

# Farewell to Earth: Fast-forward to 1960

Peter Watson

Galileo leaves Earth: NASA



## Why 1960?

1. Systematic observations (needed writing, Babylon 1500 BC)
2. Model for the universe (needed observations, Ptolemy 100 AD)
3. Collecting light (needed clear glass, telescope, Galileo, 1605)
4. Fundamental Physics (needed calculus, Newton, 1666)
5. Saving light (needed chemistry, photography, Daguerre 1850)
6. Synthesizing the ideas (needed computers, 1945)
7. Extending the spectrum (needed radar: Jansky radio-telescopes, 1955)
8. Escaping the atmosphere (needed satellites, 1956)

Need to look at last two in detail

7. Escaping the atmosphere
8. Extending the spectrum

So who wrote the first story about space-travel?

- H. G. Wells?
- Jules Verne?
- Well ...

Lucian of Samosta:

True History" (200 AD)

Voyage to Moon and Sun via waterspout and encounters with aliens



"If I succeed," says he, "in the war which I am now engaged in against the inhabitants of the sun...."

Our allies from the north were three thousand Psyllotoxotæ ...the former take their names from the fleas which they ride upon, every flea being as big as twelve elephants.

That spot, he told us, which now looked like a moon to us, was the earth.

## Earthrise from Apollo 8



## Cyrano de Bergerac:

- 1619-1655: French writer, (with a big nose!) around whose name a number of unhistorical legends accumulated..
- "États et Empires de la Lune" (1657)
- "Histoire comique des états du Soleil" (1662)
- (yes, published posthumously).



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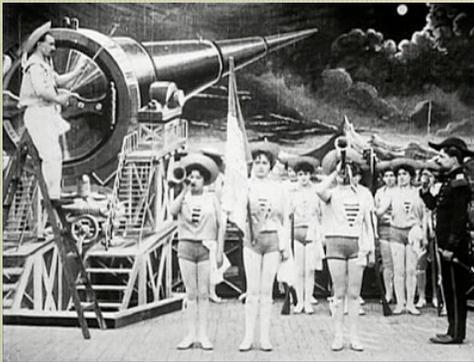
- Rostand's play made Cyrano's name famous, but aggravated the errors committed by the romantics by emphasizing only the more extravagant aspects of his life and work....

- Like Macbeth and Richard 111, he was more famous for being fictional than real....

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## Jules Verne

- Voyage to the Moon
- 1860



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## Hale: The Brick Moon

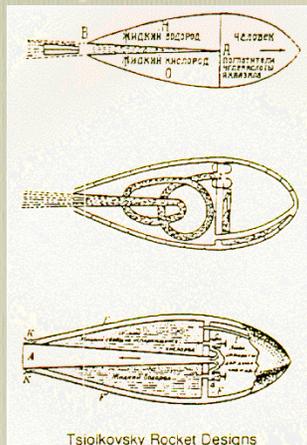
- 1899 Note
- Fundraising a major part of the story
- Brick coating to avoid burn-up in atmosphere
- Intended to help navigation by making it easier to measure longitude: predecessor of GPS!



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## Tsiolkovsky

- ~1920
- Beyond the Planet Earth (Rockets)



Tsiolkovsky Rocket Designs

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## Goddard

First Liquid Fueled Rocket



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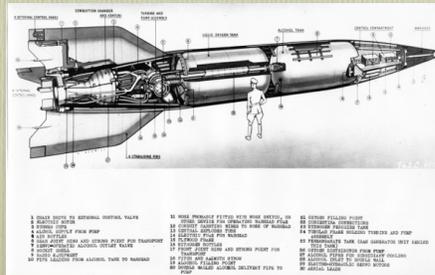
# New York Times A Severe Strain on Credulity ( 13 January, 1920)

As a method of sending a missile to the higher, and even highest, part of the earth's atmospheric envelope, Professor Goddard's multiple-charge rocket is a practicable, and therefore promising device. Such a rocket, too, might carry self-recording instruments, to be released at the limit of its flight, and conceivable parachutes would bring them safely to the ground. ..

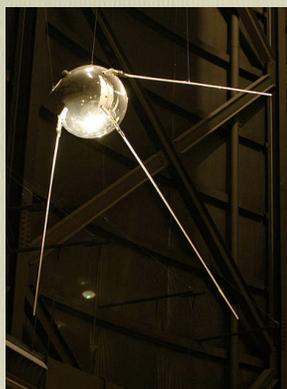
But that is a slight inconvenience, .... It is when one considers the multiple- charge rocket as a traveler to the moon that one begins to doubt and looks again, to see if the dispatch announcing the professor's purposes and hopes says that he is working under the auspices of the Smithsonian Institution. ... Still, to be filled with uneasy wonder and express it will be safe enough, for **after the rocket quits our air and and really starts on its longer journey, its flight would be neither accelerated nor maintained by the explosion of the charges it then might have left**

That Professor Goddard, with his "chair" in Clark College and the countenancing of the Smithsonian Institution, does not know the relation of action to reaction, and of the need to have something better than a vacuum against which to react--to say that would be absurd. **Of course he only seems to lack the knowledge ladled out daily in high schools.**

- Wernher Von Braun 1944
- V2 rocket reaches space



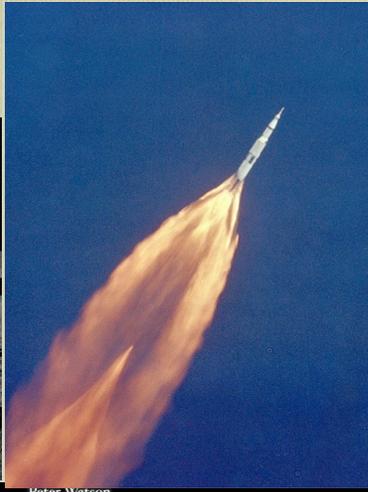
- **First artificial satellite: Sputnik 1 ("Спутник-1")**
- 4 October 1957.



# Sputnik 1

- Mostly transmitted pre-recorded signal
- However did measure electron density & temp.

- Neil Armstrong/Buzz Aldrin 1969
- Apollo 11



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## "A Correction" July 17, 1969 the New York Times

"Further investigation and experimentation have confirmed the findings of Isaac Newton in the 17th century and it is now definitely established that a rocket can function in a vacuum as well as in an atmosphere. The Times regrets the error."

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## Electromagnetic Spectrum



99.99999% of our information about the universe comes as EM radiation

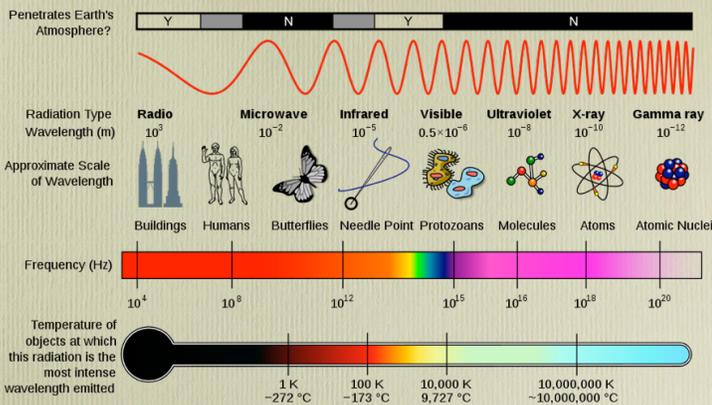
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Visible light is "seen"



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- We "see" only one octave.
- Compare to sound, we hear (well, some of us!) 10 octaves (20Hz to 20000 Hz: middle C is at 252 Hz.)

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## We can use all the wavelengths but we have to be clever!

- Radio at Sea-level
- Large dishes, many hooked together



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## Infra-Red:



- All except shortest absorbed by atmosphere
- mountain top, since H<sub>2</sub>O is worst offender
- this is Canada-France Hawaii telescope on Mauna Kea



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## Visible

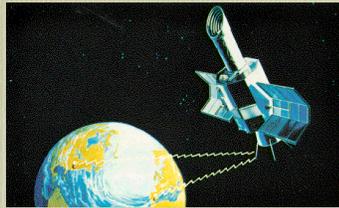


- Eye, photographic film blocked by Clouds
- Sea level, but high, dry observatories are better (to avoid twinkle)
- use laser to drive adaptive optics



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## Ultra-Violet



- satellites or mountain top observatories
- produced by very hot stars, hot gas

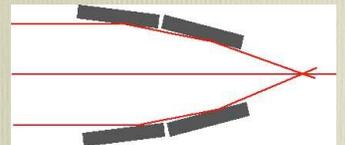


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## X-rays



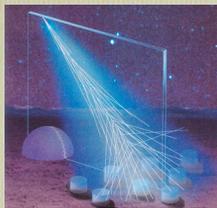
- must get above atmosphere
- can't reflect or focus X-rays
- XMM satellite



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## gamma-rays

- Satellites or use the atmosphere
- Pierre Auger observatory (Argentina)



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and above all, the Hubble which sees in the UV and IR and is above everything!



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- How much better is Hubble?
- Not quite fair, but this shows two pictures of the same region of the sky
- M16 aka the Eagle nebula: large star forming region



## 1980's Anglo-Australian Telescope



- still on film
- red is hydrogen gas, heated up by young stars



## 1995 Hubble “Pillars of Creation”



## Acknowledgements

- Astronomy Picture of the Day (APOD)
- NASA
- ESA
- Dick Hallion
- Next talk: On to the planets

