

Welcome the Centenary!

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In fact I shall cover two centenaries:

**Discovery of cosmic rays by Victor Hess,
7th August 1912. During this ECRS, we
are to look back, but mostly forward!**

**Centenary of the birth of Lajos Jánossy,
2nd March 1912. We are now to look back
to some of his achievements in CR physics.**



How it all began ...

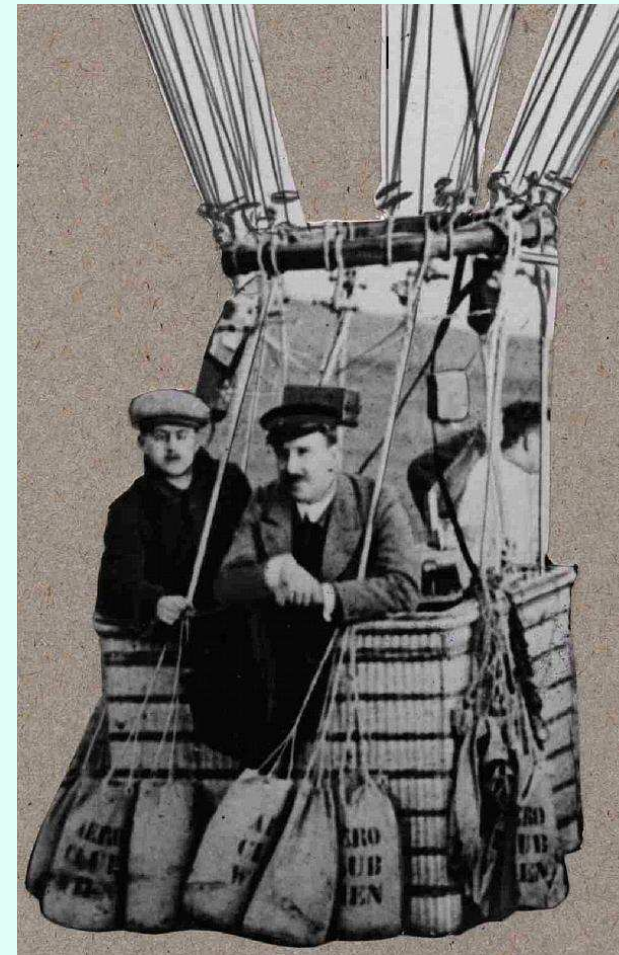
Old puzzle: spontaneous leakage of electric charge (Coulomb, 1785)
~1900: X-rays and radioactivity do ionize dust-free dry air.
Elster, Geitel and CTR Wilson: some charge leakage always persists
Spontaneous ionisation of the air, or very penetrating radiation?

1901, Wilson: perhaps radiation from outside the atmosphere? He put the electroscope into the **Caledonian railway tunnel** (in Southern Scotland), and the leakage still continued! False (but logical) conclusion: **It is not extraterrestrial radiation!**

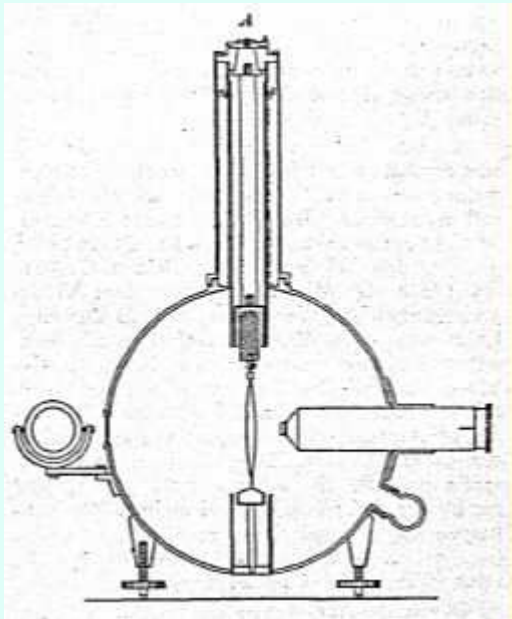


International efforts to understand the cause of the tiny excess

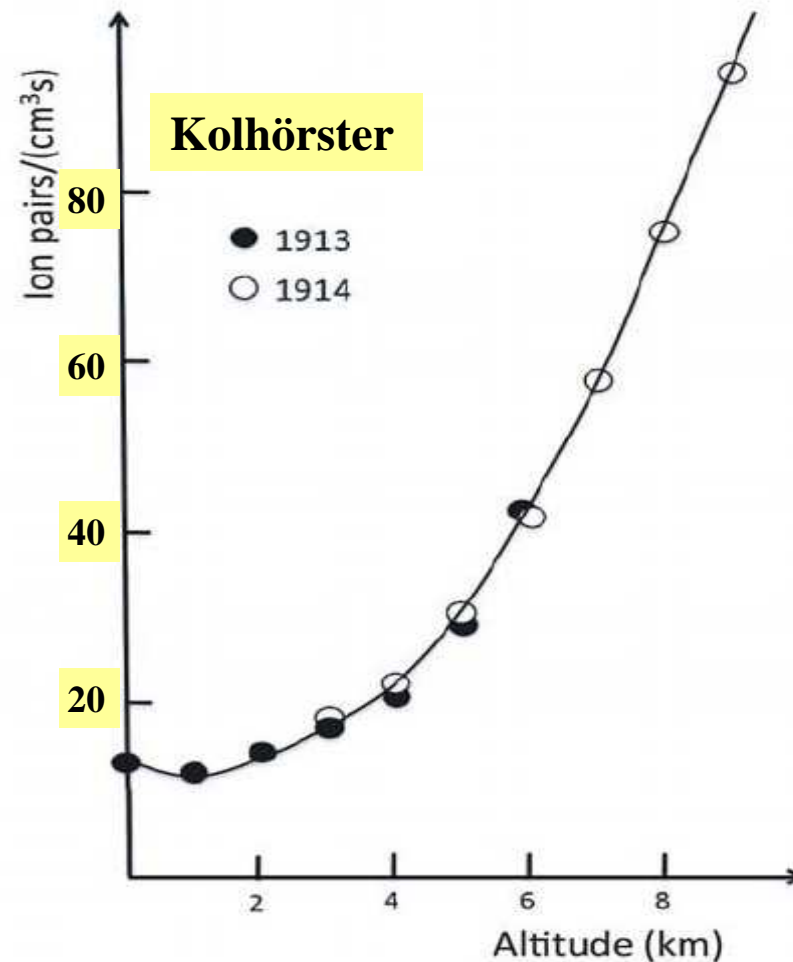
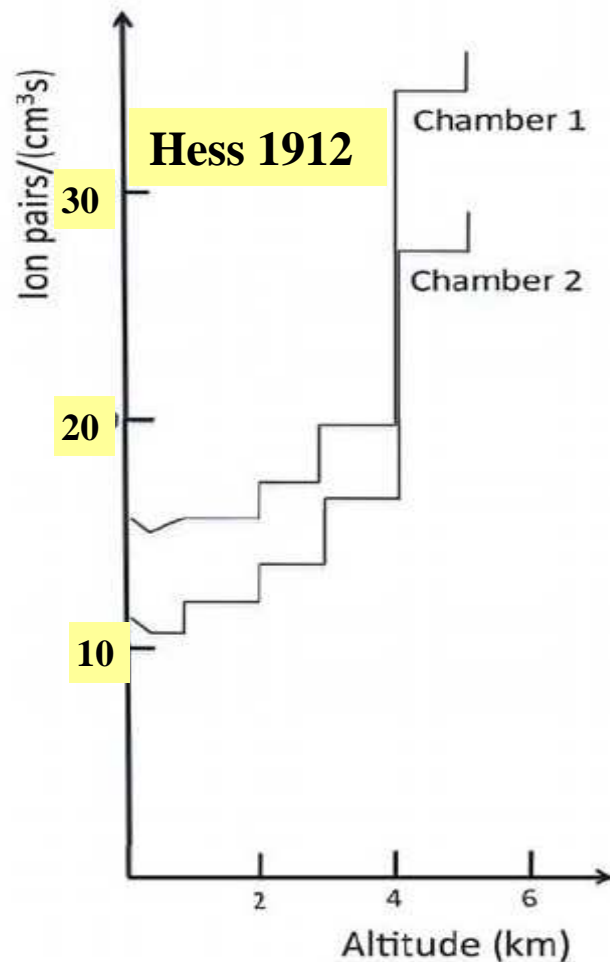
Measurements over a variety of terrains
Constructing new ionisation chambers
Shielding by lead, water, ice, rocks
Balloon ascents: Bergwitz, Gockel: 1909
Instrumental problems, no firm results
Wulf: measurement on the Eiffel tower
Victor Hess checked gamma-absorption
7 ascents in 1911-12, also solar eclipse
Discovery flight 7 August 1912, 5350m
Werner Kolhörster: first criticized the
results of Hess, then confirmed them
in 1913-14. Highest altitude: 9300 m.



Victor Hess demonstrating in 1952 how he measured the ionisation of air with the Wulf electrometer



Decisive, but later debated results of Hess and Kolhörster



About 2 I, i.e. 2 ion pairs/(cm³s) only are caused by secondary cosmic rays at sea level

A very long controversy following the discovery (aggravated by WW1 and its consequences)

Flight of Hess: „one of the last notable scientific achievements of the Austro-Hungarian Empire” (Sekido and Elliot, 1985)

Millikan’s group claimed much smaller increase up to 15 km.

Absorption by lead measured at Pikes peak, 1923: **no real CRs!**

Nov. 1925: Millikan claims to discover **REAL cosmic rays!**

Angry European responses, intercalibrations, new measurements.

Final agreement on altitude variation: 1932: Regener, Picard.

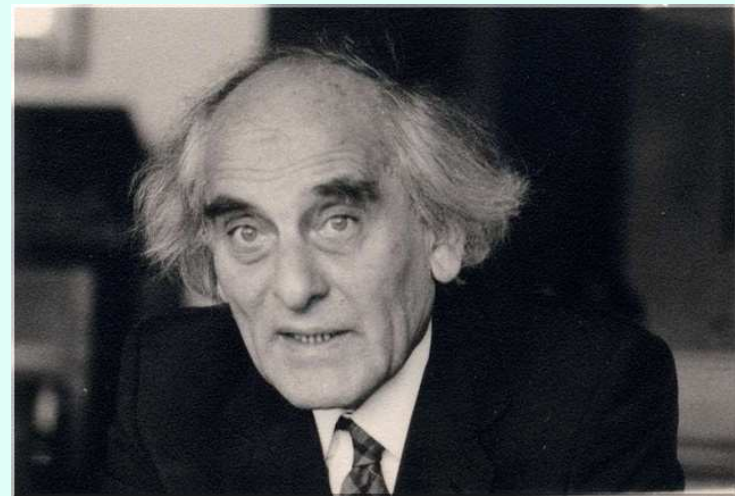
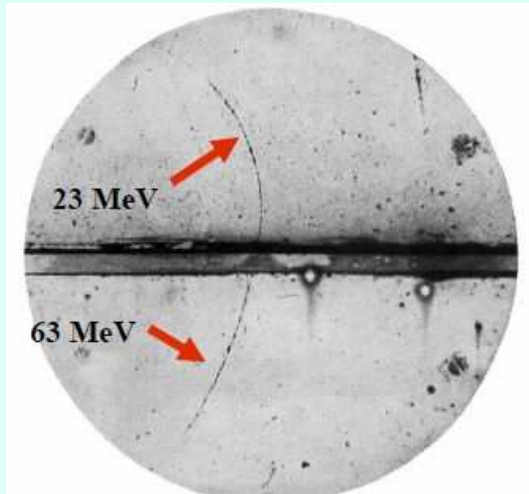
New technologies: Wilson chambers, GM tubes, coincidences.

New questions: particles in CRs? Latitude dependence, time variation, zenith angle dependence, E-W effect.

Particle tracks in Wilson chambers, discovery of positrons, and the dawn of high-energy physics

Pioneering work by **Skobeltsyn, Kolhörster, Bothe, Tuwim, Myssowsky, Millikan, Compton, Rossi, Blackett, Occhialini.**

1932-33: discovery of the first new particle in cosmic rays!
Anderson in US, **Blackett and Occhialini** (right) in UK.



**Hall of
Fame for
early CR
Research**



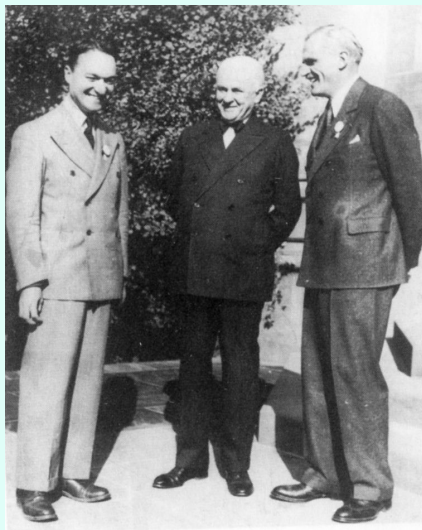
CTR Wilson



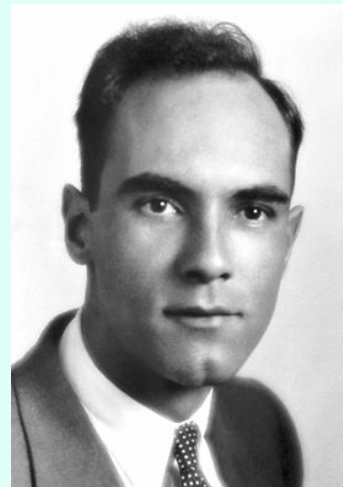
Victor Hess



Werner Kolhörster



Rossi, Millikan, Compton



Carl Anderson



PMS Blackett

Nobel prizes have put a final stamp of approval on priority issues

CR discovery: Victor Hess, 1936 (*before the decision, Hess wrote a 16 page handwritten letter to a Hungarian colleague, Magdolna Forró, complaining about the bitter debates*)

Positron: Carl D. Anderson, 1936 (shared)

Cloud chamber researches: PMS Blackett, 1948

Photographic method, pion: Cecil F. Powell, 1950

Coincidence method: Walter Bothe (shared)

Those missed out: **Werner Kolhörster, Giuseppe Occhialini**

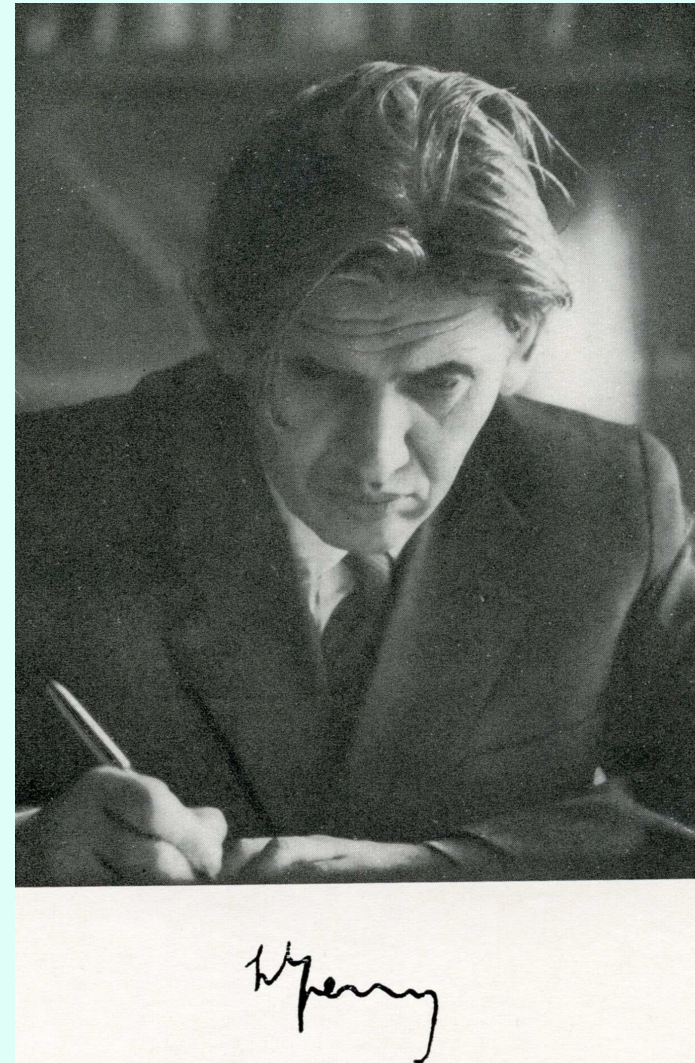
Lajos Jánossy, 1912 - 1978

Started research with Kolhörster in Potsdam, then in Dahlem (1934-37)
Continued with Blackett in London, then in Manchester (1937-1947).

During WW2, worked with George Rochester on penetrating showers.

Senior professor in Dublin, 1947-50

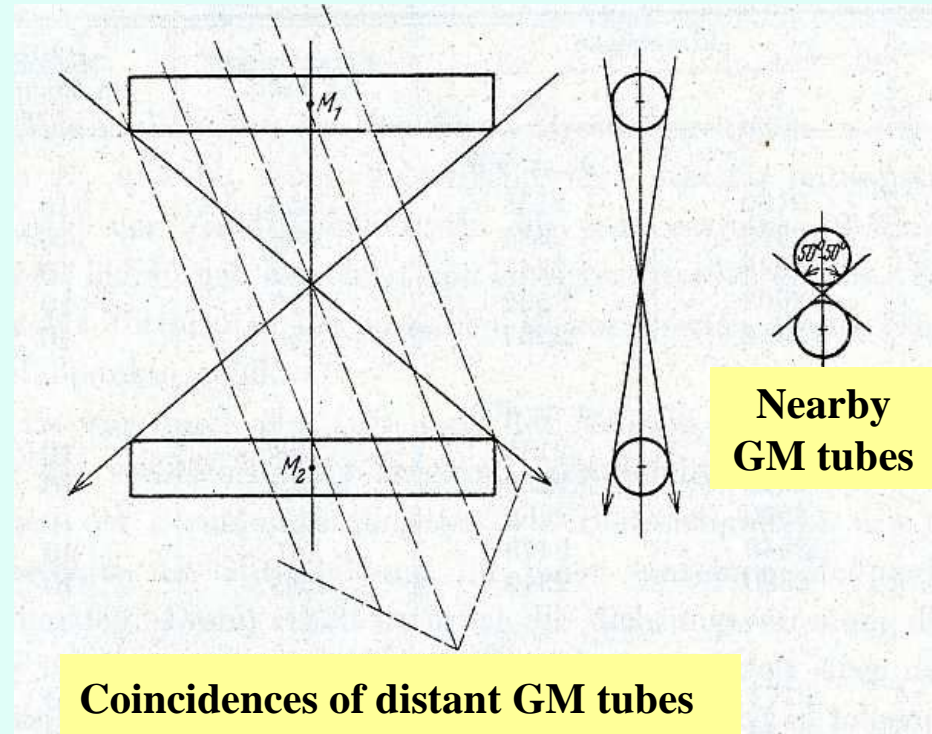
Returned to Hungary in 1950, one of the founders of the Central Res. Inst. for Physics of the Hungarian Academy of Sciences.



GM-tube theory and the early work of Jánossy in Potsdam

Under the guidance of Kolhörster, Jánossy continued and also generalized the GM tube and coincidence theories of L. Tuwim.

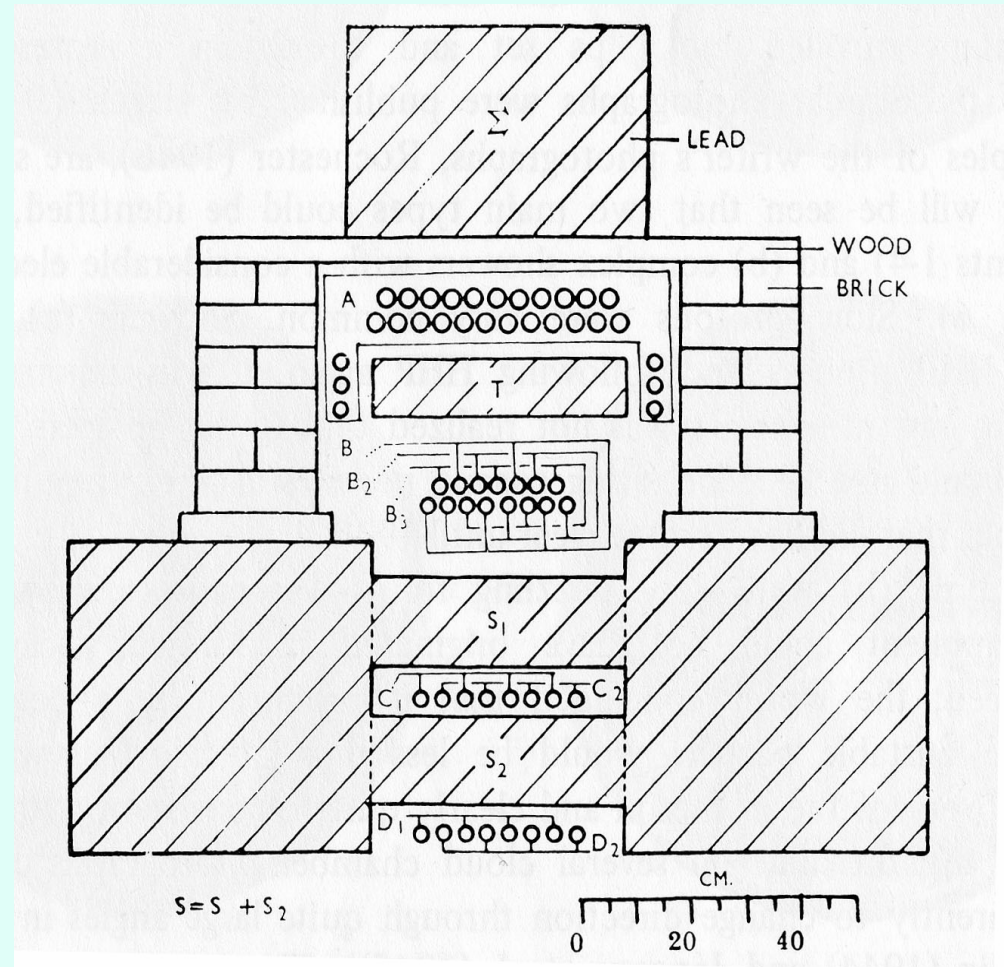
The zenith angle distribution of sea-level cosmic rays was calculated from coincidences of nearby GM tubes, thus avoiding too many random coincidences. Sophisticated mathematical methods were applied. (Leo Tuwim died in a car accident in August 1933).

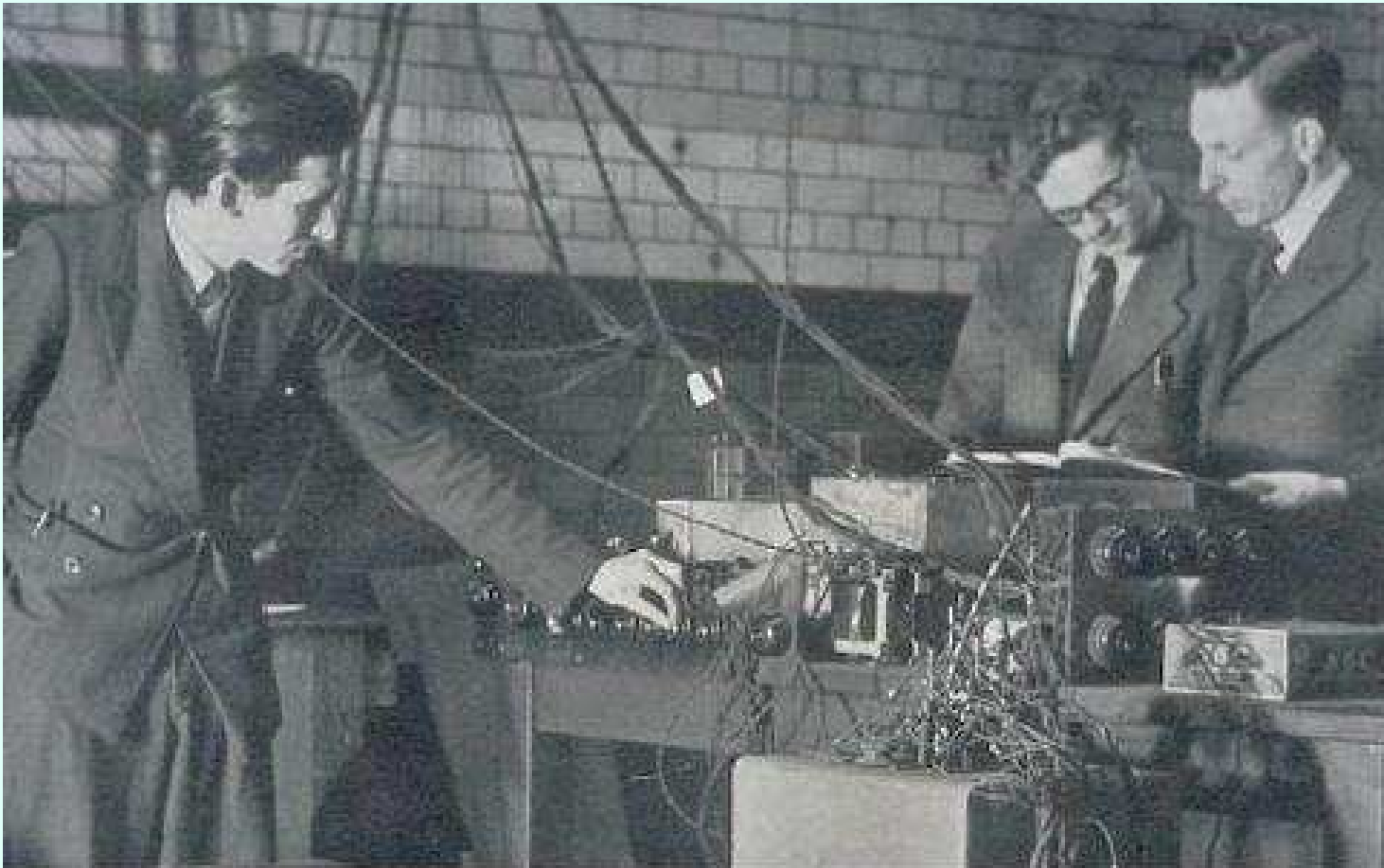


Sophisticated coincidence arrangements of Jánossy and Rochester

In order to study nuclear and electromagnetic interactions of energetic cosmic rays, rather complicated arrangements were constructed. Jánossy was among the first to study the penetrating showers and their connection with EAS.

The arrangement on the right served to study penetrating showers caused by neutral CR particles.





Jánossy, Broadbent and Rochester in Manchester, 1944, in their laboratory where most of their penetrating shower experiments were done.

Left: Lajos Jánossy with Eamon de Valera and Paul Dirac
Right: Jánossy with Max Born and Erwin Schrödinger.
Both pictures: at a summer school in Dublin, probably in 1945. Later, between 1947 and 1950 Jánossy was a „senior professor” in Dublin, before returning to Hungary in 1950.



Carl D. Anderson, discoverer of both the positron and the muon, was given opportunity after the war to make CR experiments aboard a B-29 „flying fortress”. Looking back, he wrote:



*„Had we forgotten the B-29, and spent a week in the nearby High Sierra arguing about CRs and physics, we might have done better. All the clues were present and published, one of the most important being the **experiments by Lajos Jánossy**, in which he used counter arrays separated by various thicknesses of lead chosen to select nuclear collisions of high energy.”*



**C.D. Anderson (1905 – 1991)
Nobel-díj: 1936.**

Jánossy and cosmic ray research in Hungary after the War

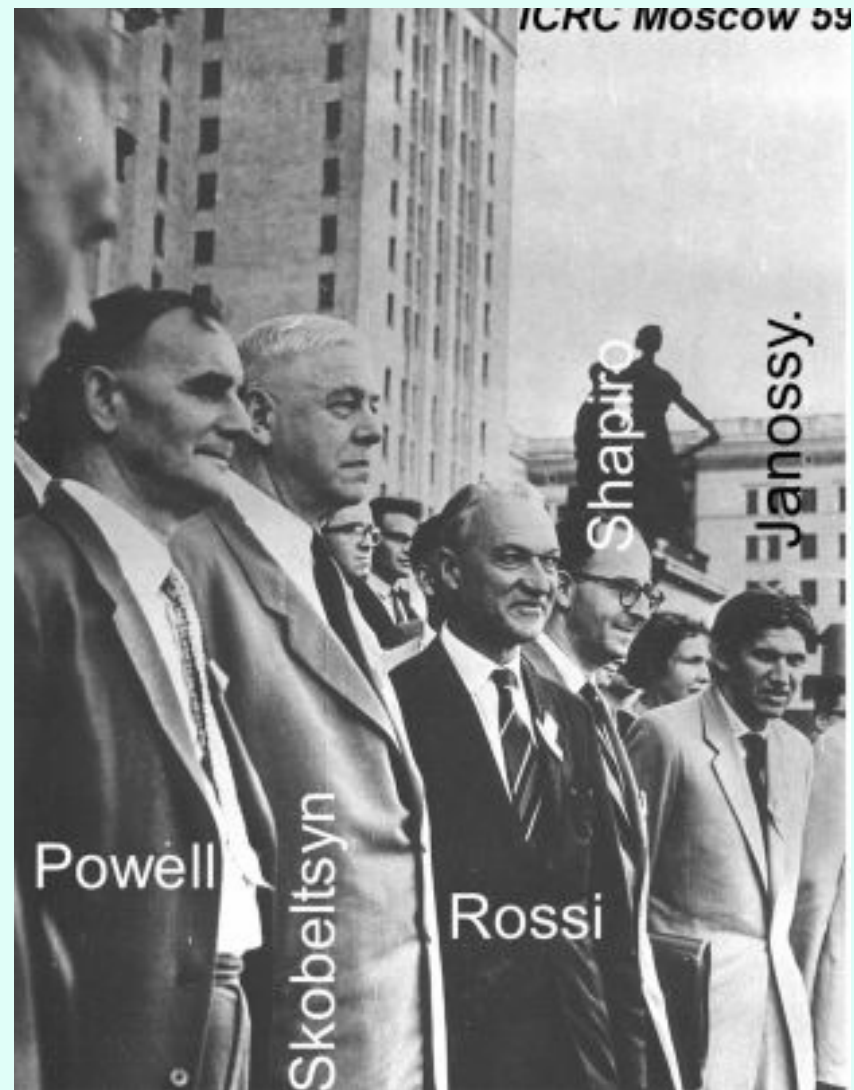
The CR department led by Jánossy was among the first two in the newly founded Central Research Institute for Physics. He later moved to other interests, but considered that CRs were ideal for training scientists both for HE and space physics.

The HE field was first led by **Ervin Fenyves**, then by D. Kiss and others, while the SH and Geo fields, and later space physics, were led by **Antal Somogyi**, who also became chair of the IUPAP Cosmic Ray Commission, and organized the 11th ICRC in Budapest. He was also one of the initiators of the ECRS series, and host to the 11th and 14th ECRS.

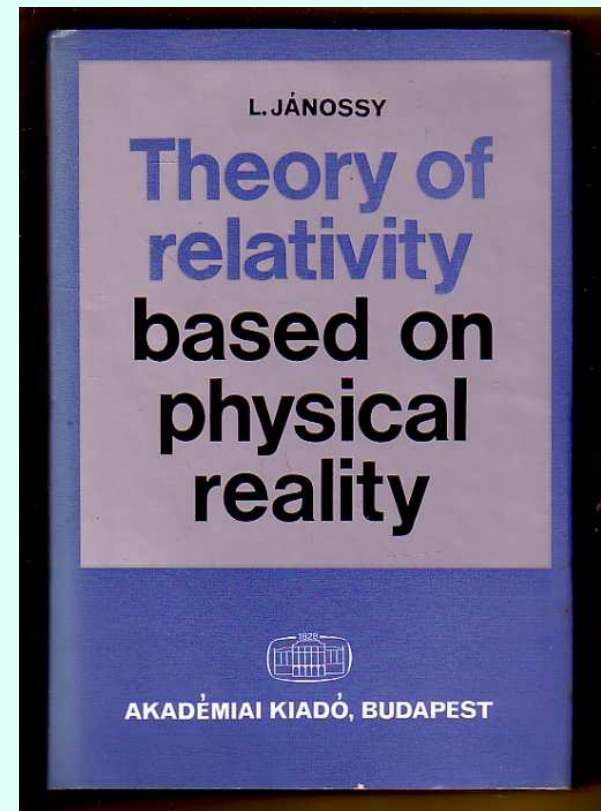
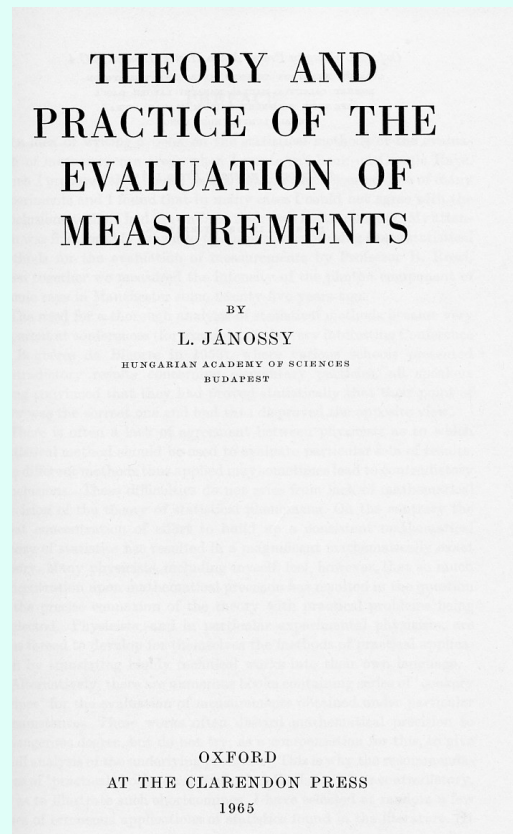
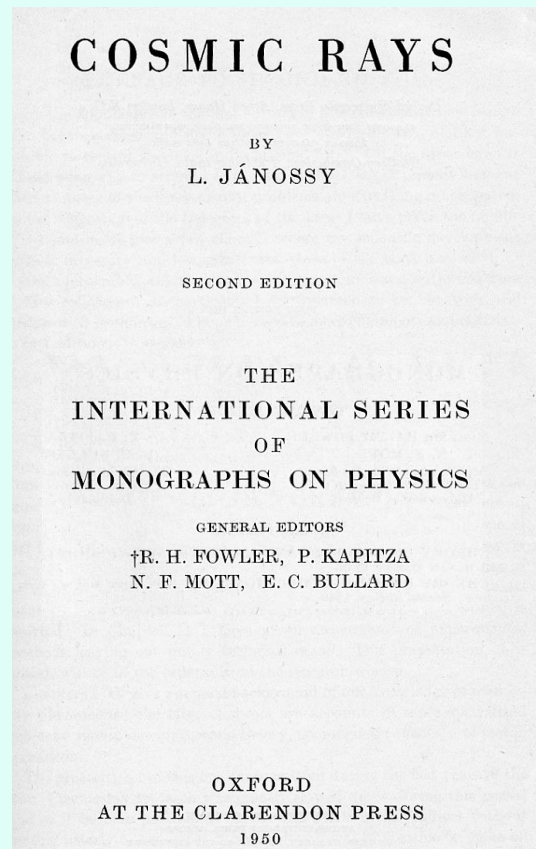
Jánossy with Ervin Fenyves in KFKI



Jánossy with other distinguished cosmic ray physicists in 1959, during the 6th ICRC in Moscow (borrowed from Maury Shapiro's photo album)



Some of the monographs of Lajos Jánossy





George Rochester and Jánossy in Northumberland, after the 65th birthday of Rochester

The END of this talk
about the past century.



Many more are to come about the
Present and the **Future**

