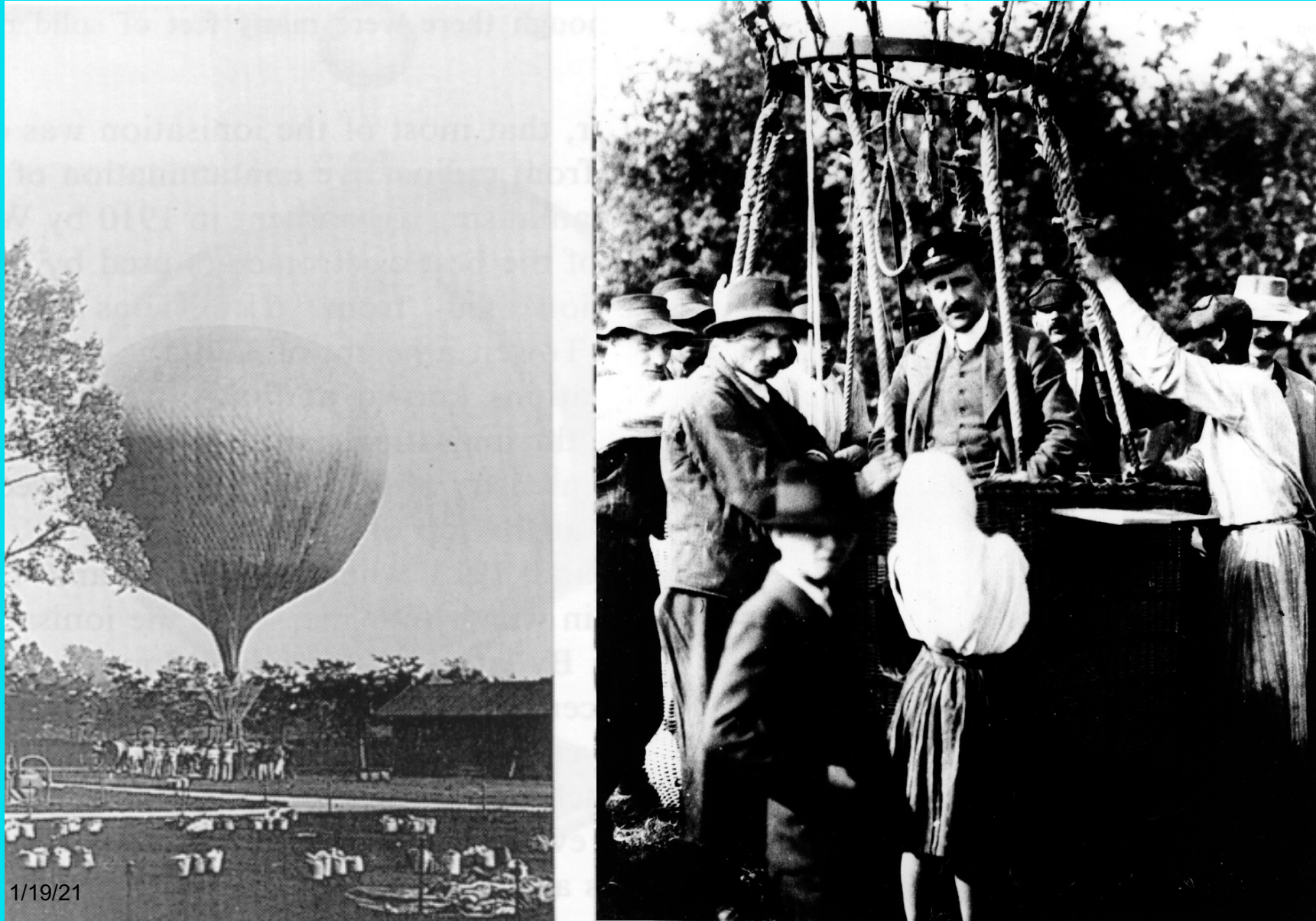


# Victor Hess in a hot air balloon

## 7 August, 1912

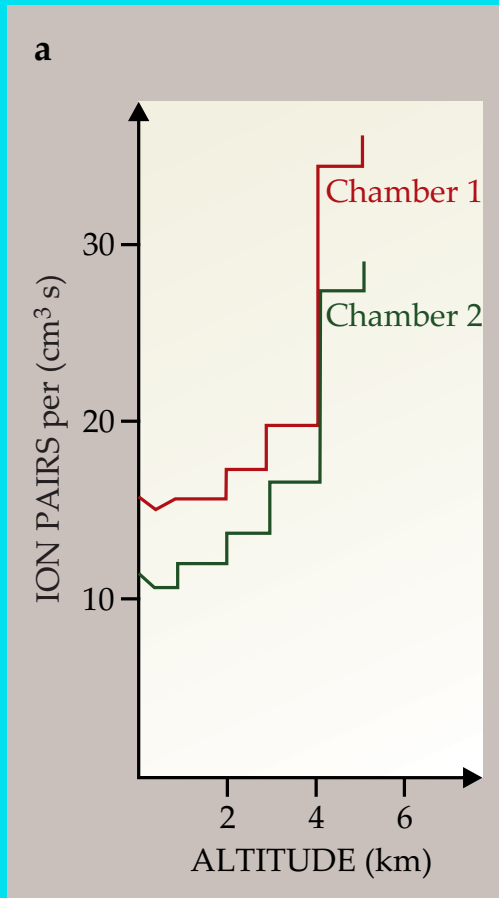


1/19/21

13

# Discovery of Höhenstrahlung

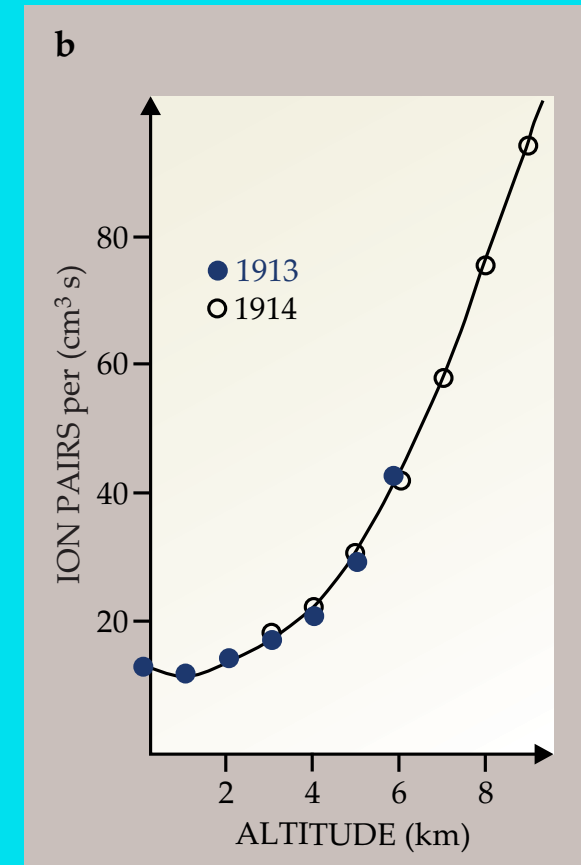
## radiation at heights, high altitude radiation



“The results of the present observations seem to be most readily explained by assuming that radiation of very high penetrating power enters the atmosphere from above and can still produce a part of the ionization observed in closed vessels at the lowest altitudes.”

V. Hess, 2012  
1/19/21

Electromagnetic radiation??



W. Kolhörster,  
2013 & 2014<sup>14</sup>



# Polyester and polyethylene balloons

Right after WWII

Otto Winzen, manufacturing in Minneapolis

Consultations with people at the Univ. of Minnesota of physics of heat transfer, balloon shapes, etc.

Winzen, now acting on his own, succeeded in obtaining contracts from the US Navy, one of which was “for the development of a plastic balloon designed to drop a research missile for the study of trans-sonic phenomena from an altitude of 30000 m” (Winzen, 1971). With the contracts in hand, he was able to interest again a manufacturing company in Minneapolis which let him set up an effective aeronautical research laboratory in 1946. This was the birth place of the plastic balloon, named after the U.S. Navy project ‘Skyhook’. The first balloon on this project, designed to carry about 32 kg to 30 km height, was successfully flown on September 25, 1947. Its construction was patented in 1950 (Winzen, 1950). This was the break-through to the immense and manifold use of plastic balloons up to sizes of 300000 m<sup>3</sup> which can carry potentially about 5000 kg to the altitude of 28000 m, or 1000 kg to 35000 m.

The open-necked, constant-level balloons are constructed of polyethylene films or

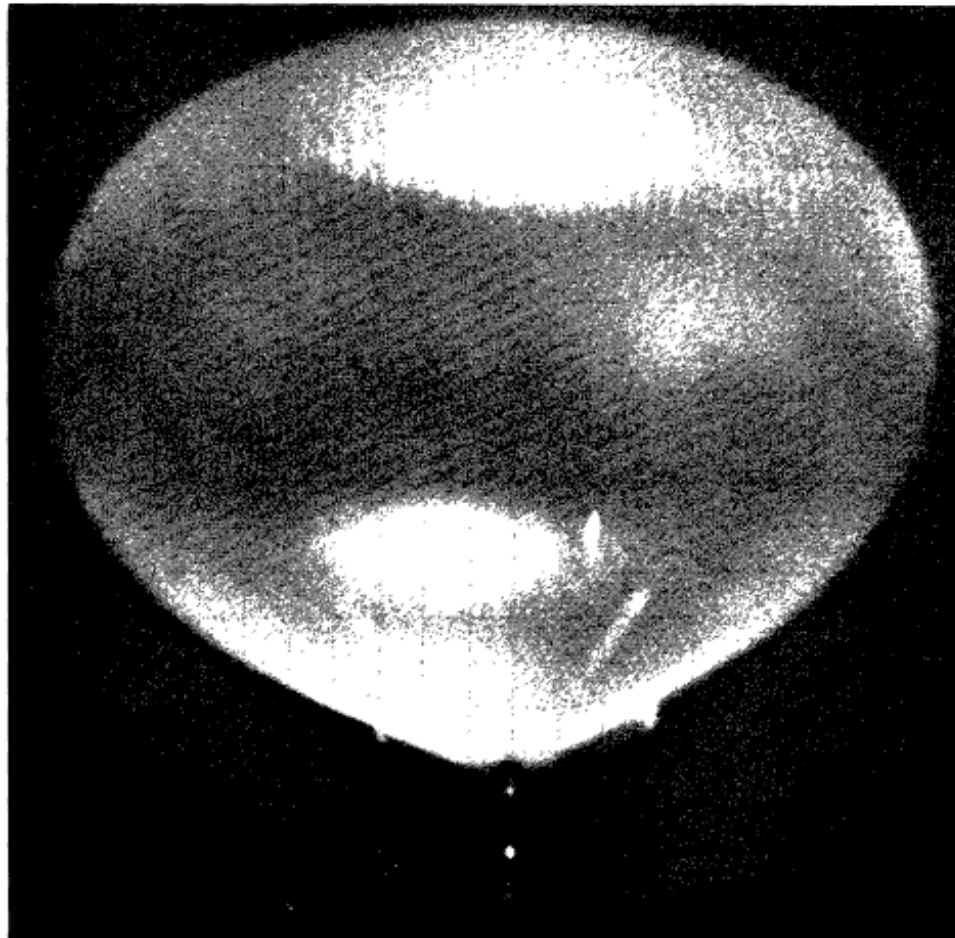


Fig. 29. Record breaking WRI low stress balloon or balloon with ‘natural shape’ at ceiling. The balloon had a volume of 0.83 million m<sup>3</sup> and was floating at an altitude close to 50 km, with a scientific payload of 150 kg. It was photographed through a large telescope (Winzen, 1970). Courtesy O. C. Winzen.

Photo, 1947, of a  
Winzen balloon at  
float 98,000 feet

Balloon volume 30  
million cubic feet

Photographed  
through a large  
telescope







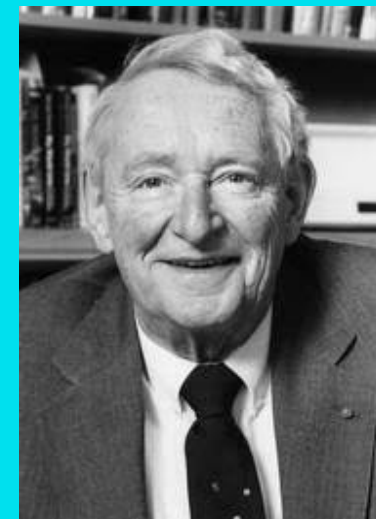
# I head for Graduate School

**Stanford University, '61**



Recession, no jobs  
Decide to go to graduate school

1/19/21



Ed Nye

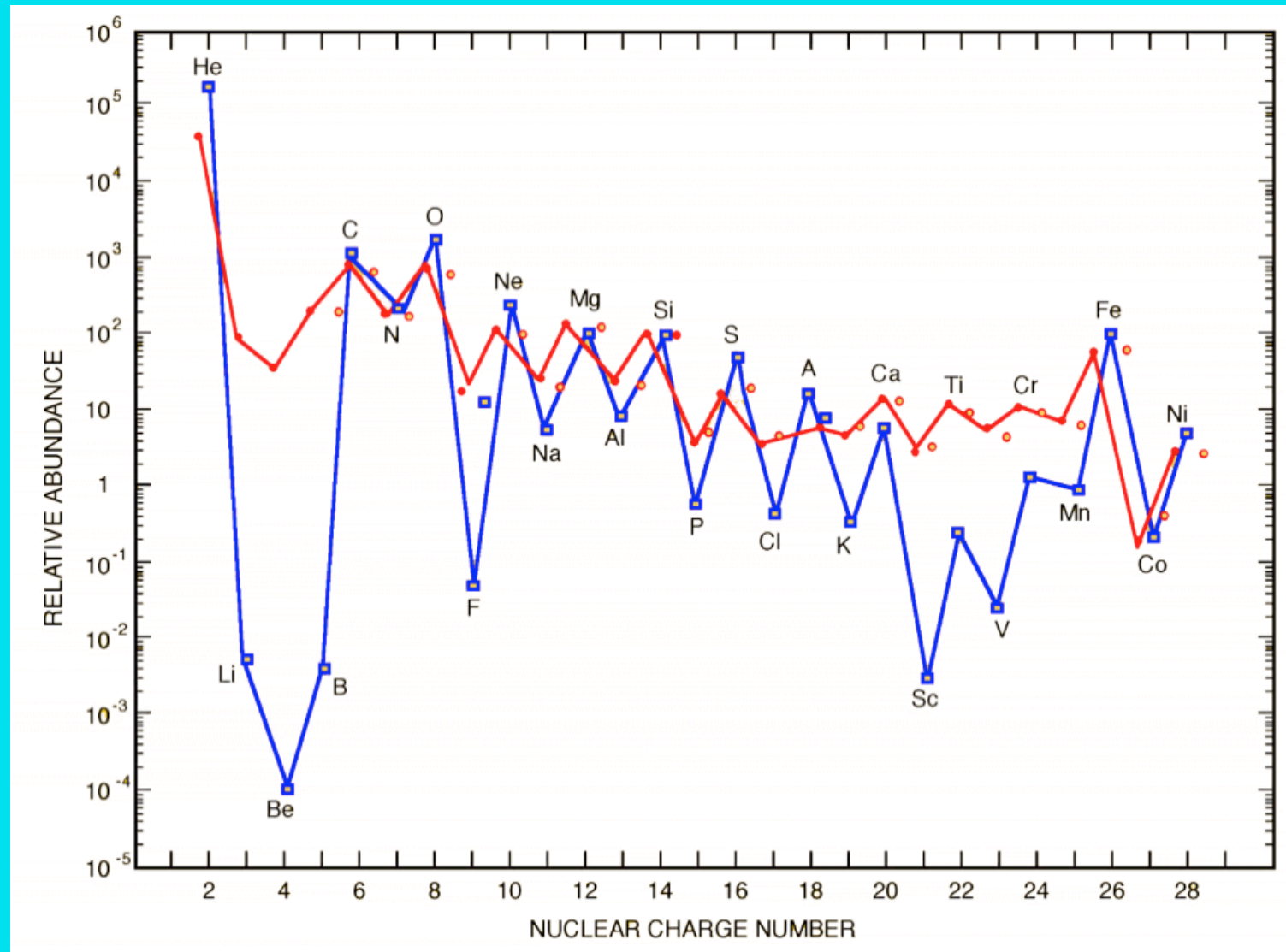
18

# Cosmic ray nuclear abundances

Freier, Ney, Oppenheimer: 1948, discovered heavy nuclei in cosmic rays

Cosmic  
Rays

Solar  
system  
material



# My Professor's plan

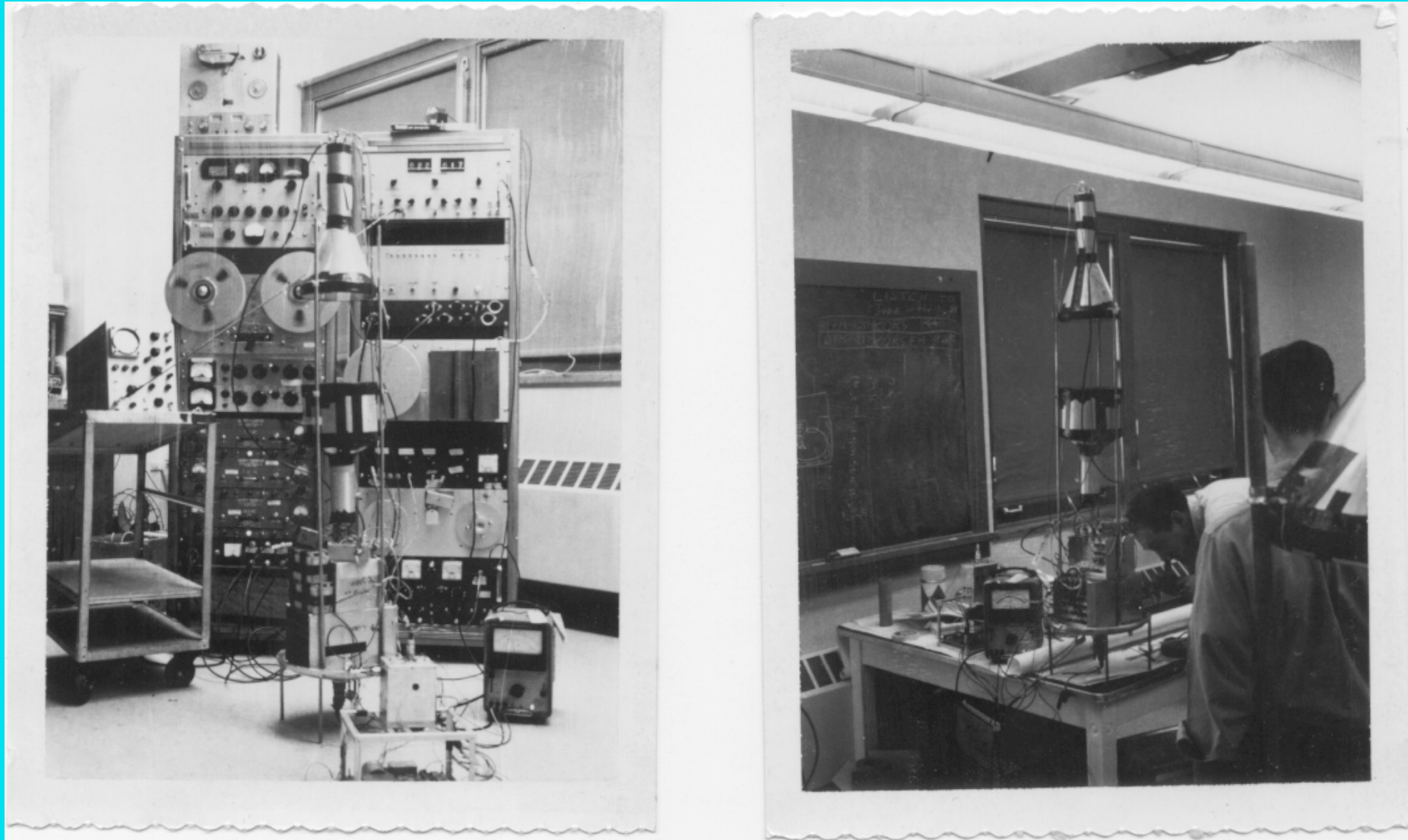
- Measure the cosmic ray composition and spectra as a function of latitude at high altitudes on balloons.
- Balloons developed in Minneapolis by people at the physics dept. and local companies, Winzen & Raven.
  - Polyethelene resin
  - Not affected by uv light
  - 0.0001 inches thick (half as thick as my thinnest hair)
- Small balloons were to be launched from Minneapolis, Devil's Lake, ND, Fayetteville, AK, and in Lake Country in northern MN, north of Hibbing
  - Latter payload was lost in a thunderstorm; never found.
- Project Skyhook flights from Ft. Churchill, Manitoba
- Then Tucuman, Argentina & Queensland, Australia

My plan: Join Cosmic Rays and See the World



# Dissertation hardware

## The two “goose” experiment



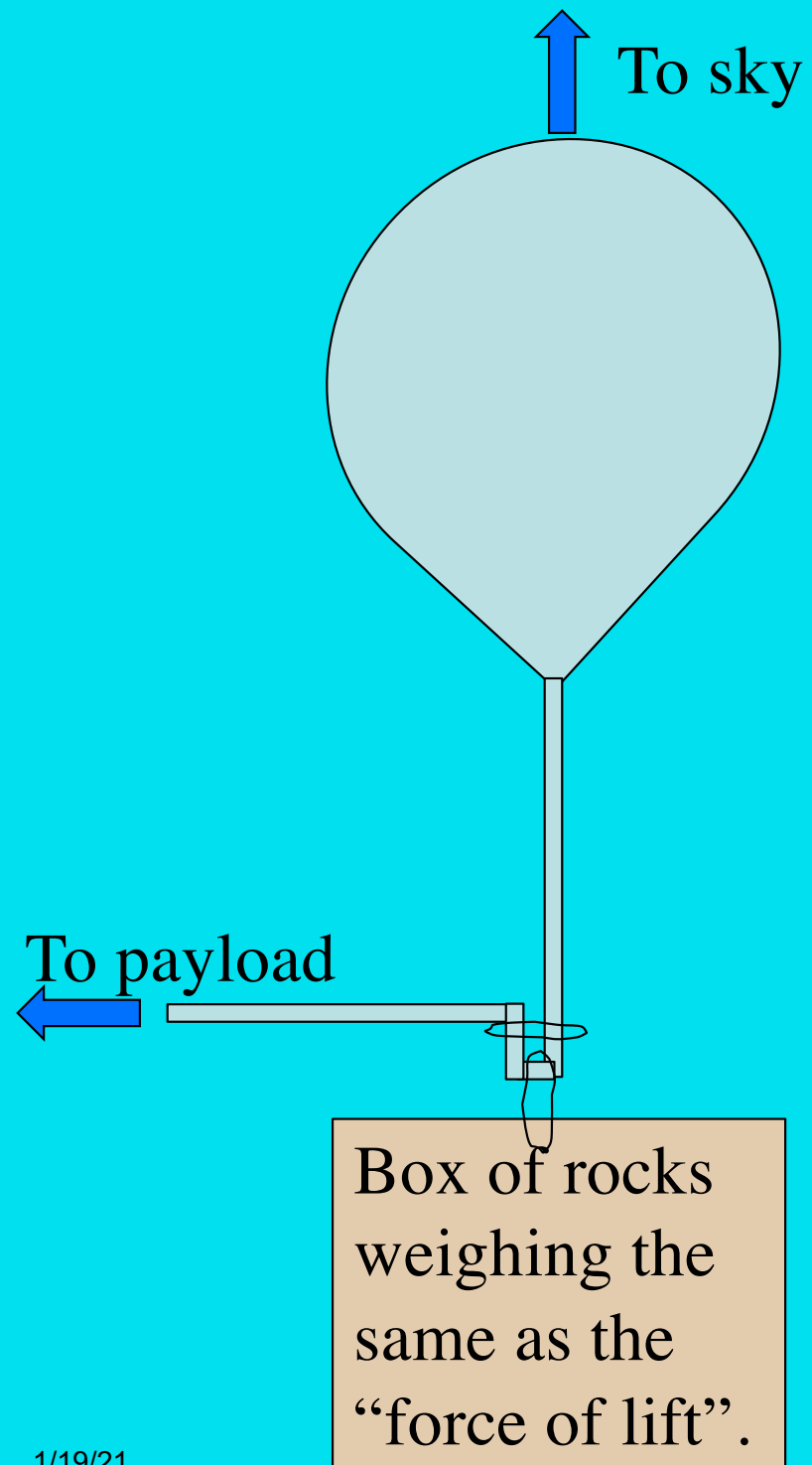


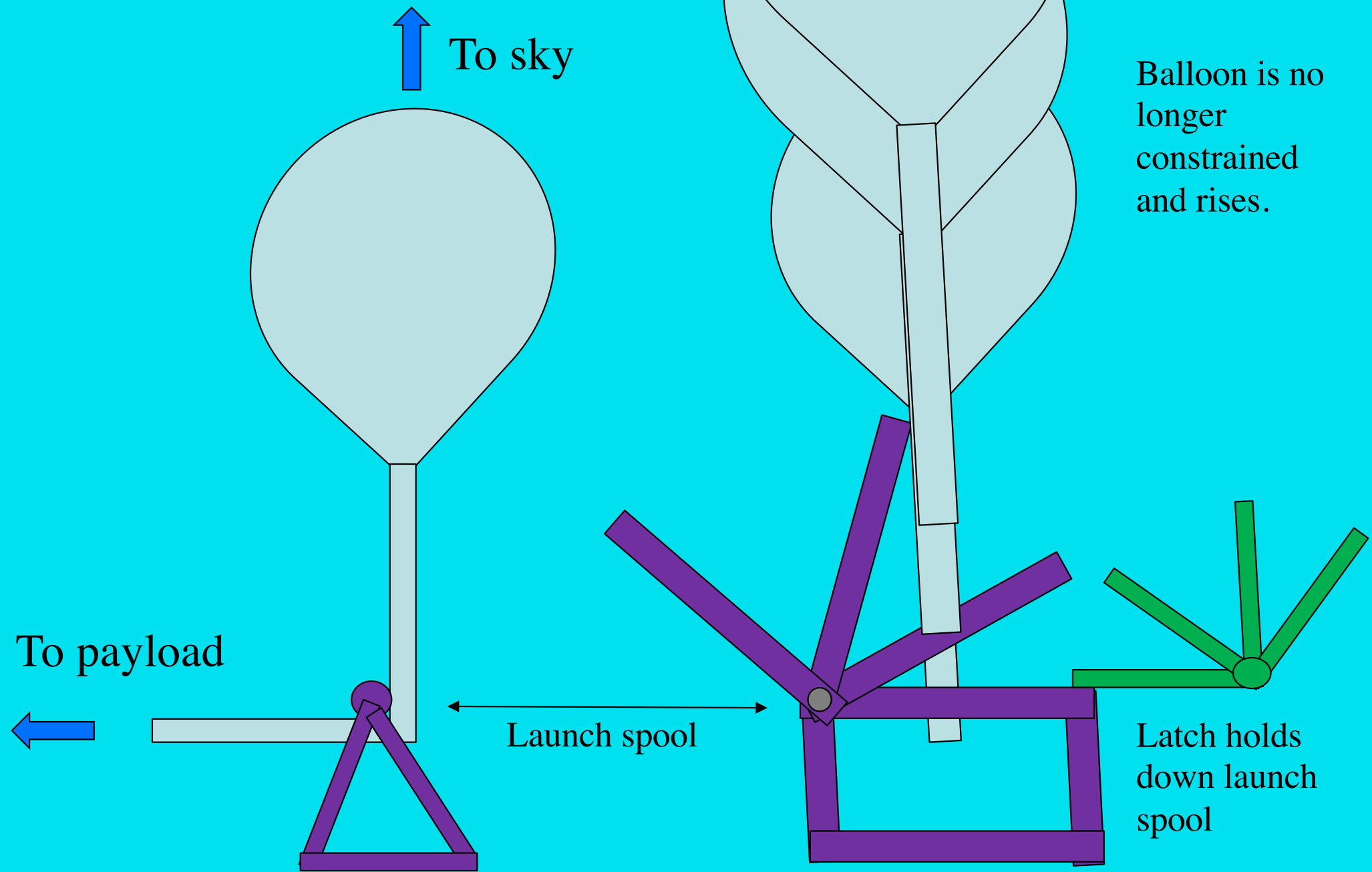


# Univ. of Minnesota balloons launched with small A-frame launcher

- Balloons 300,000-600,000 cubic ft in volume.
- Balloons went up to about 110-120,000 ft
  - 3x height of typical commercial airline flight
- Sometimes the balloon would stall
  - Entering the troposphere.
  - Carried iron ballast to drop, reducing the load and giving it a “push” upward.
  - Small beads of iron or lead
- Payloads of up to 1000 lbs of detector, electronics and batteries and ballast.
  - Balloons typically weight 3-4 times the payload
  - Depends on the altitude to be achieved.







A-frame launcher held down by sandbags

Helium, sometimes hydrogen, gas comes in pressurized cylinders.





# 300,000 ft<sup>3</sup> balloon



1/19/21



27





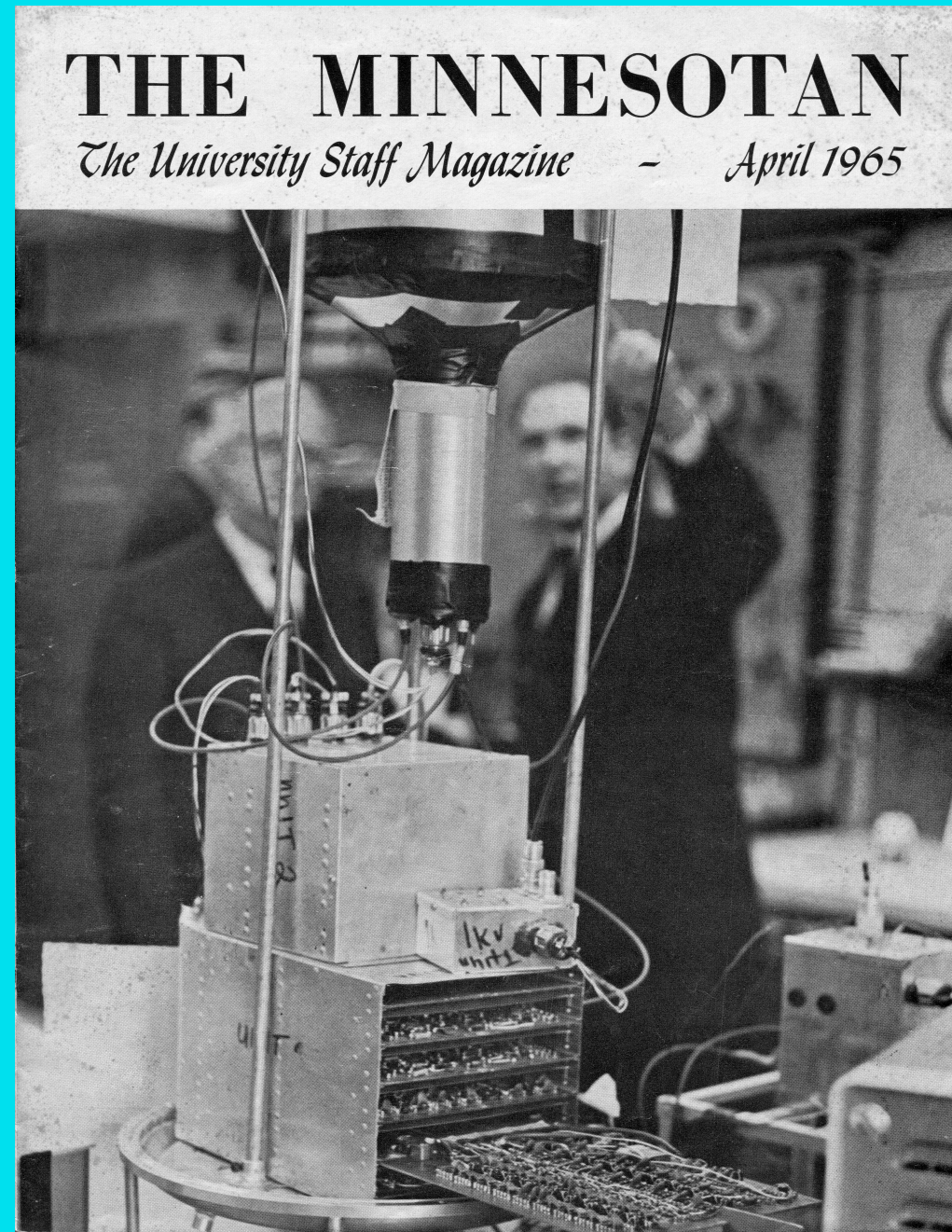
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28

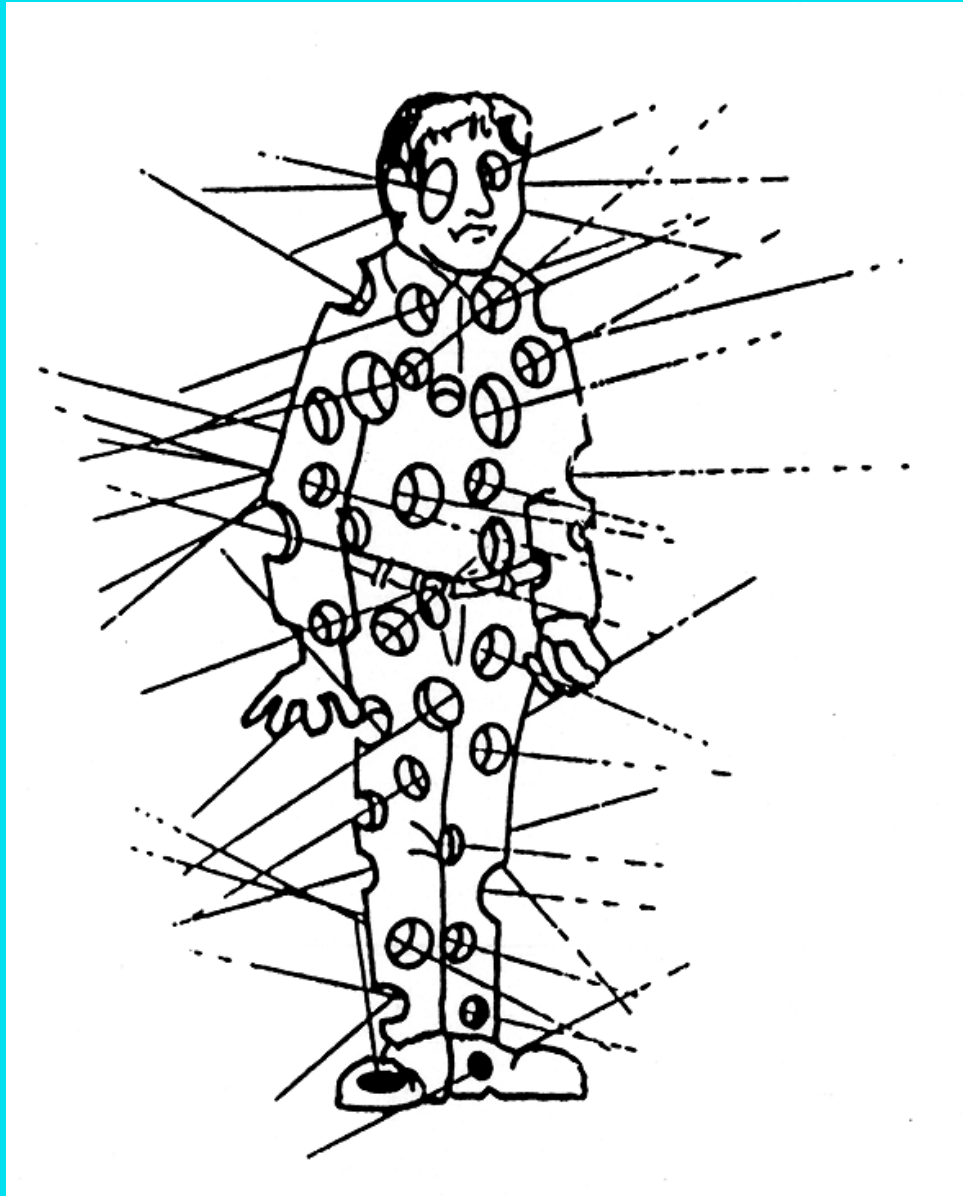


# Cover boy: the only cover I ever made





# Minnesota *Technolog* circa 1966



**About 100,000 cosmic ray muons will pass through you each hour.**

- **Fortunately, muons are “weakly interacting particles” and leave only an ion trail in their wake.**
- **They do not interact with your nuclei, leaving your basic chemistry unaffected.**
- **They do cause a background in CCD camera arrays!**