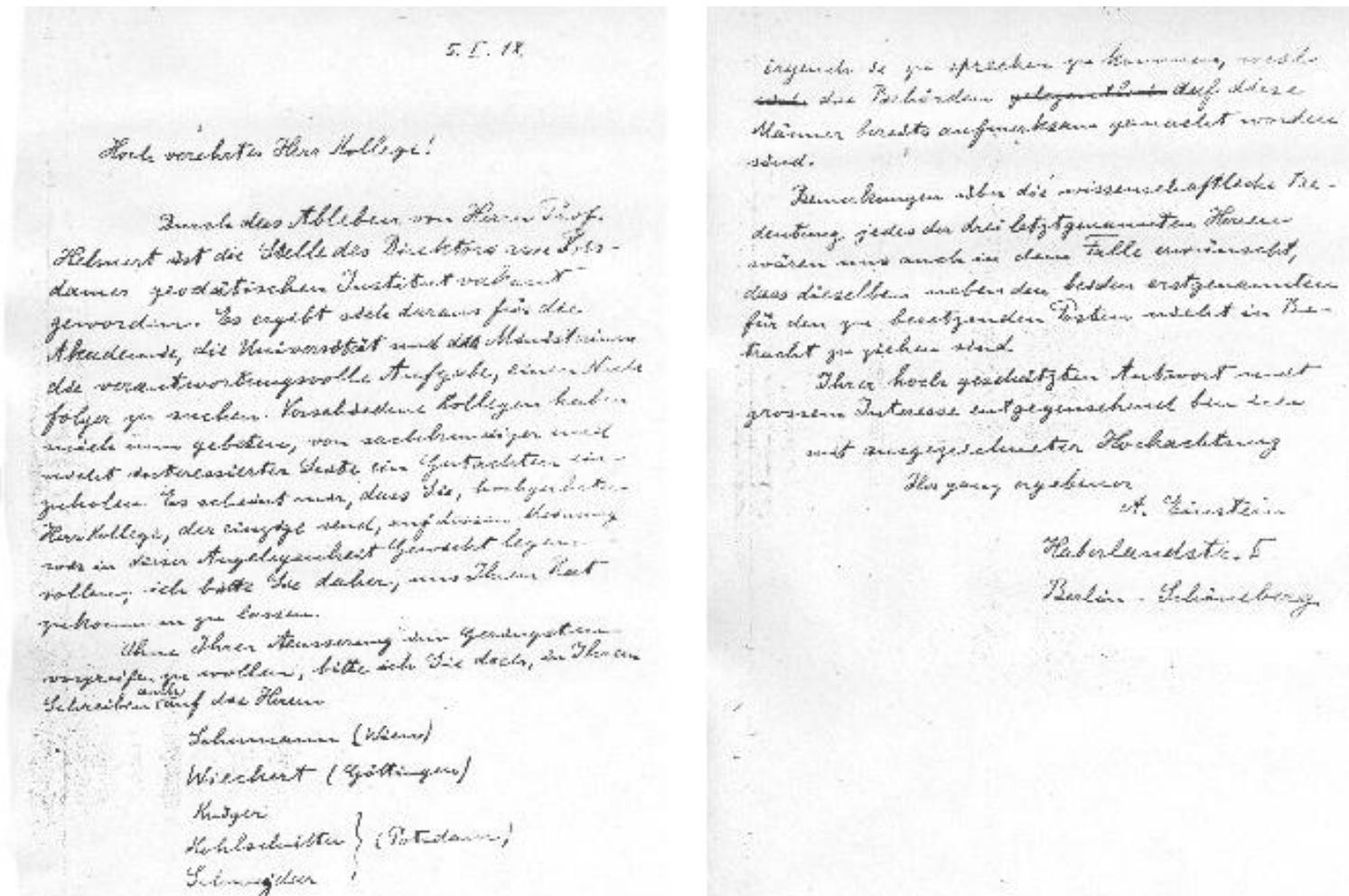
was allowed to spend his WWI internment period (1914–1918)
with research work in the Library of the Hungarian Academy of Sciences.
The theory about the link between long-term changes in climate and astronomical factors
affecting the amount of solar energy received at the Earth was founded here.

A Föld Napja – 2017 – Earth Day
MTA CSFK, MTA KIK

Mileva Marić (Márity Miléva, mothers name: Rizuts Mária, Titel, 1875 - Zürich, 1948)
Serbian mathematician and physicist, the first wife of Albert Einstein

She learned Hungarian in elementary school, so in Zurich she, as Einstein's companion, was able to read scientific publications from Hungary, including the works by Eötvös.

A letter by Albert Einstein
to Roland Eötvös



2. Family background and CV

The Vásárosnaményi Baron Eötvös family (Bereg county, NE-Hungary)

Great-great-grandfather: Miklós Eötvös (1716–1783): *General of the Cavalry, Baron from 1768*
Great-grandfather: Ignác Eötvös (1763–1838): *Doctor of Arts, Royal Majesty, Under-Sheriff*
Grandfather: Ignác Eötvös (1786–1851): *Doctor of Philosophy and Law,
Treasurer Master, Vice-Chancellor*
Father: József Eötvös (1813–1871): *Lawyer, Writer,
Minister of Public Education and Religion,
President of the Academy*

Father:

József Eötvös (1813–1871)



Mother:

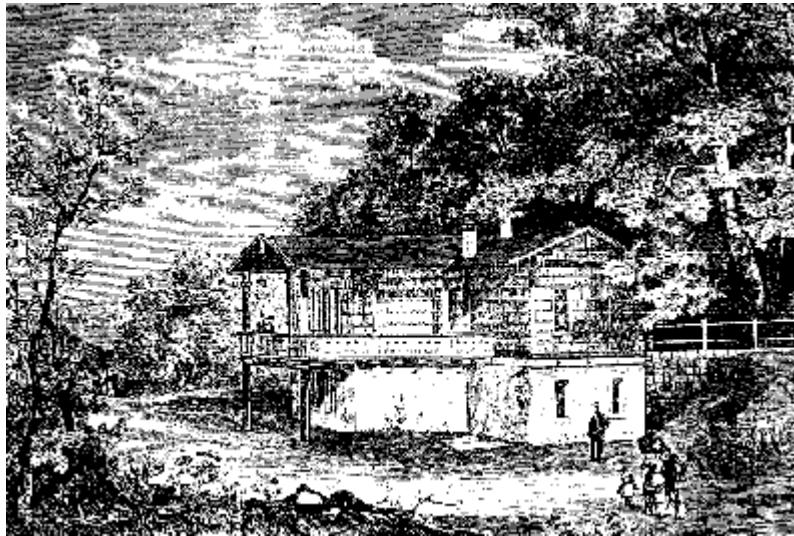
Ágnes Rosty (1821–1913),
Daughter of Albert Rosty
(1779–1847)
Unter-Sheriff in Békés

József Eötvös and Ágnes Rosty married in 1842 and had four children:

Ilona (1846–1924), Jolán (1847–1909), Loránd (1848–1919), Mária (1851–1928)



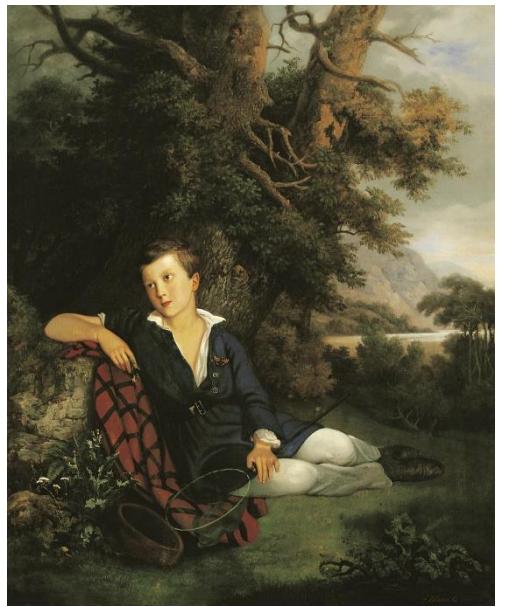
József Eötvös with his son.
Vasárnapi Újság (Sunday News), 1860



Loránd was born in
Buda, 27 July, 1848

„Ambition and sense of duty, which binds not only to a privileged nation, but to the whole of mankind, were born with me. To satisfy these two aspirations, and to satisfy my individual independence is my life goal; and at least so far I've found that I can answer it the most if I enter the scientific career.”

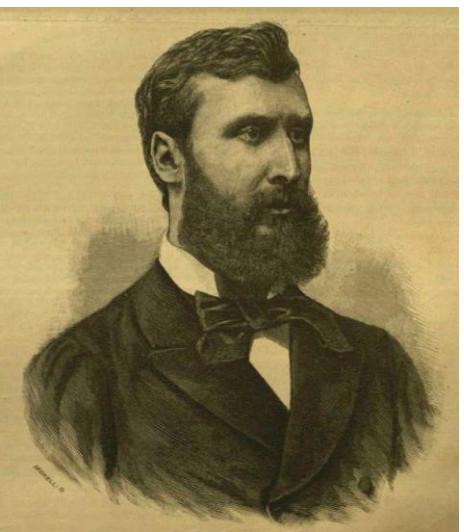
From the letter of Roland Eötvös to his father
28 March, 1866



1858 (by Gusztáv Keleti)



Student in Heidelberg



Young professor

Married in 1876 with Gizella Horváth (1853–1919)

Daughters: Jolán (1877–1879), Rolanda (1878–1952), Ilona (1880–1945)

Eötvös did not have any grandchildren

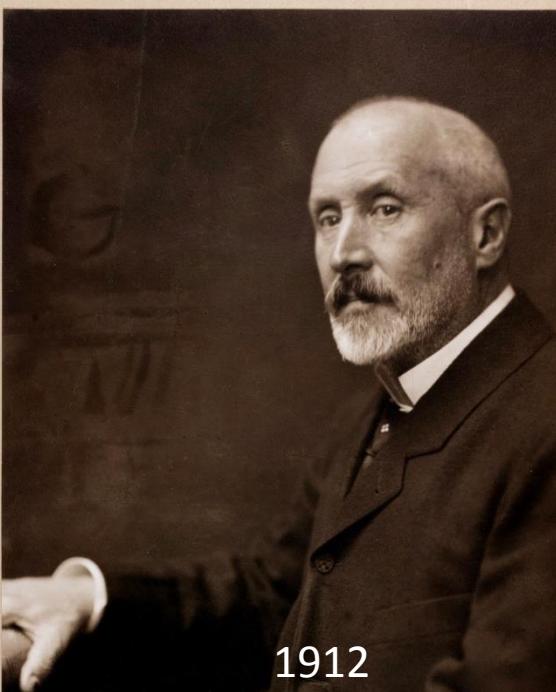
Roland EÖTVÖS Loránd (1848–1919)



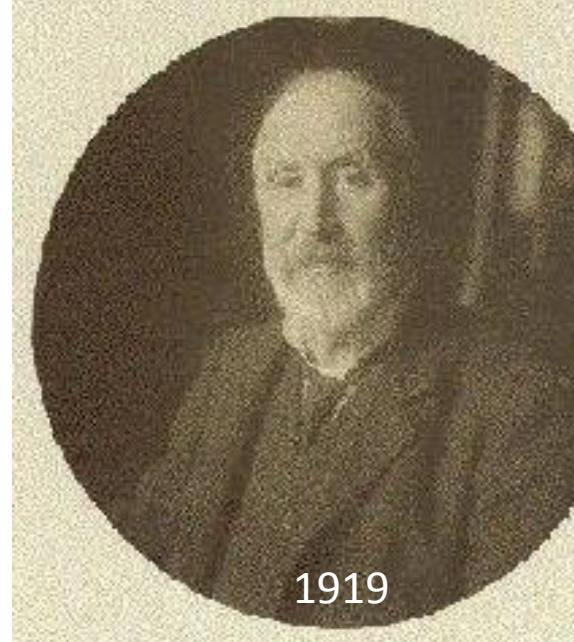
1896



1905

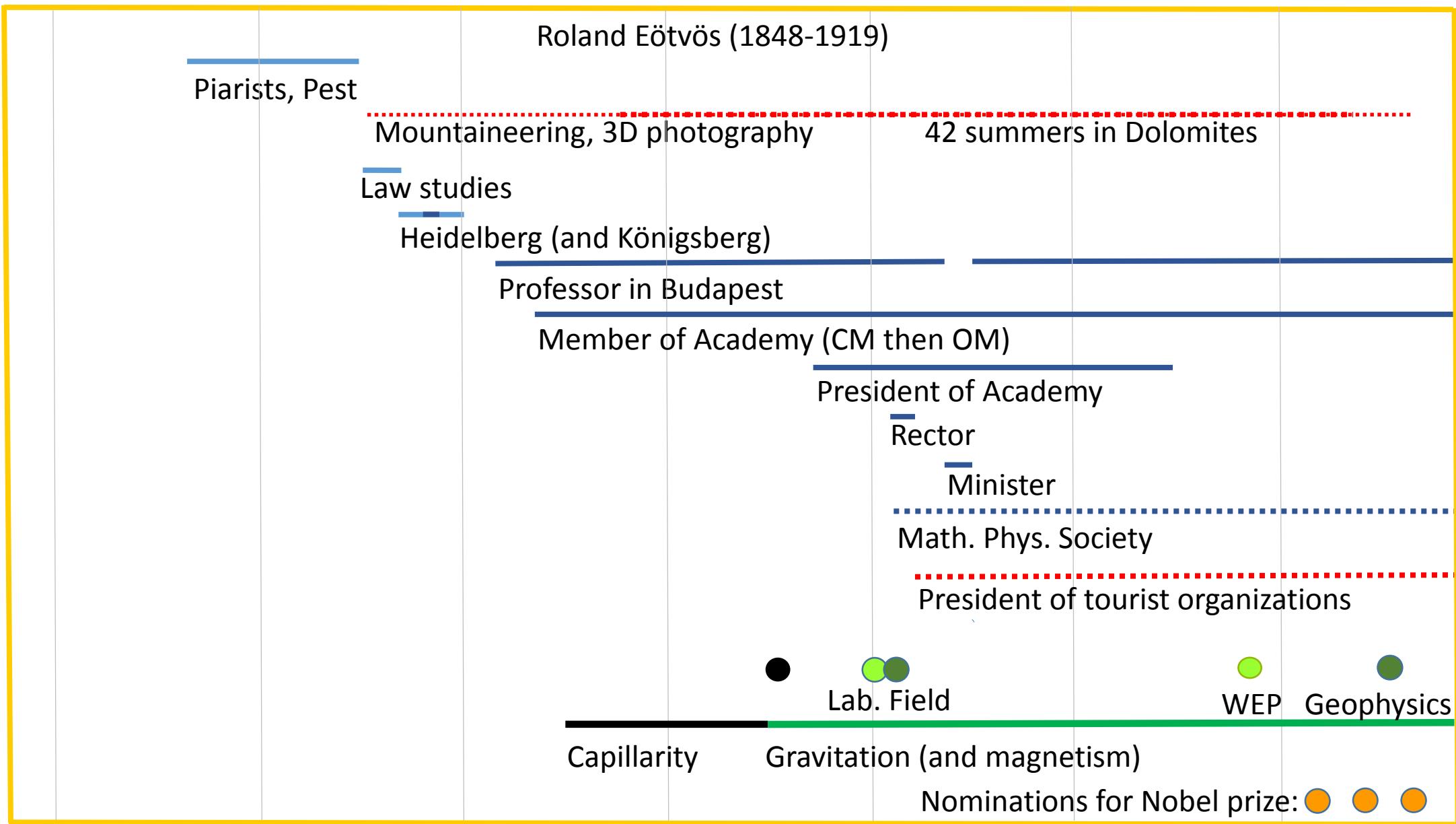


1912



1919

1850 1860 1870 1880 1890 1900 1910 1920



1850 1860 1870 1880 1890 1900 1910 1920

3. Achievements: concepts and terms named after him

SCIENTIFIC CONCEPTS AND TERMS NAMED AFTER ROLAND EÖTVÖS

Capillarity (surface tension of liquids):

Eötvös rule (Eötvös law)
Eötvös constant
Eötvös number

Weak equivalence principle
(inertial/gravitational mass
proportionality):

Eötvös experiment
(EPF or Eötvös-type experiment)
Eötvös parameter

Laboratory and field instrument:

Eötvös torsion balance
(Eötvös pendulum)

Geodesy:

Eötvös tensor

Gravitation on a rotating planet:

Eötvös effect
Eötvös correction

Gravity and magnetism:

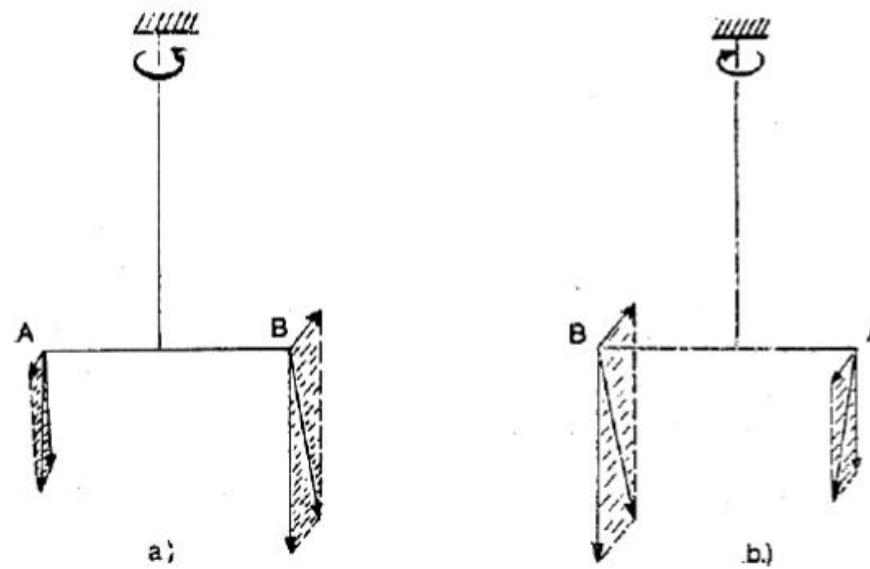
Eötvös law of magnetism
(the Poisson-Eötvös relationship)

Eötvös's Law of Capillarity states the relationship between the surface tension of a liquid and the temperature of a liquid. In particular, we have

$$\gamma = k(T_0 - T)/\rho^{3/2},$$

where the surface tension γ (also called the capillarity constant) of a liquid is related to its temperature T , the critical temperature of the liquid (T_0), and its density ρ . The constant k is approximately the same for many common liquids such as water. Note that T_0 is the temperature at which the surface tension disappears or becomes zero.

Eötvös rule (Eötvös law)



Eötvös experiment

(EPF or Eötvös-type experiment)

$$\frac{(m_g/m_i)_1 - (m_g/m_i)_2}{[(m_g/m_i)_1 + (m_g/m_i)_2]/2}$$

Eötvös parameter

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

Eötvös constant



Eötvös torsion balance (Eötvös pendulum)

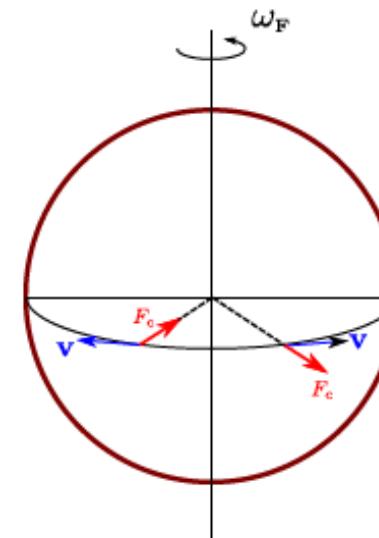
Gravitational force/surface tension

Georgescu, Achard (2004): Eötvös published his results 50 years earlier than Bond; the name „Bond number” is new (1978)

Eötvös number

$$\begin{bmatrix} dg_x \\ dg_y \\ dg_z \end{bmatrix} = \begin{bmatrix} W_{xx} & W_{xy} & W_{xz} \\ W_{yx} & W_{yy} & W_{yz} \\ W_{zx} & W_{zy} & W_{zz} \end{bmatrix} dx \quad dy \quad dz$$

Eötvös tensor



Eötvös effect

Eötvös correction

Terrestrial Magnetism

and Atmospheric Electricity

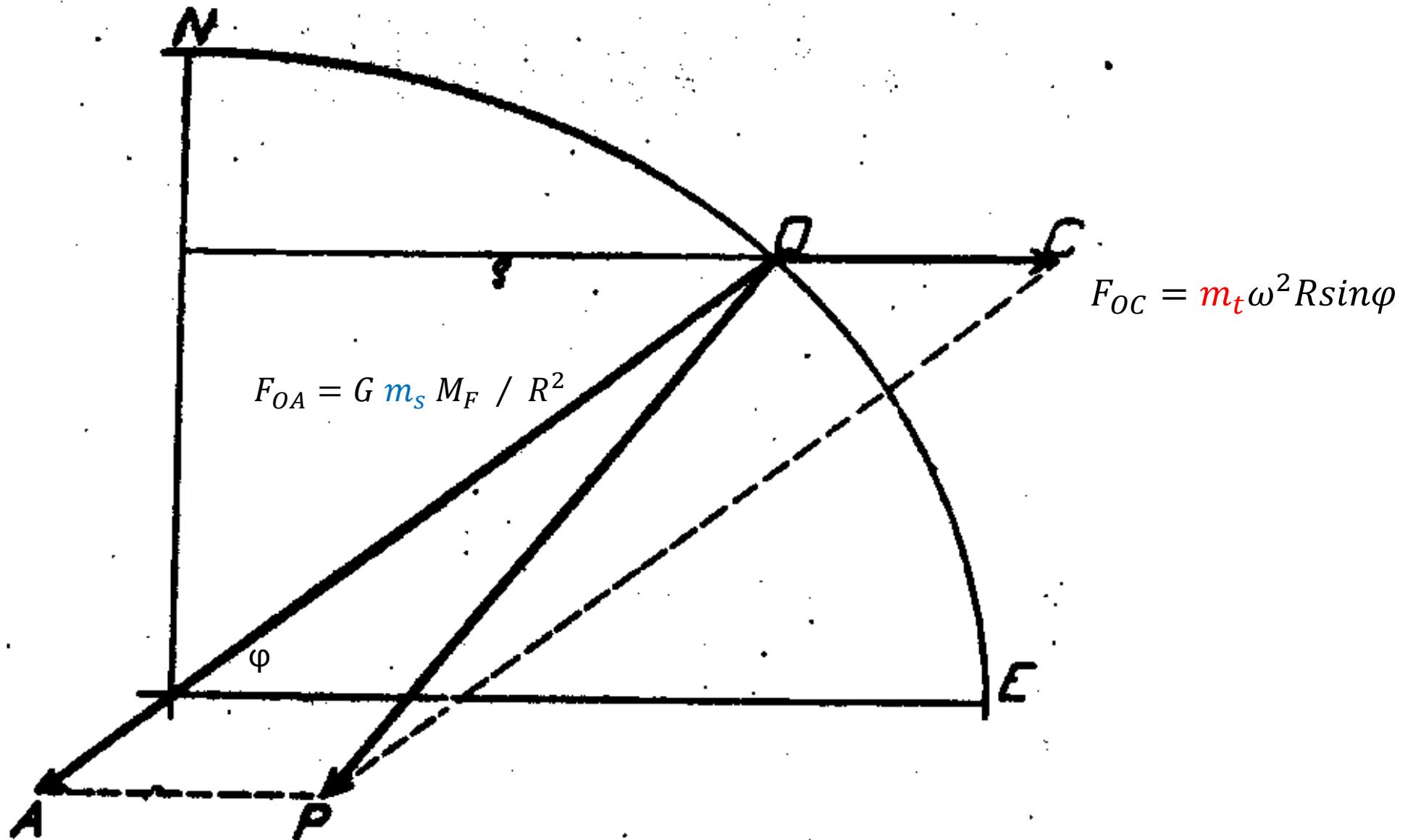
VOLUME XXVI

SEPTEMBER, 1921

NUMBER 3

R. DE EÖTVÖS' LAW CONCERNING THE CONNECTION BETWEEN THE LOCAL DISTURBANCES OF THE MAGNETIC FORCE AND THOSE OF GRAVITY.

Eötvös law of magnetism (the Poisson-Eötvös relationship)



Gravity field (OP) is a sum of the gravitation (OA) and the centrifugal force (OC).
(Eötvös, 1908, Meskó 1998). The Earth tide effects are not shown

$$F = G m_s M / R^2 , \quad g = G M / R^2 , \quad F = m_s g \quad \text{Newton's gravitational law}$$

m_s : gravitational mass

$$F = m_t a \quad \text{Newton' second law}$$

m_t : inertial mass

$$a = g (m_t / m_s)$$

$h = \frac{1}{2} a t^2$, and the time of the freefall:

$$t = \sqrt{\frac{2h m_t}{g m_s}}$$

Galilei: 10^{-3} (slope)
 Bessel: 10^{-5} (physical pendulum)
 Eötvös: 10^{-9} (torsion balance)

The world's first lithospheric geophysical survey

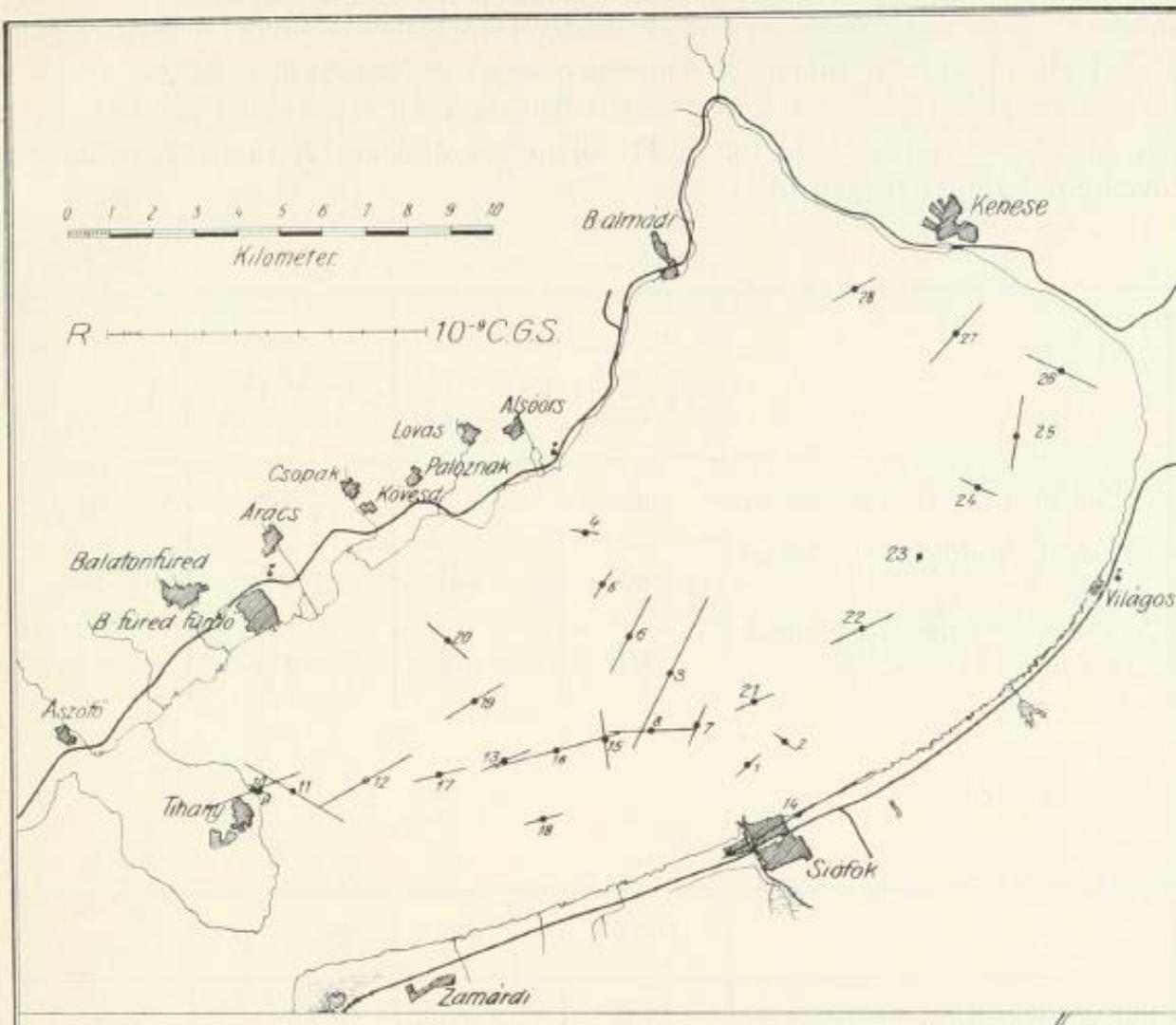
1891: the first field geophysical experiment (Ság-hegy)

1898: the „Balaton torsion balance”

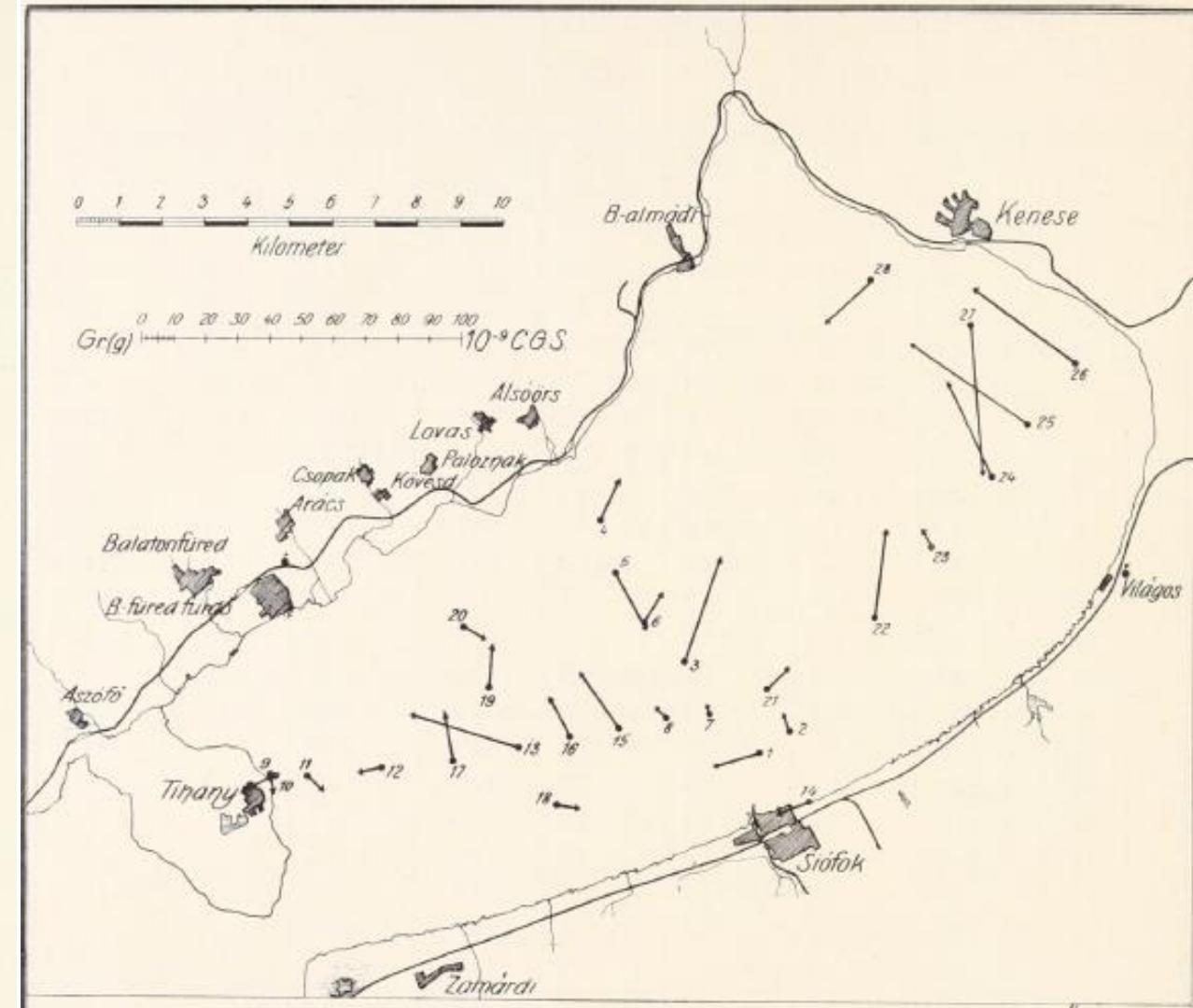
1901, 1903: field measurements on the frozen lake



Az R irányítóképességek subterrán rendellenességei.



A gradiensek subterrán rendellenességei.



Physical unit

éötvös (unit)

The éötvös (or eotvos, E): unit of acceleration divided by distance. $1 \text{ éötvös} = 1E=10^{-9} \text{ s}^{-2}$

Nature forms named after Roland Eötvös

Mineral

Lorándite

Lorándite is a mineral (thallium arsenic sulfosalt, 1894), being used for detection of solar neutrino

Mountain peak

Eötvös Peak (Cima di Eötvös, Eötvösspitze)

The Eötvös Peak is the second highest, or south-western Cadin peak in the Dolomites (2837 m)

Routes, caves etc.

Via Eötvös (≠Via Eötvös Dimai)

First climbing route of Croda da Lago. (Via Eötvös Dimai is named after his daughters.)

Eötvös-út (Eötvös Loránd-turistaút, Etveska, Eötvösova cesta)

A hiking trail above Banska Stiavnica (Selmechbánya, Schemnitz), named after Roland Eötvös (1896)

Eötvös caves

Aggtelek Karstic Mts and Krecsunesd / Crăciunești (Şura de Sus)

Moon crater

Eötvös crater

The Eötvös crater is the remains of a lunar impact crater on the far side of the Moon. It lies to the north-northwest of the walled plain Roche, and east-southeast of the equally ruined Bolyai.

Asteroid

12301 Eötvös

12301 Eötvös is a main belt asteroid with an orbital period of 3.65 years (1991).

Significance of Eötvös in 2019

For physicists: The Eötvös experiments are of crucial importance in modern theoretical (gravitational) physics.

For earth scientists: Roland Eötvös represents a cohesion force in the Carpathian Basin.

He deserves to be a role model.

4. Eötvös 100 Commemorative Year (more than 100 events through 2019, Hungary and abroad)

Eötvös 100 Honorary Board Members

ADELBERGER Eric, COLOMBO Oscar L., DOMOKOS Gábor, FISCHBACH Ephraim, von FRESE Ralph, GOMBOSI Tamás, MÉSZÁROS Péter, MÉTRIS Gilles, MILGROM Mordehai, MILYUKOV Vadim, NAGY F. András, University of Michigan, RODRIGUES Manuel, TOUBOUL Pierre, VERLINDE Erik, WEISS Rainer, WETTERICH Christoph, WILL Clifford M. etc. physicists,

BEER Tom, BERNABINI Marcello, BIELIK Miroslav, BRIMICH Ladislav, CLOETINGH Sierd, DOGLIONI Carlo, GRAFAREND Erik W., GROSEN Erwin, HAJNAL Zoltán, HIRT Christian, HOLOTA Petr, KALAB Zdenek, KAUTZLEBEN Heinz, LÜHR Hermann, MARKOVIČ Slobodan, MEURERS Bruno, MOCANU Victor, MORITZ Helmut, MUELLER Ivan, MÜLLER Jürgen, NAGY Dezső, PASTEKA Roman, EGLI Ramon, RUMMEL Reiner, RYBACH Ladislaus, SANSÓ Fernandó, SCHUH Harald, SIDERIS Michael, SNEEUW Nico, TORGE Wolfgang, VANÍČEK Petr, WHALER Kathy etc. earth scientists.

PARTNERS AND SUPPORT

The Eötvös 100 is realized by the Hungarian Academy of Sciences, Eötvös Loránd University, Hungarian National Commission for UNESCO, Eötvös Loránd Physical Society, Association of Hungarian Geophysicists, and many other organizations.

Support: Ministry for Innovation and Technology, Ministry for Human Resources, National Cultural Fund of Hungary, National Research and Development Office

Natural scientists in the Eötvös 100 Coordination Team (info@eotvos100.hu)

Jenő Sólyom physicist,

András Patkós physicist,

József Ádám geodesist,

László Szarka (Chair) geophysicist,

Gábor Zelei geophysicist.



Academy Exhibition
14.01.2019



Eötvös 100 Opening
Hungarian Academy of Sciences
14.01.2019

Digitally converted
3D anaglyph photo

Fruska Gora, Titel, 1902

Conversion:
Zsolt Regály
Konkoly Observatory

nka
National Cultural Fund of Hungary

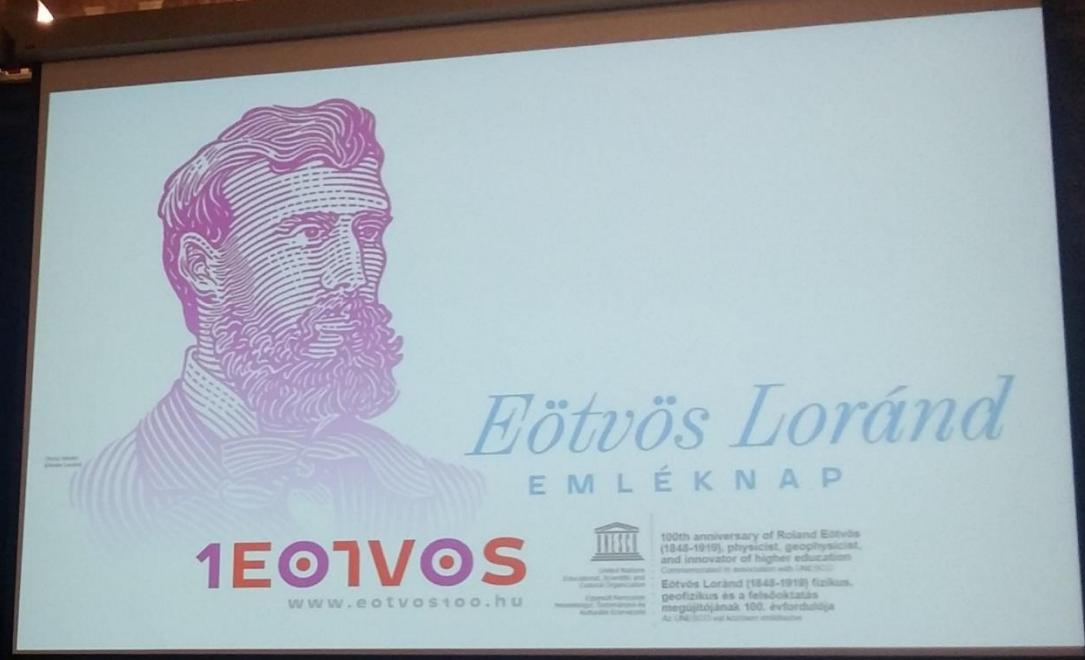




3D photo presentation
14.01.2019

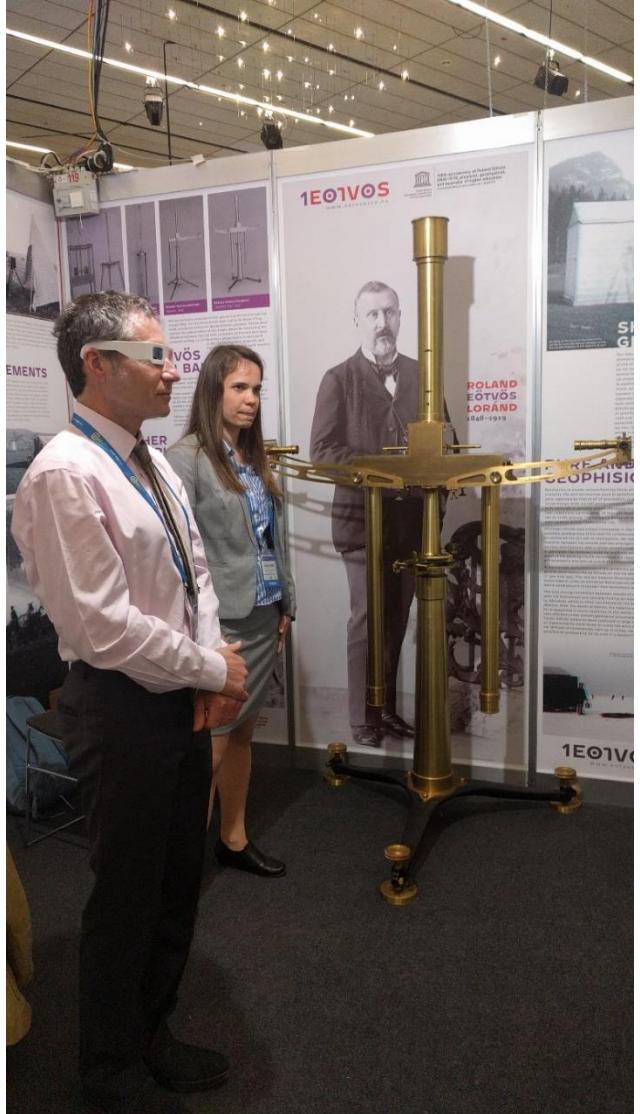


Living stream from the Vienna EGU with the EGU and the AE presidents



1EÖTVÖS

Eötvös 100 exhibition at the EGU 2019 in Vienna
(with 3D stereoscopic photos by Eötvös and the „doubled” torsion balance)



Jonathan Bamber
President, EGU



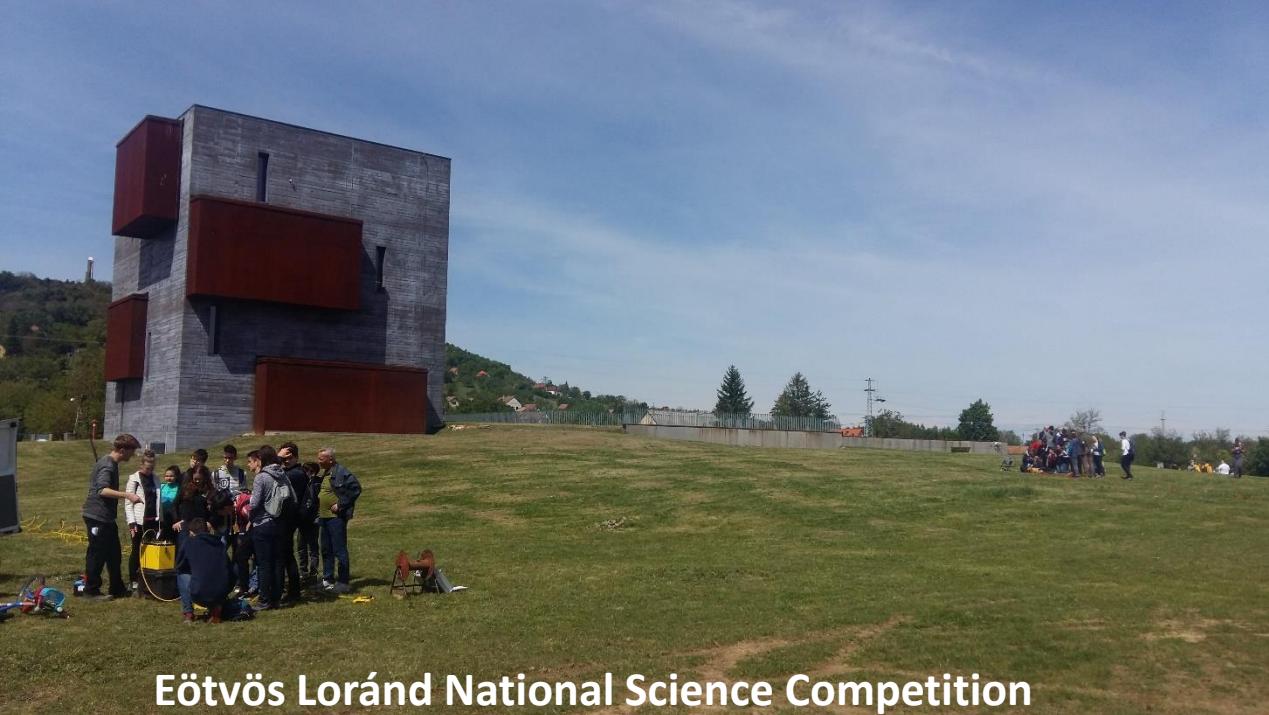
Sierd Cloetingh
President, AE



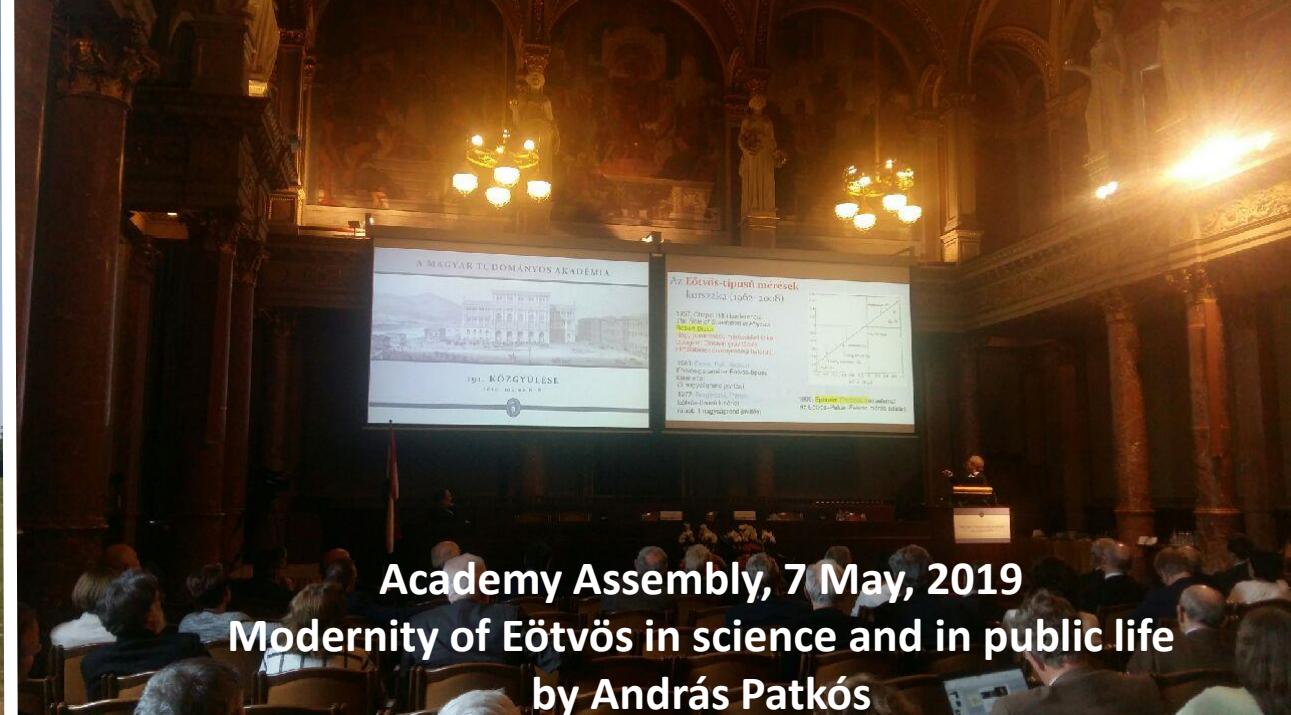
Robin Elisabeth Bell
President, AGU



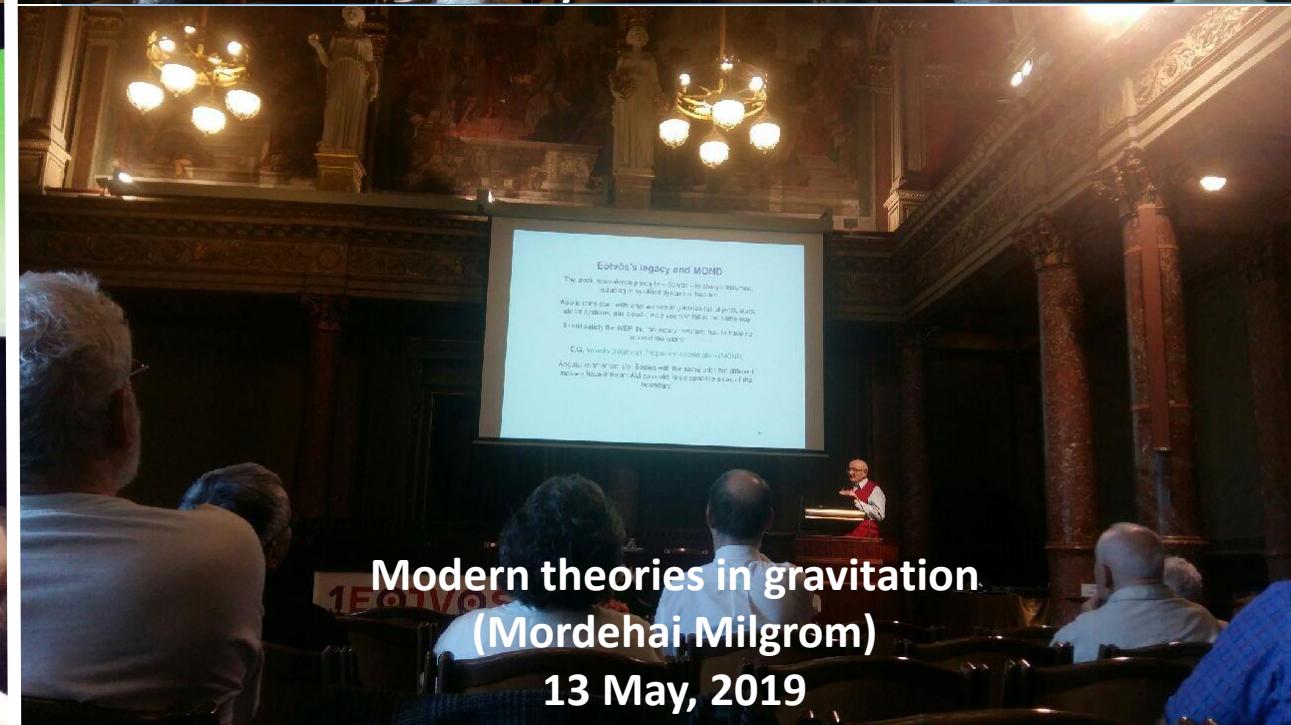
Alik Ismail-Zadeh
SG, IUGG



Eötvös Loránd National Science Competition
Final: Ság hill (Celldömölk, 11-12 May, 2019)



Academy Assembly, 7 May, 2019
Modernity of Eötvös in science and in public life
by András Patkós



Modern theories in gravitation
(Mordehai Milgrom)
13 May, 2019

IUGG
Montreal,
July 2019



Demonstration of the
Eötvös torsion balance
(Sopron, 22.08.2019)



Exhibition of stereographic
photos made by Eötvös in
South Tyrol.
Toblach/Dobbiaco
09.08.2019



Cent'anni fa moriva Eötvös

L'Ungheria e il Comune di Dobbiaco onorano il Barone

A un secolo dalla scomparsa, l'Ungheria e il Comune di Dobbiaco onorano il Barone Loránd Eötvös, scienziato e alpinista, con una mostra fotografica a ricordo dei suoi soggiorni dolomitici.

Fino alla Prima Guerra Mondiale, Dobbiaco e i vicini borghi di Höhlenstein-Landro e Schluderbach-Carbonin accoglievano d'estate molti villeggianti di spicco, dei quali buona parte apparteneva alle classi sociali più elevate: regnanti, nobili, uomini politici, artisti e scrittori. Tra le personalità di maggior caratura, emerge la figura del Barone magiaro Eötvös

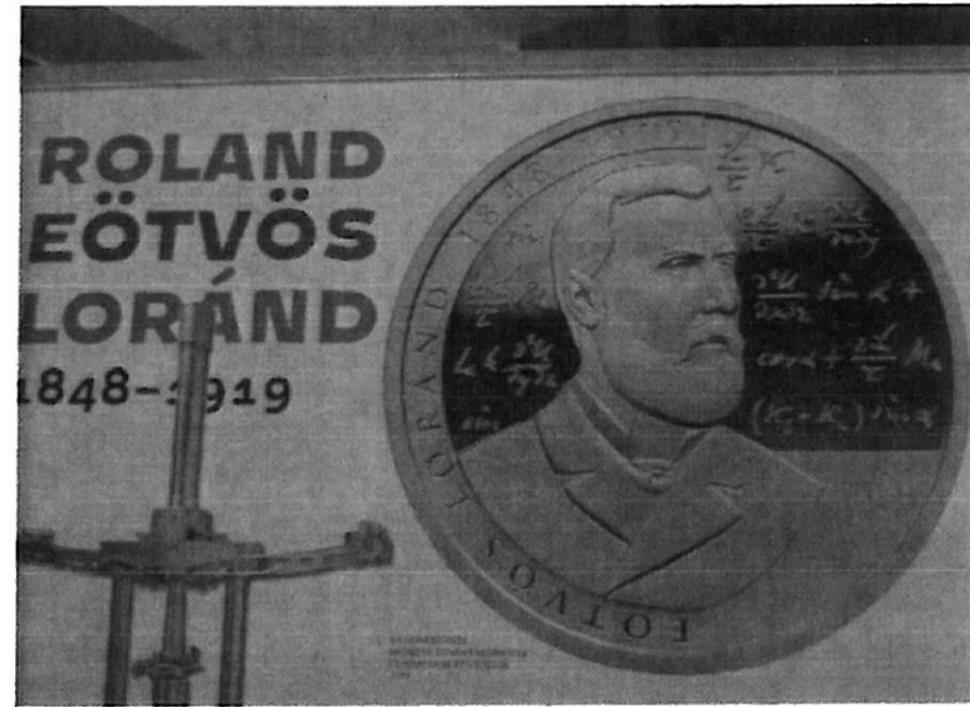
(1848-1919), Ministro della pubblica istruzione, docente di fisica e Rettore dell'Università di Budapest, che dal 1950 è intitolata a lui.

Dal 1875 la famiglia di Eötvös frequentò la Val Pusteria in entrambe le stagioni, fermandosi all'Hotel Ploner di Schluderbach. Lo scienziato amava molto le montagne e fu un provetto alpinista. Prima con la guida Michel Innerkofler di Sesto, poi con quelle ampezzane e dal 1896 con le figlie Rolanda e Ilona (che, arrampicando con Dimai, Verzi e Dibona, raggiunsero il quinto grado di difficoltà) si cimentò in moltissime escursioni e

scalate, distinguendosi in una quindicina di prime, tra le quali, il 19 luglio 1884, quella della Croda da Lago a Cortina.

In coincidenza con il centenario della morte dell'insigne conterraneo, l'Ungheria ha promosso una serie di appuntamenti per ricordarne la vita e le opere.

Il Comune di Dobbiaco si è inserito di buon grado nel quadro delle celebrazioni in onore del Barone e, con l'Accademia ungherese delle scienze, ha aperto presso la Haus Johannes-Galerie in viale San Giovanni 25 una mostra di fotografie scattate da Eötvös nei suoi



La medaglia celebrativa di Eötvös. (Foto I.D.F.)

soggiorni montani. Le immagini, riprodotte in stereoscopia, costituiscono documenti di storia spesso commoventi, e svelano un panorama molto ampio sulle escursioni e le visite del fisico magiaro e dei suoi familiari durante le vacanze

ai confini dell'Impero.

La mostra è stata aperta il 9 agosto al cospetto di una delegazione ungherese e del Presidente del Comitato «Eötvös 100» Laszlo Szarka, e rimarrà aperta fino al 21 settembre.

E.M.



Roland Eötvös bicycle tour from Székesfehérvár to the Dolomites (610 km)
(06.09.2019)



ÖKKFEHÉRVÁR
Molnár Artúr

Eötvös 100
(Kiscell Museum,
08.09.2019)



Lake reconstruction
(Eötvös Collegium
09.09.2019)



The Eötvös peak (2837 m, Cadin Dolomites, South Tyrol)

11.09.2019.



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Nyomtatás

4582. Dolomitok-Eötvös emlékhely (GCMISU)

Bázisunk, Dolomiti panzió

Szélesség N 46° 34,615'
Hosszúság E 12° 17,092'
Magasság: 2620 m
Mege/ország: Olaszország
Térképen: TuHu - OSM - GMaps
Koordináták letöltése GPS-be
Közeli ládák
Közeli pontok

Elhelyezés időpontja: 2019.09.11 13:00
Megjelenés időpontja: 2019.09.20 20:53
Utolsó lényeges változás: 2019.09.20 20:53
Utolsó változás: 2019.09.23 21:28
Rejtés típusa: Hagyományos geoláda
Elrejtő: ha2
Felhasználó: ha2
Nehézség / Terep: 2.5 / 4.5
Úthossz a kiindulóponttól: 5100 m
Megtalálások száma: 0

Az indulásnál



At the Roland Roland Eötvös plaque
in Heidelberg

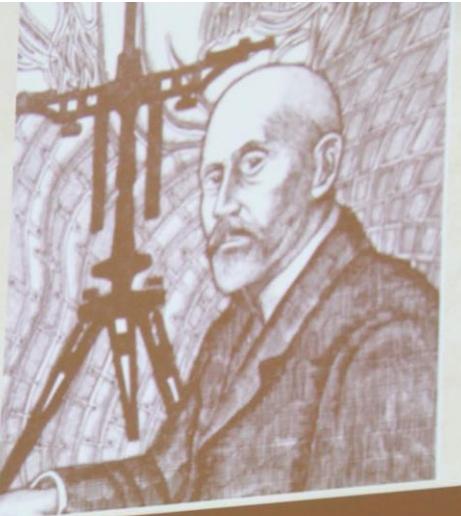
17.09.2019



21.09.2019

The Hungarian Heritage Prize

Ceremony at MOM (The Süss Works)





Eötvös 100 conference in Gbely /Egbell

October 17, 2019





Inauguration of
an Eötvös 100
commemorative plaque
at the starting point
of the Eötvös road
October 19, 2019





KÖZÉLETI EST

Előadó: Dr. Szarka László Csaba

EÖTVÖS LORÁND ÉLETE ÉS MUNKÁSSÁGA

2019. OKTÓBER 29-ÉN,
EURÓPA KOLLÉGIUM DÍSZTERME, 20 ÓRÁKOR

A graphic overlay featuring a large portrait of Eötvös Loránd on the right. On the left, there is a collage of historical scientific illustrations and text related to his work.

Európa Kollégium, Újvidék (Novi Sad), 29.10.2019

Roland Eötvös

COMMEMORATIVE YEAR
2019

EÖTVÖS
www.eotvos100.hu

**EÖTVÖS 100 EVENTS IN
BUDAPEST, CONCOMITANT
WITH THE WORLD SCIENCE
FORUM AND THE FEAST
OF THE HUNGARIAN SCIENCE**

20 November WEDNESDAY:
**Eötvös 100 Special Session at the
World Science Forum** (in English,
Ceremony Hall, Hungarian Academy of
Sciences, 1051 Bp., Széchenyi tér 9.)

- 11:00-12:30** "Eötvös 100": Outcomes of the Eötvös 100 Commemorative Year. Moderators: Kathryn Whaler, President of the International Union of Geodesy and Geophysics, and Alik Ismail-Zadeh, Secretary of the International Science Council
- 11:00-11:10** The Eötvös 100 Commemorative Year László Szarka, Chair of the Eötvös 100 Coordination Team
- 11:10-11:30** Stereoscopic photos by Roland Eötvös and their digital conversion Zsolt Regály, CSFK Konkoly Observatory
- 11:30-11:50** Experiences and results from re-running the Eötvös experiment Lajos Völgyesi, BME
- 11:50-12:00** Discussion

12:00-12:30 Book launch: The Eötvös experiment in its historical framework Gábor Dávid, Stony Brook University, and Jenő Sólyom, President of the Eötvös Loránd Physical Society. Complimentary copies of the English version will be made available to participants of the Eötvös 100 Special Session.

11:35-11:55 Presentation of the first copies to László Borhy, Rector of ELTE, László Lovász, President of MTA, Miklós Réthelyi, Chair, Hungarian National Commission for UNESCO

11:55-12:00 Welcome by András Sándor Kocsis, President & CEO of Kossuth Publishing

22 November FRIDAY:
"Eötvös 100": A Temporary Exhibition (ELTE University Library, 1053 Budapest, Ferenciek tere 6.)

13:00-14:00 Opening Ceremony of the Eötvös 100 Exhibition (in Hungarian)
Open on
22 November: 14:00-18:00,
23 November: 11:00-18:00,
25-29 November: 10:00-18:00

23 November SATURDAY:
Finals of the "Roland Eötvös Commemorative Competition" for high schools (Ceremony Hall, Hungarian Academy of Sciences, 1051 Budapest, Széchenyi tér 9.)

10:00-16:00 Invited guests only (in Hungarian)

26 November TUESDAY:
The Roland Eötvös Memorial Album (MTA Reading Room, 1051 Budapest, Széchenyi tér 9.)

11:00-12:00 Book Launch: The Roland Eötvös Memorial Album (ceremony: in Hungarian)

11:00-11:05 Welcome by László Szarka, Chair, Eötvös 100 Coordination Team

11:05-11:35 Presentation of the album Gábor Gyáni and András Patkós co-editors

28 November THURSDAY:
High School Students at the Academy: Eötvös 100 Presentations

10:00-12:00 Programme (in Hungarian)

10:00-10:15 Gyula Tóth (BME): Re-running of the Eötvös Experiment

10:15-10:30 Péter Ván (Wigner FK): The Fifth Force

10:30-10:45 Péter Raffai (ELTE): Astronomy with Gravity Waves

10:45-11:00 Armand Abordán (ME): The Eötvös Torsion Balance in Geophysics

11:00-11:15 Márk Szijártó (ELTE): Research in Capillarity

11:15-11:30 Veronika Barta, Csenge Czanik (CSFK): Eötvös 100 at International Meetings in 2019

11:30-12:00 Discussion

19 November TUESDAY:
"From Eötvös to Eötvös" conference (ELTE BTK, 1088 Bp. Múzeum krt. 4/A*)

Permanent EÖTVÖS 100 EXHIBITION:
MBFSZ Roland Eötvös Memorial Collection (1145 Bp. Columbus u. 17-23.)
Open from Monday to Friday: 10:00-16:00

Baron Eötvös' truths on gravitational force and surface tension will remain in a thousand years as true and valuable they are today, even when our actual concepts for the gravity and for the smallest parts of the matter would happen to be eliminated."

Sándor Mikola, 1929

1EÖTVOS
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United Nations
Educational, Scientific and
Cultural Organization

Egyesült Nemzetek
Nevelésügyi, Tudományos és
Kulturális Szervezete

- 100th anniversary of Roland Eötvös (1848-1919), physicist, geophysicist, and innovator of higher education
- Commemorated in association with UNESCO
- Eötvös Loránd (1848-1919) fizikus, geofizikus és a felsőoktatás megújítójának 100. évfordulója
- Az UNESCO-val közösen emlékezve

„So, finally, we must rest assured that science does not give the true explanation of natural phenomena, but only leads to the border where the elusive begins.”

Eötvös, 1877