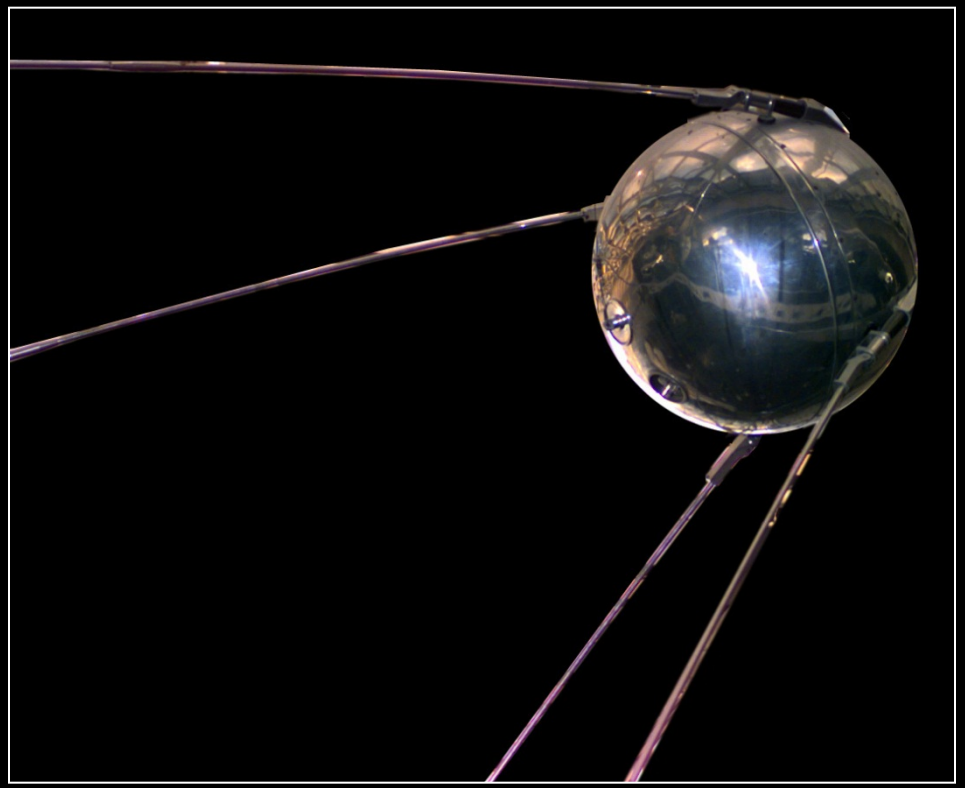
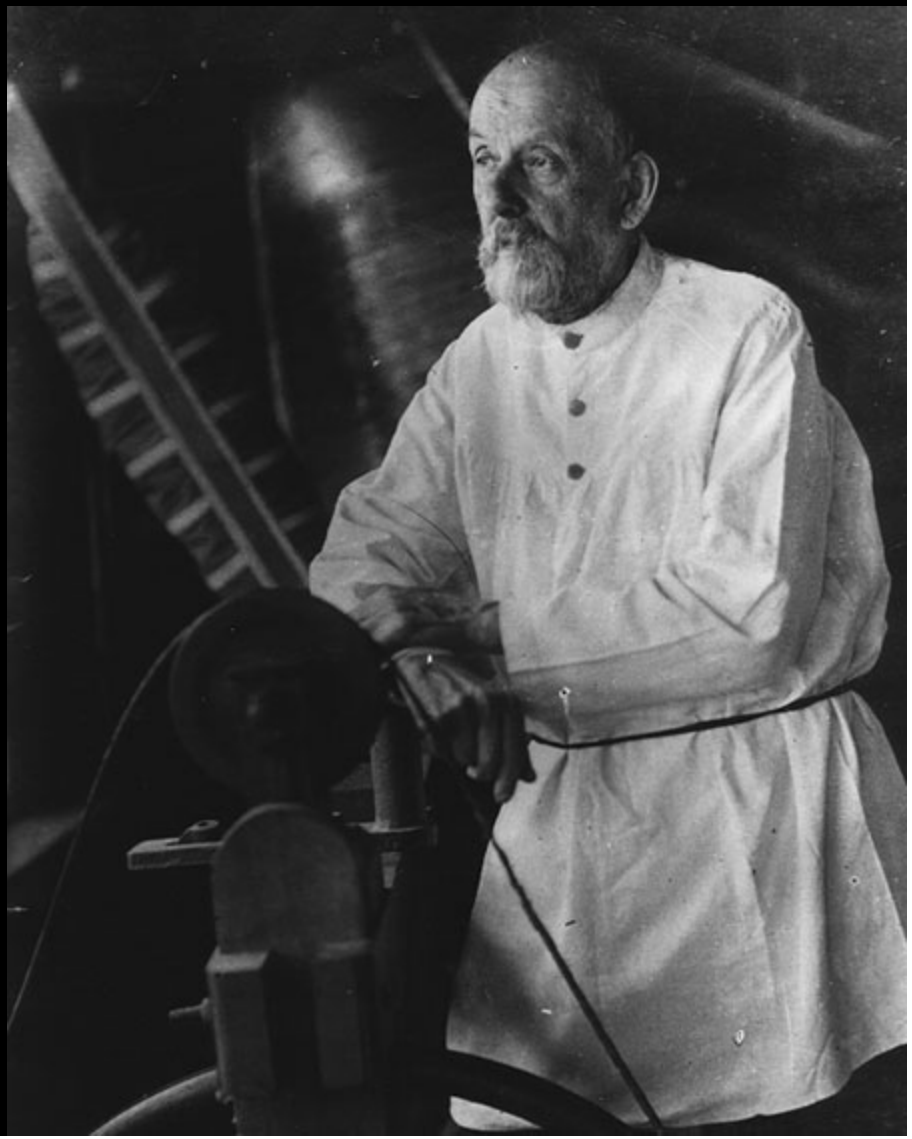
The Soviet and Russian Space Program

You may think it started with *Sputnik 1* in 1957…



…but it really started much earlier, with Konstantin Tsiolkovsky.



Konstantin Tsiolkovsky (1857 - 1935):

"A planet is the cradle of the mind, but one cannot stay in the cradle forever."

The rocket equation showed that rockets can travel in empty space:

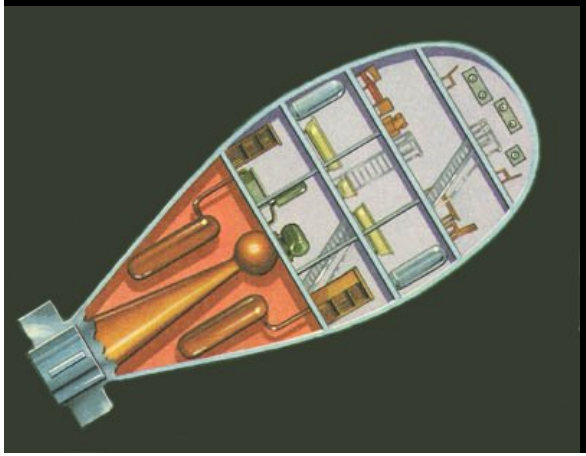
$$\Delta v = v_{exhaust} \ln(m_{initial}/m_{final})$$

Tsilkovsky published it in 1903.

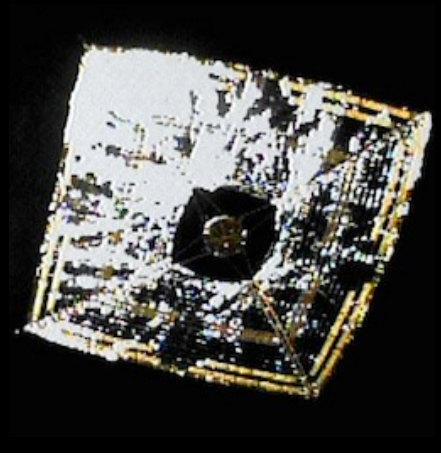
Liquid hydrogen is the most powerful chemical fuel, per weight.

Rotating, wheel-shaped ("O' Neill") colonies

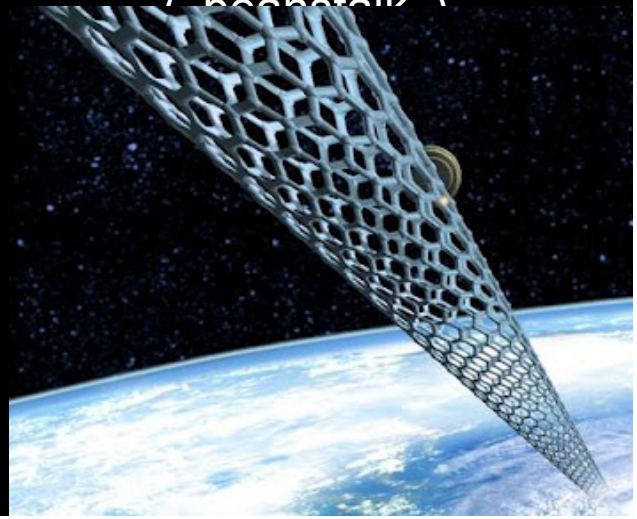
Human (formerly "manned") spacecraft



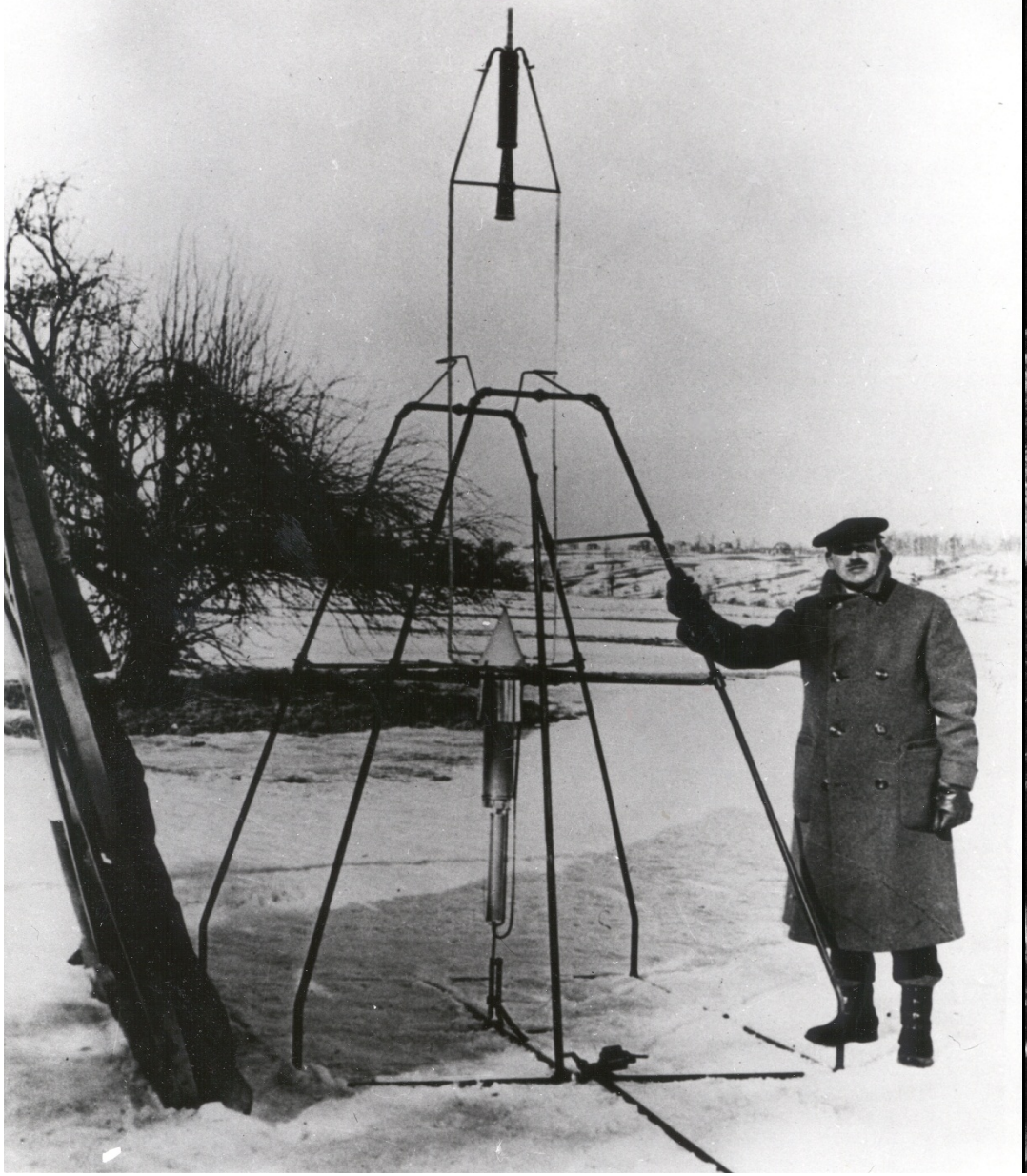
Solar sail (with Friedrich Tsander)



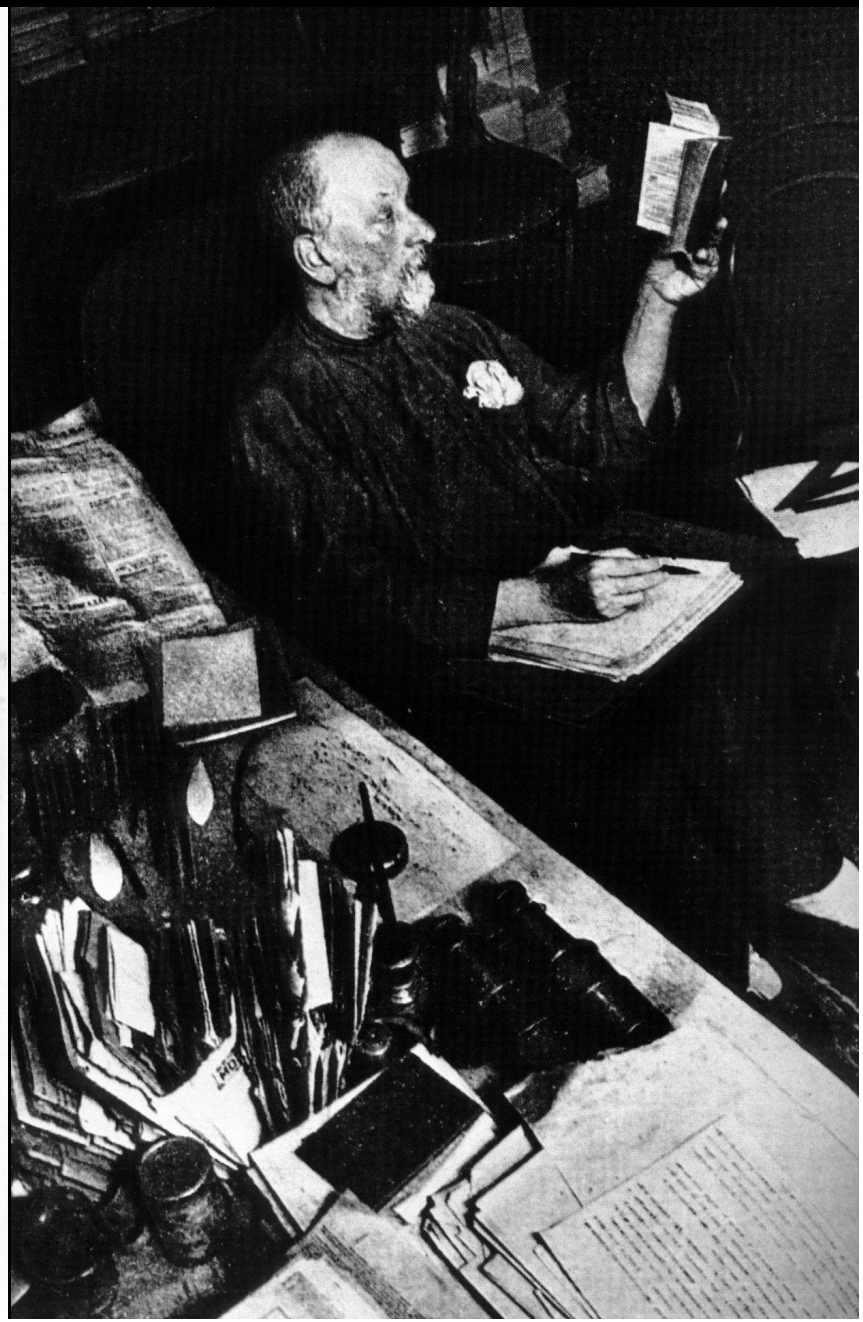
Space elevator ("beanstalk")



In the U.S., rocket pioneer Robert Goddard (shown in 1926) was derided as a crank…



…whereas Tsiolkovsky died a Hero of the Soviet Union, in 1935.



The Cold War between East and West,
primarily Soviet Union (U.S.S.R., including Russia) versus the U.S.,
1945-1989

Nuclear fission
"atomic" bomb:
U.S. 1945
U.S.S.R. 1948

Nuclear fusion
"hydrogen" bomb,
1000 times more powerful:
U.S. 1952
U.S.S.R. 1954

Intercontinental
ballistic missiles
(I.C.B.M.s)

U.S.S.R. R-7 1957
U.S. Atlas 1959

Sergei Korolev (1906-1966) was "The Chief Designer" of the Soviet Union.

Achievements:

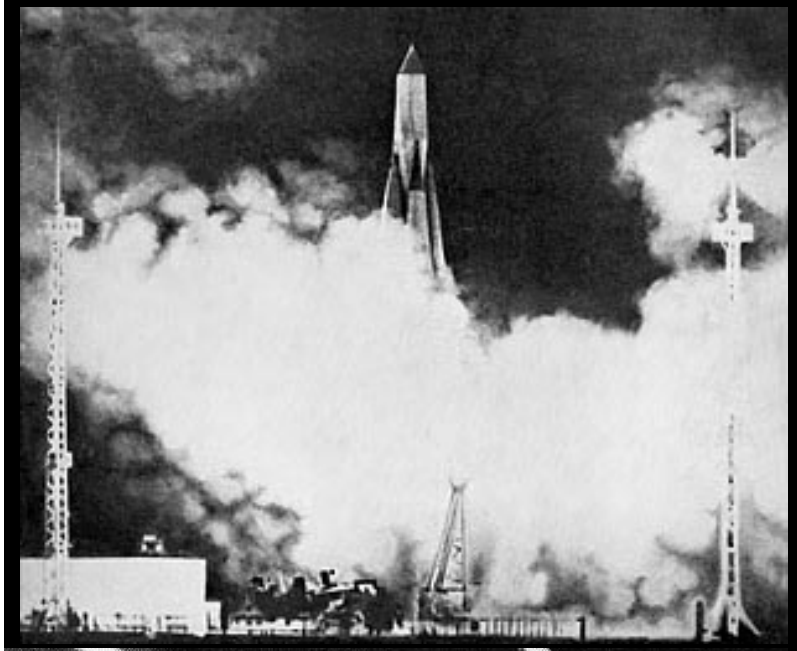
- R-7 rocket
- Sputnik satellite
- Vostok one-person spacecraft
- Voshkod three-person spacecraft
- Soyuz spacecraft,
intended as a Moon ship

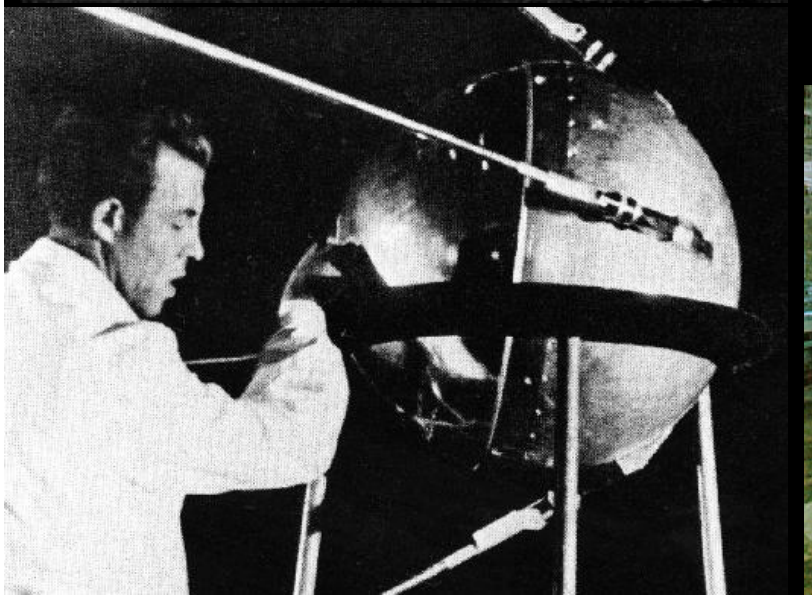
Young pilot

Purged, 1938-1945

Soviet Premier Nikita Khrushchev
kept up the pressure.

Sputnik 1 was launched on October 4, 1957,
from the Baikonur Cosmodrome in Kazakhstan.





It was the first Earth-orbiting artificial satellite.

It weighed 184 pounds, and had a radio transmitter that went “beep-beep” that any amateur “ham” radio operator could receive.

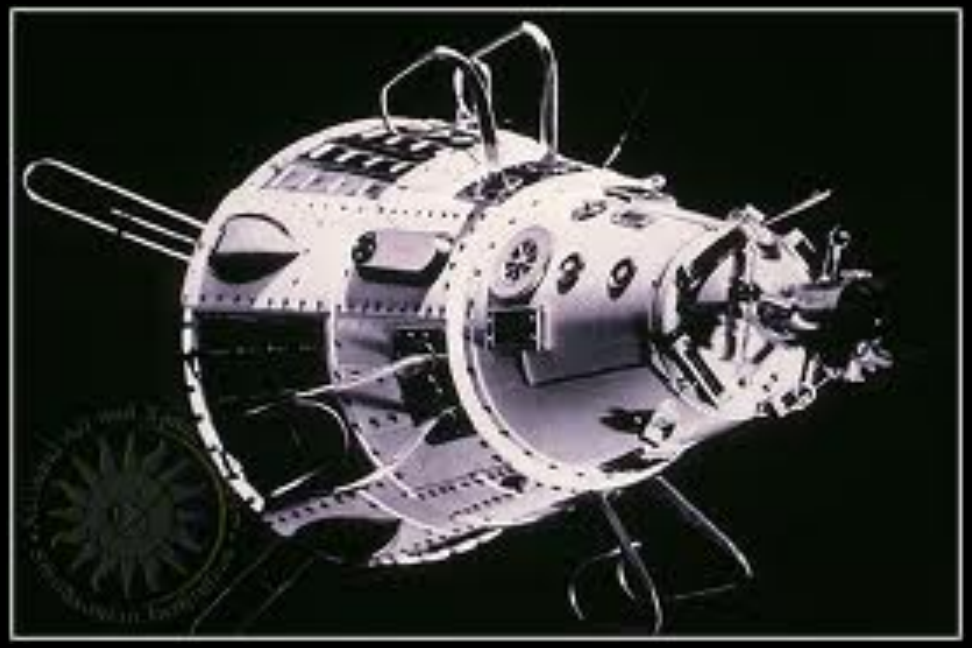
It was also a complete surprise to the West.

R-7 “Semyorka” booster

Sputnik 2 was launched on November 3, 1957.

It weighed over 1000 pounds, and carried a live dog, "Laika."

It was sophisticated enough to carry cameras,
and large enough to carry a nuclear bomb.



Sputnik 1 and *2* established a pattern: Soviets often did things twice, before the U.S. did. (The illustration is from *Pale Blue Dot*, by Carl Sagan.)

SPACECRAFT EXPLORATION OF THE SOLAR SYSTEM

NOTABLE EARLY ACHIEVEMENTS

1950 1960

SOVIET UNION/RUSSIA

1957 First **artificial satellite of the Earth** (*Sputnik 1*)

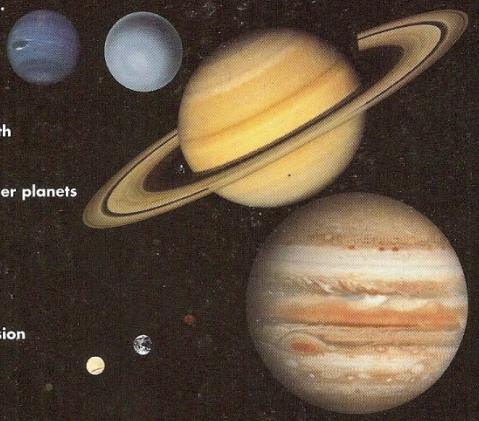
1957 First **animal in space** (*Sputnik 2*)

1959 First **spacecraft to escape the Earth's gravity** (*Luna 1*)

1959 First **artificial planet of the Sun** (*Luna 1*)

1959 First **spacecraft to impact another world** (*Luna 2* to the Moon)

1959 First **view of the far side of the moon** (*Luna 3*)



1961 First **human in space** (*Vostok 1*)

1961 First **human to orbit the Earth** (*Vostok 1*)

1961 First **spacecraft to fly by other planets** (*Venera 1* to Venus;
1962 *Mars 1* to Mars)

1963 First **woman in space** (*Vostok 6*)

1964 First **multiperson space mission** (*Voskhod 1*)

1965 First **space "walk"** (*Voskhod 2*)

1966 First **spacecraft to enter the atmosphere of another planet** (*Venera 3* to Venus)

1966 First **spacecraft to orbit another world** (*Luna 10* to the Moon)

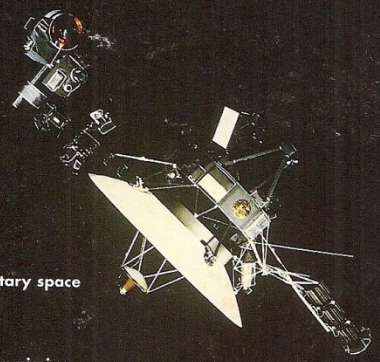
1966 First **successful soft landing on another world** (*Luna 9* to the Moon)

1950 1960 1970

UNITED STATES

1958 First **scientific discovery in space —Van Allen radiation belt** (*Explorer 1*)

1959 First **television images of the Earth from space** (*Explorer 6*)



1962 First **scientific discovery in interplanetary space —direct observation of the solar wind** (*Mariner 2*)

1962 First **scientifically successful planetary mission** (*Mariner 2* to Venus)

1962 First **astronomical observatory in space** (*OSO-1*)

1968 First **manned orbit of another world** (*Apollo 8* to the Moon)

1969 First **landing of humans on another world** (*Apollo 11* to the Moon)

1969 First **samples returned to Earth from another world** (*Apollo 11* to the Moon)

1971 First **manned roving vehicle on another world** (*Apollo 15* to the Moon)

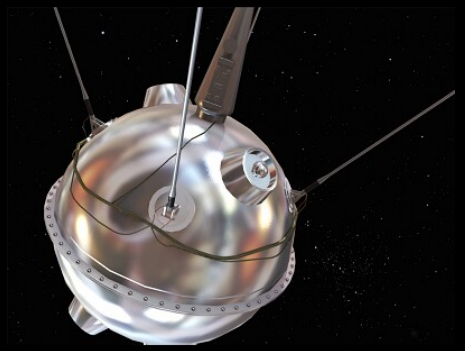
1971 First **spacecraft to orbit another planet** (*Mariner 9* to Mars)

1974 First **dual-planet mission** (*Mariner 10* to Venus and Mercury)

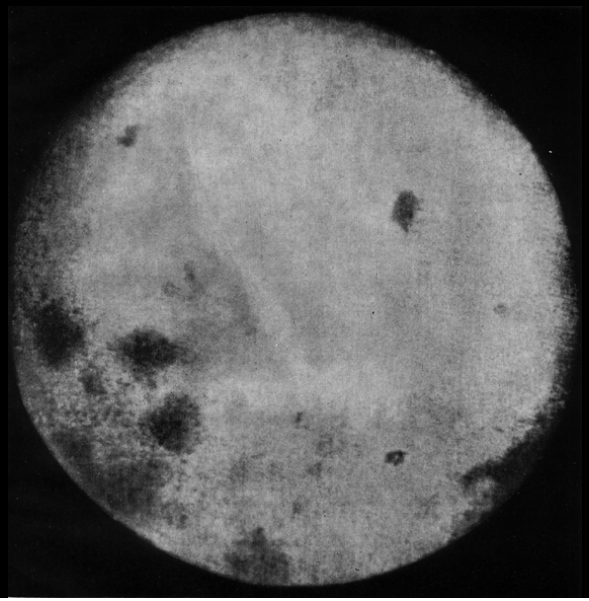
1976 First **successful Mars landing; first spacecraft to search for life on another planet** (*Viking 1*)

1959: The Soviet *Luna 1* robot was first flyby of the Moon, and the first spacecraft to escape Earth's gravity and go into orbit the Sun.

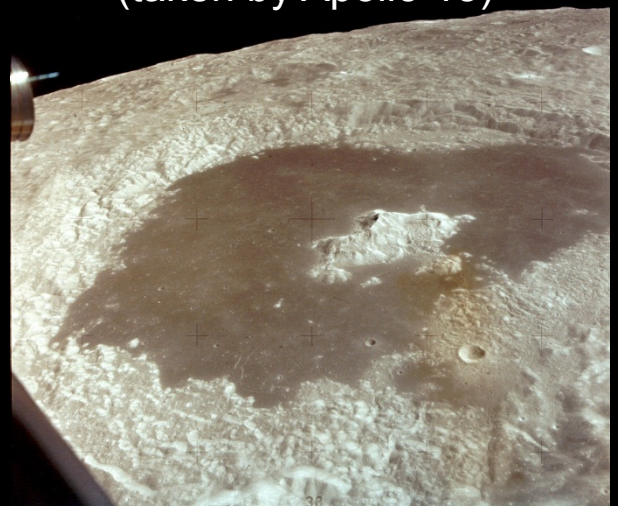
The Soviet *Luna 2* robot was the first spacecraft to make an impact on another world.



The Soviet *Luna 3* robot took the first photos of the far side of the Moon.



Tsiolkovsky crater (taken by Apollo 15)

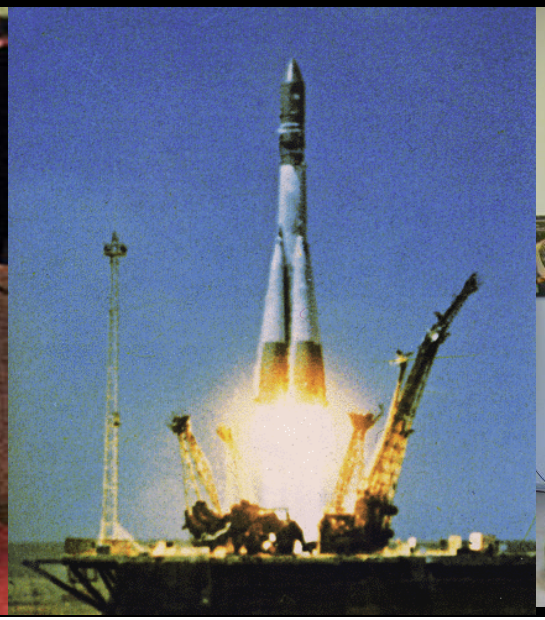


1960:
The Nedelin disaster

was the worst accident in the history of rocketry, with 126 killed at Baikonur.

It was kept secret by the Soviets, until after the end of the Cold War.

April 12, 1961: Yuri Gagarin became the first human in space, or "cosmonaut" (U.S. "astronaut," China "taikonaut"), in *Vostok 1*.

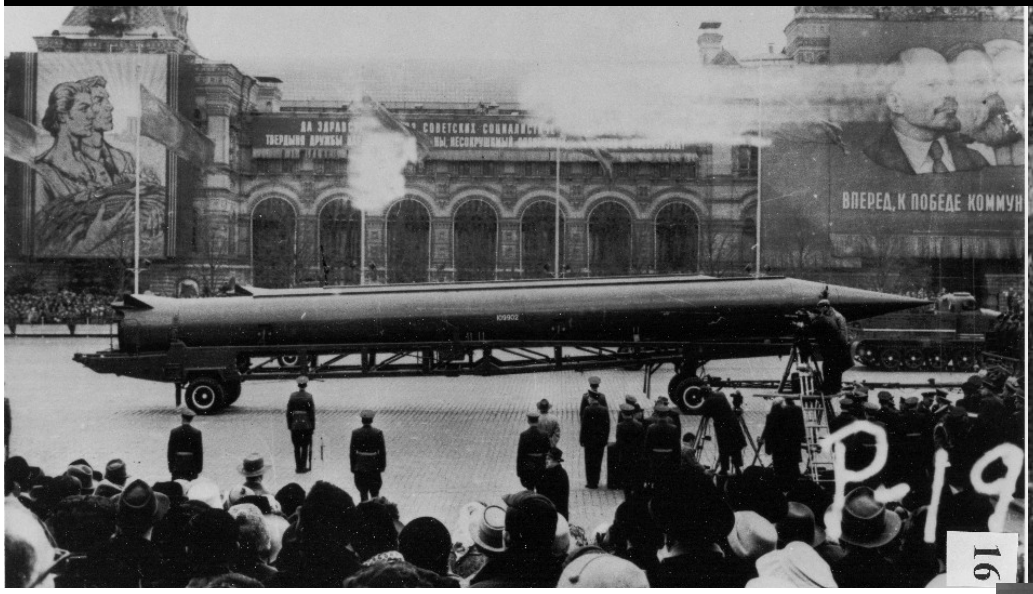


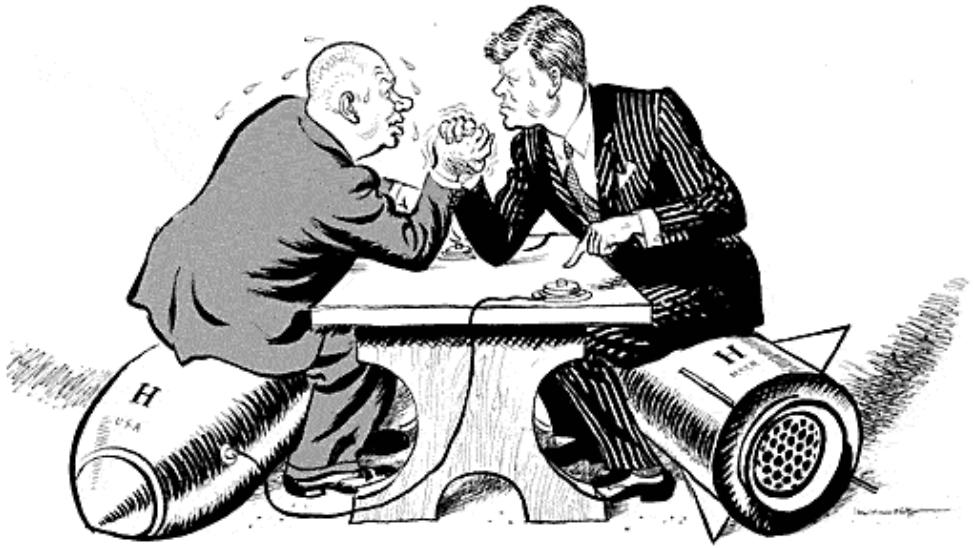
May 5, 1961: Alan Shepard became the first American in space, without orbiting.

Gagarin said: "We sent a few dogs up and down, just like Alan Shepard."

May 25: U. S. President John F. Kennedy announced that America should "land a man on the Moon, and return him safely to the Earth" by the end of the 1960s.

October 1962: the Cuban missile crisis

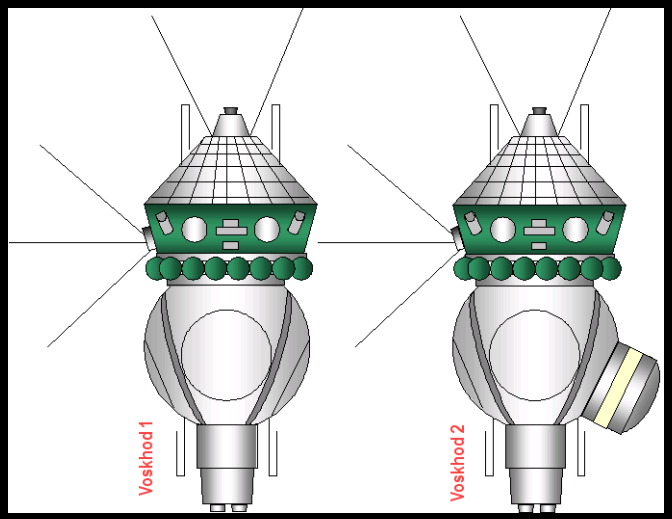




1963-1965: a bumper crop of Soviet space heroes

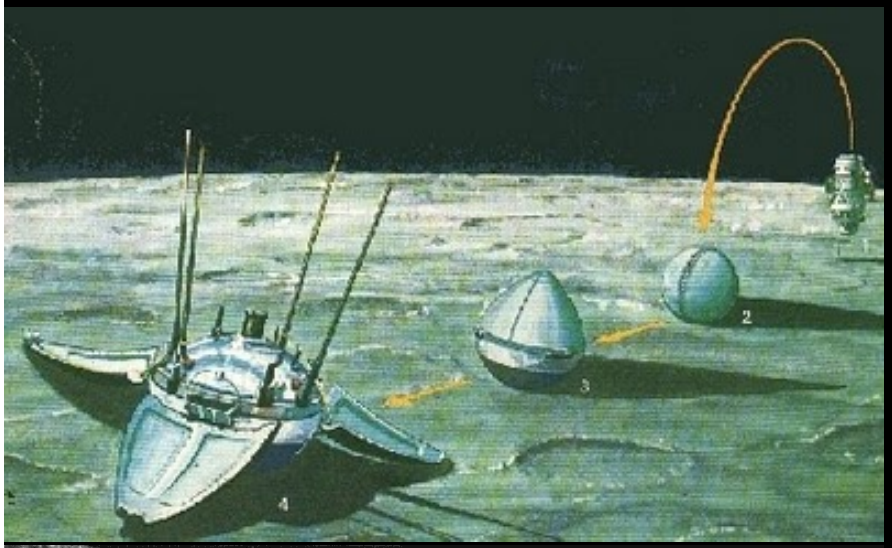
1963: Valentina Tereshkova was the first woman in space on *Vostok 6*.

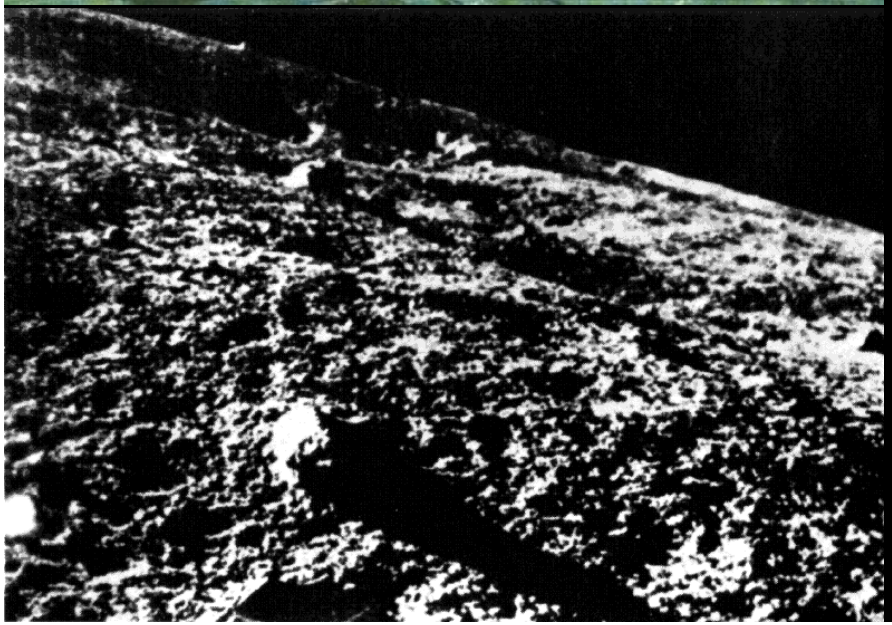
1964: *Voskhod 1* was the first multi-person (3 man) spacecraft



1965: Alexei Leonov made the first space walk on *Voskhod 2*.

1966: The Soviet *Luna 9* was the first robot to land on the Moon.





The Soviet *Luna 10* was first robot to orbit the Moon.

January 1966: Sergei Korolev died

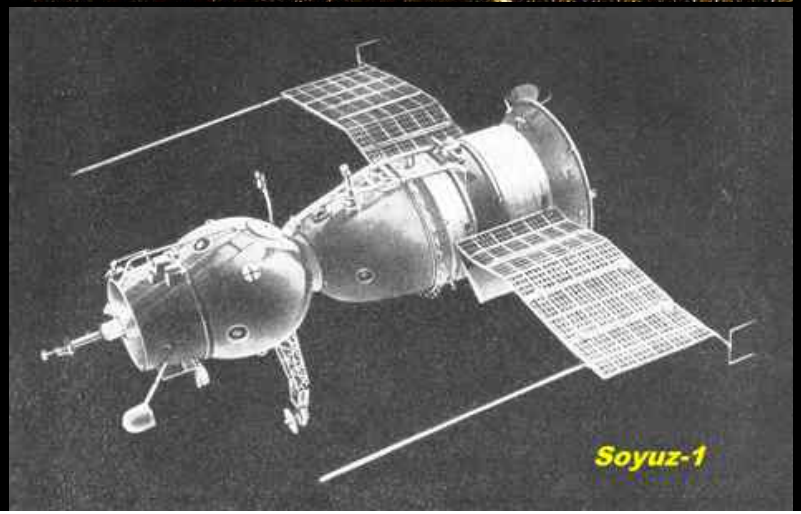
1967 January 27:
U.S. Apollo 1 fire,

partly caused by putting schedule before safety

April 23: Vladimir Komarov

was the first human to die in spaceflight, during the first flight of a U.S.S.R. Soyuz spacecraft, due to inadequate checkout.

"Devil machine!
Nothing I put my hands
on works!"

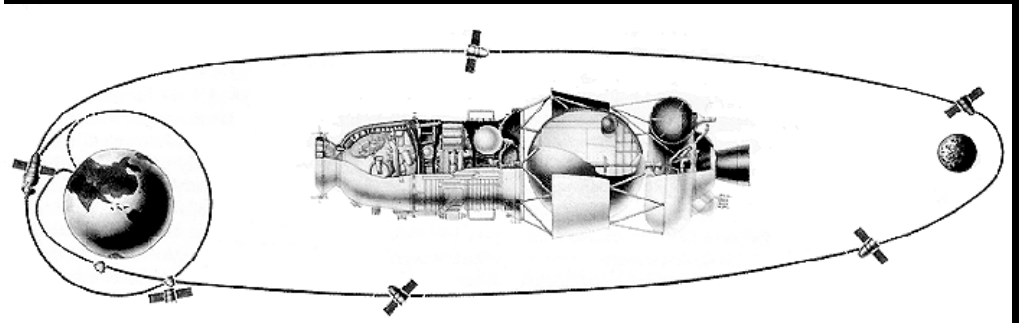


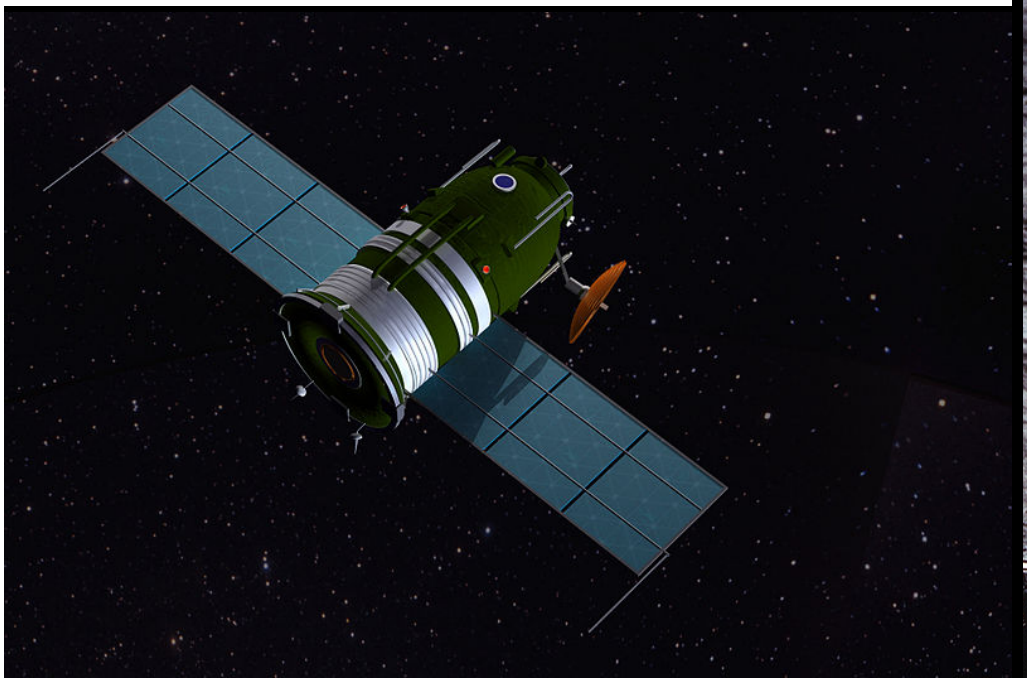
1968 September 19: A Soviet N-1 super-booster was seen on the pad at Baikonur.

KH-8 Image of Space Booster at the Tyuratam Missile Test Center in the Former Soviet Union, 19 September 1968

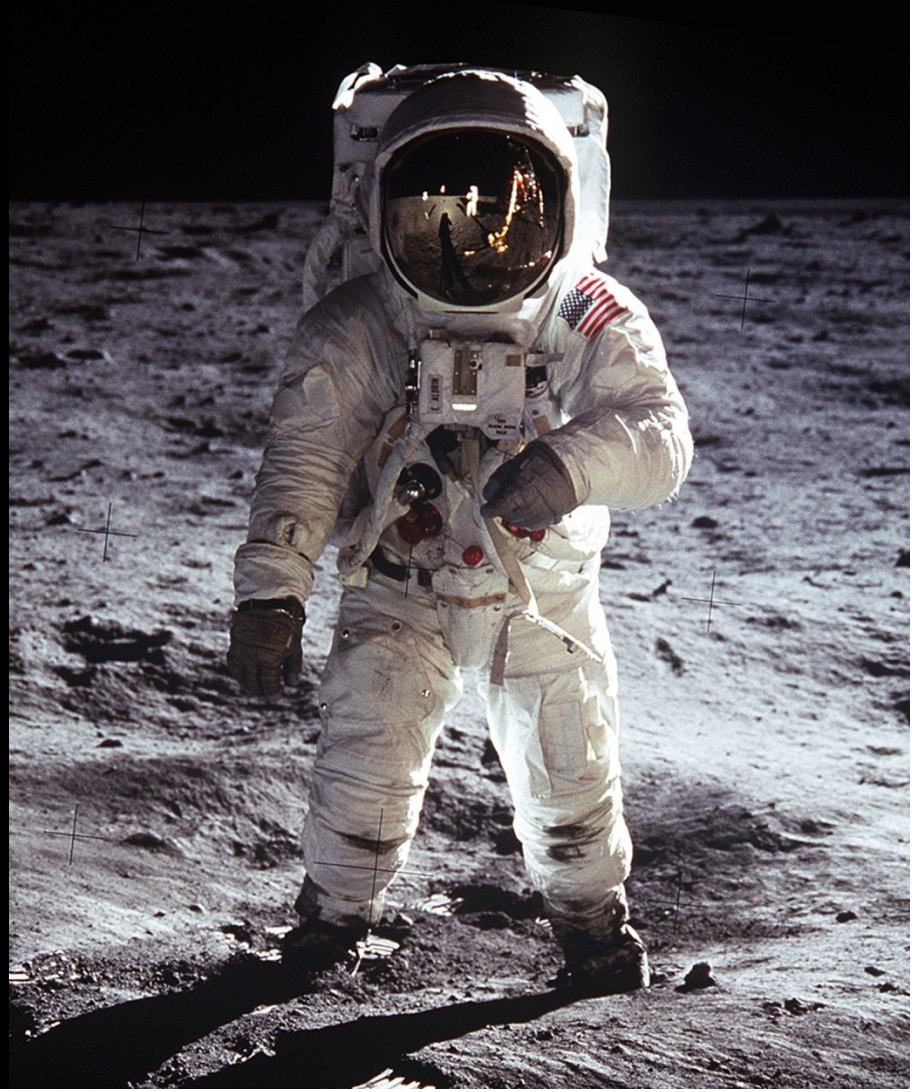
December 24: the U.S. *Apollo 8* crew became the first humans to orbit the Moon.

1968-9: Soviet *Zond 5* and *6* became the first robotic spacecraft to fly around the Moon and return to Earth



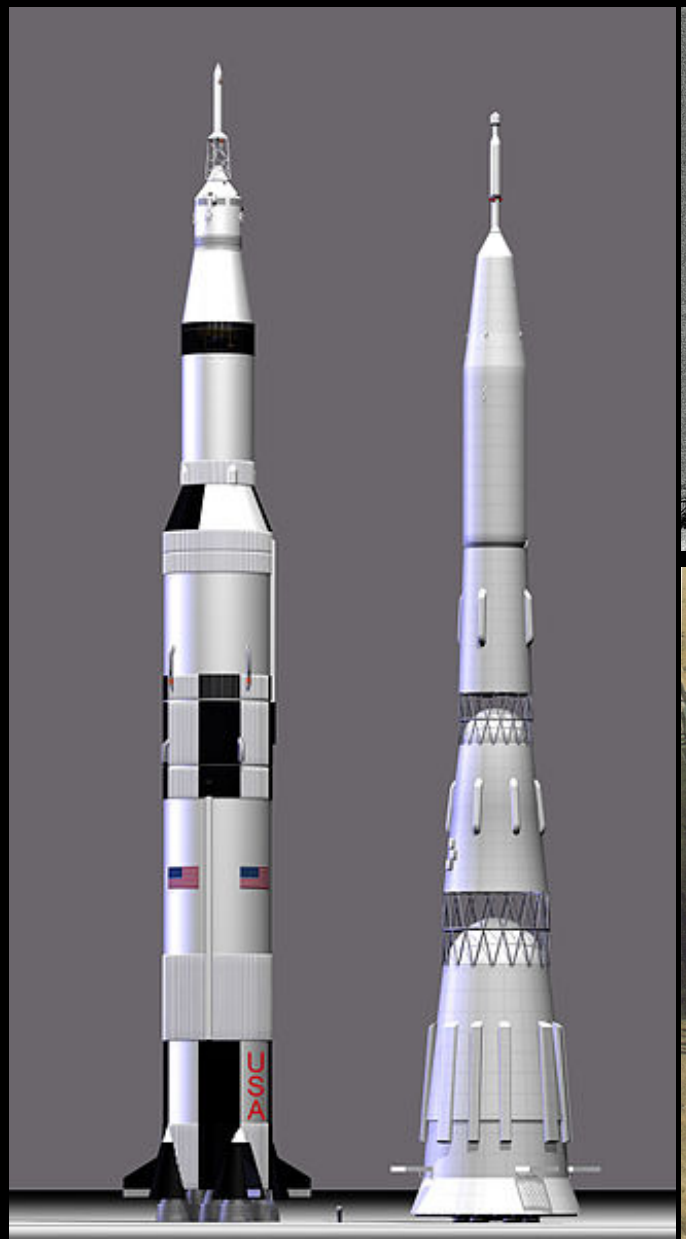


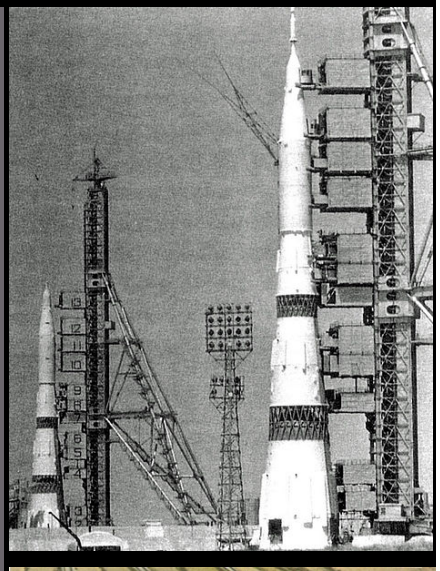
July 20: Neil Armstrong and Buzz Aldrin on *Apollo 11* became the first humans to land and walk on the Moon.



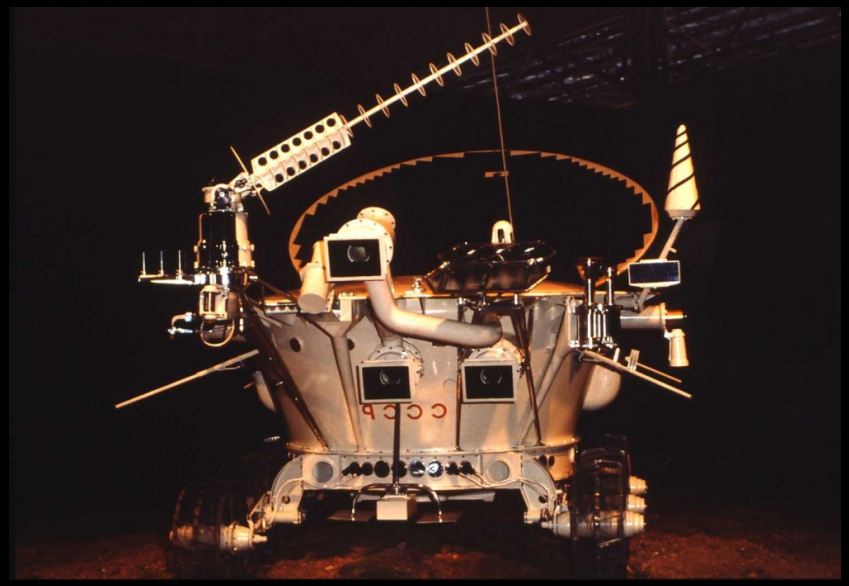
1969-1972: *Apollo 12-17*

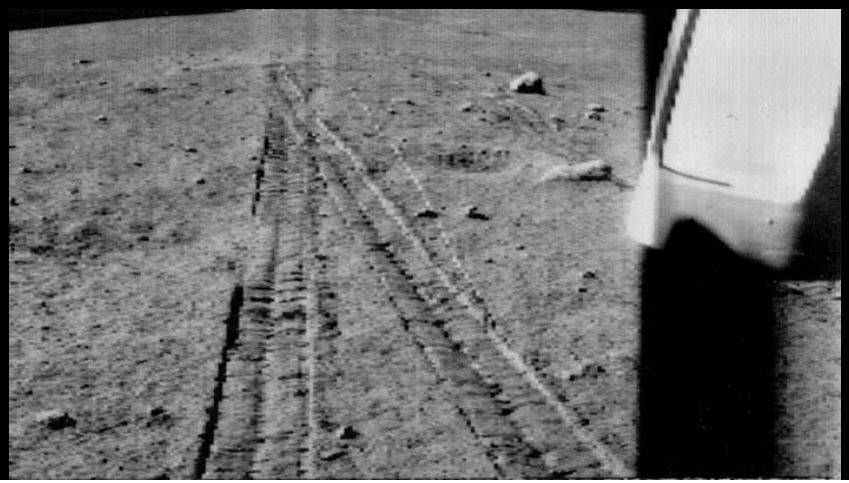
1969-1972: Four N-1 failures led to cancellation of the program in 1976.



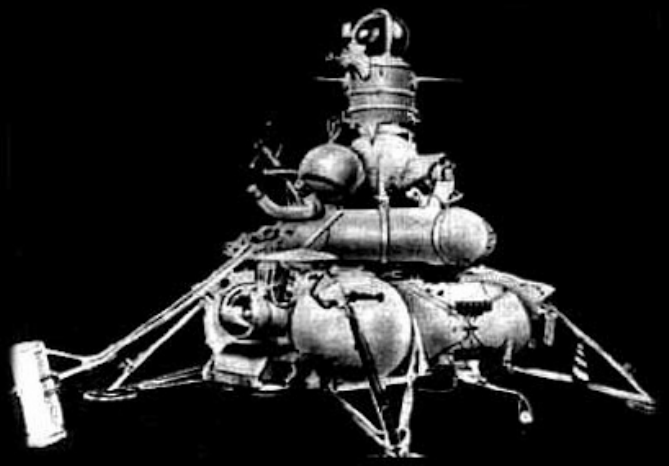


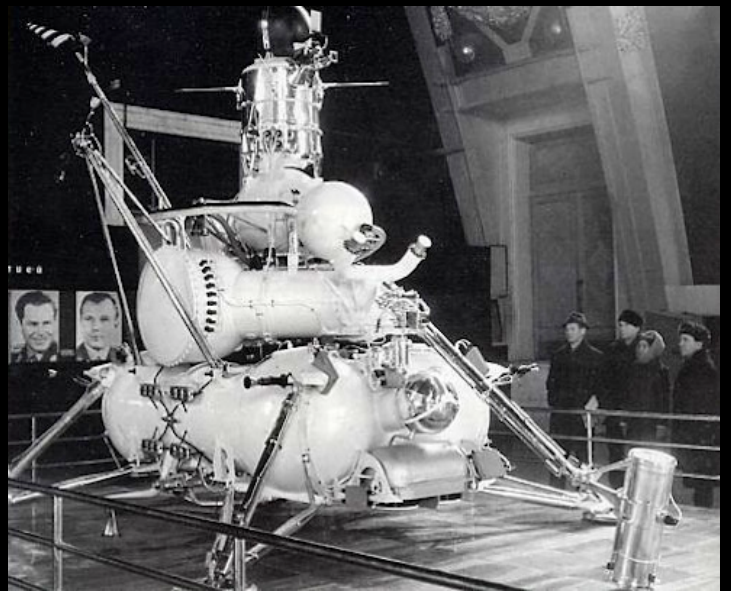
1970 and 1973: Soviet *Lunokhod 1* and *2* became the first robotic rovers on another world.



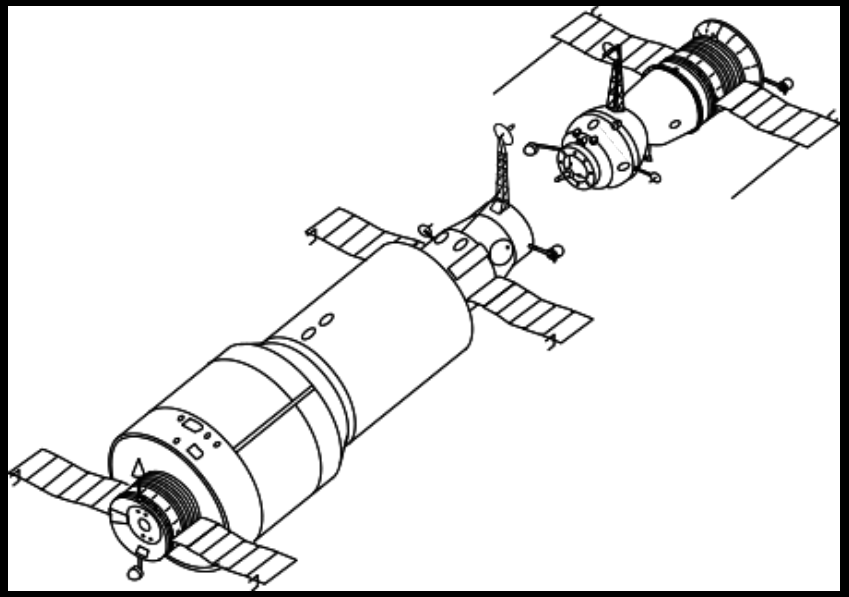


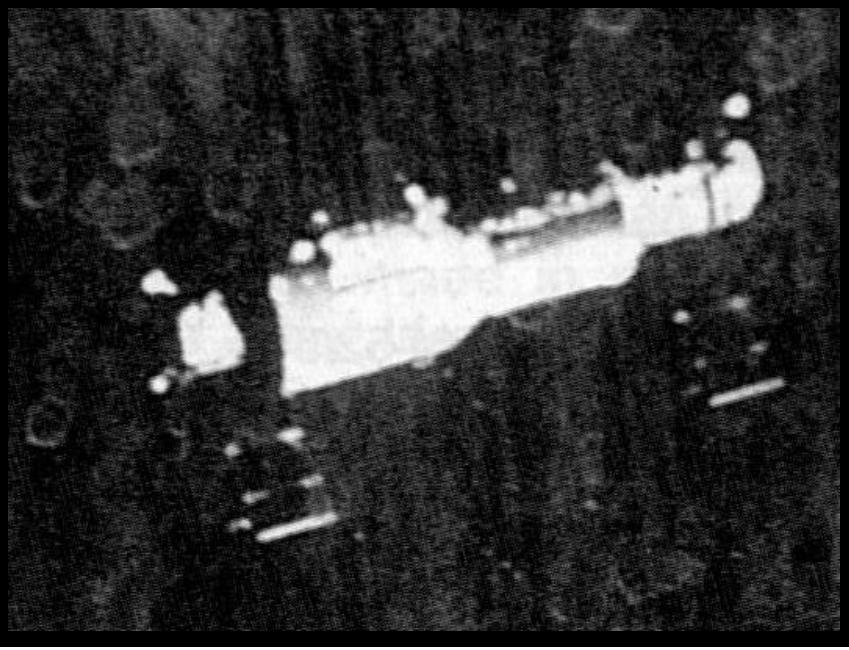
1970 - 1976: Soviet *Luna 16, 20,* and *24* became the first robot sample returns from space.





1971 April: Soviet *Salyut 1* became the first space station.



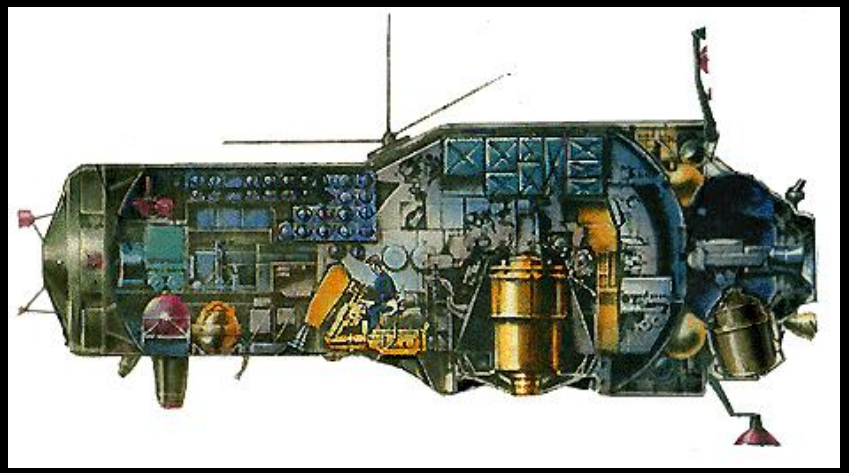


1971 June: The *Soyuz 11* crew spent 23 days on *Salyut 1*.

They were lost upon return to Earth, becoming the first humans to die in space.

1971-1991: the Soviet *Salyut 1-7* space stations

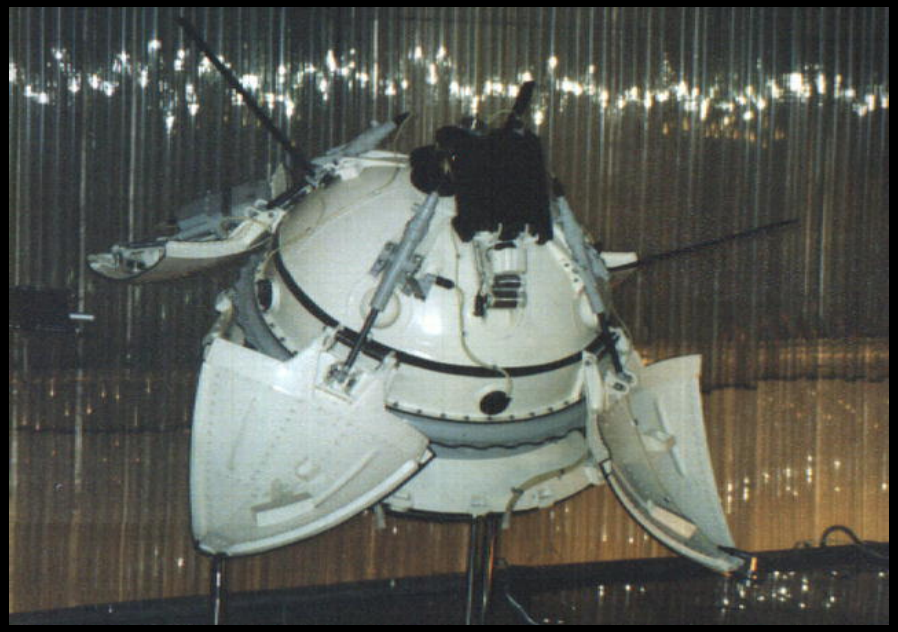
Salyut 3 ("Almaz"), in 1974, had a 23mm cannon.



1982 and 1984: Svetlana Savitskaya became the second woman in space, the first woman to fly in space twice, and the first woman spacewalker, on *Salyut 7.*

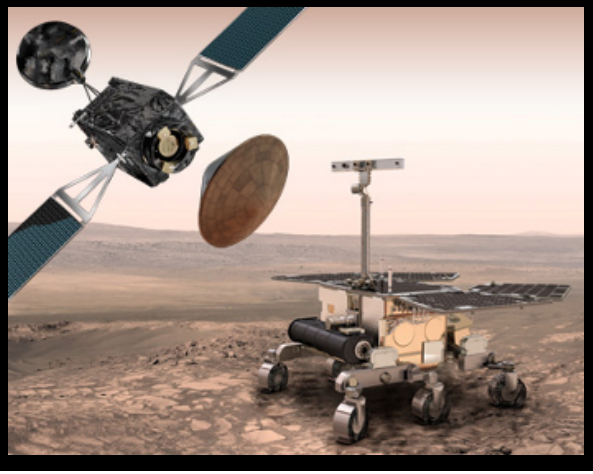
Salyut 7

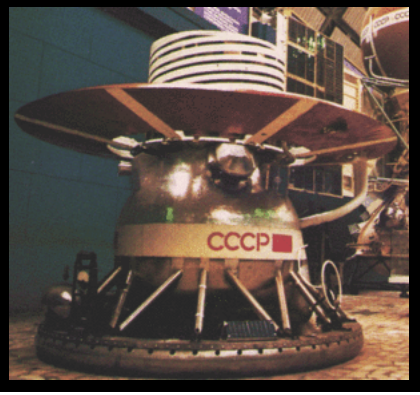
1971: Soviet *Mars-3* robot made the first soft landing on Mars.



1965-1985: Soviet *Venera* robot atmospheric probes, landers, aerostats (balloon probes) to Venus.

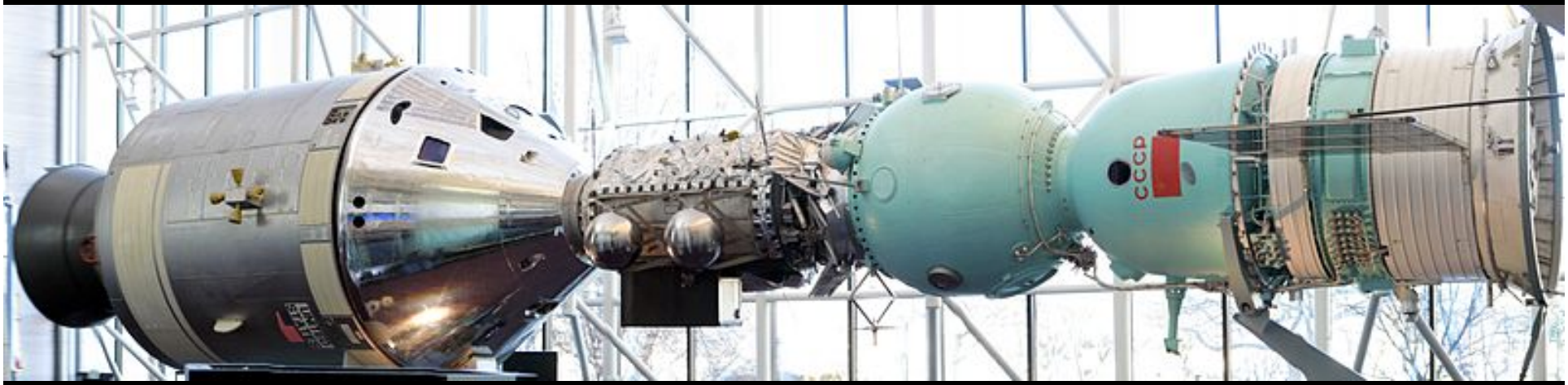
Russia may participate in the European Space Agency's planned *ExoMars* orbiter and rover.





1975: the U.S./U.S.S.R. Apollo-Soyuz Test Project

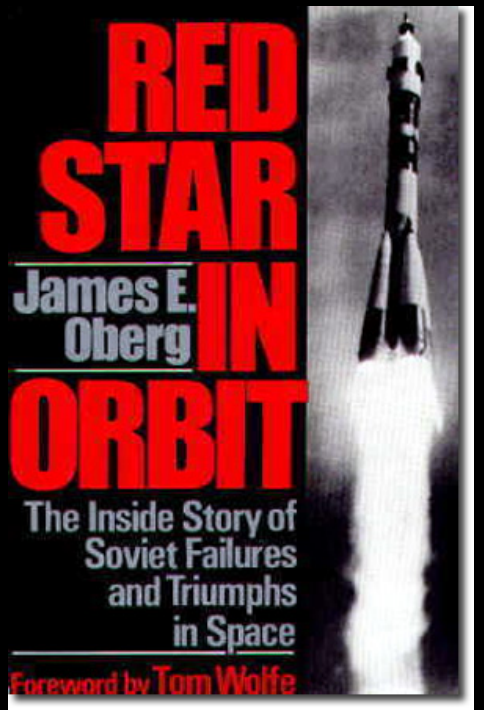
"handshake in space"



April 12, 1981: First launch of a U.S. Space Shuttle, STS-1

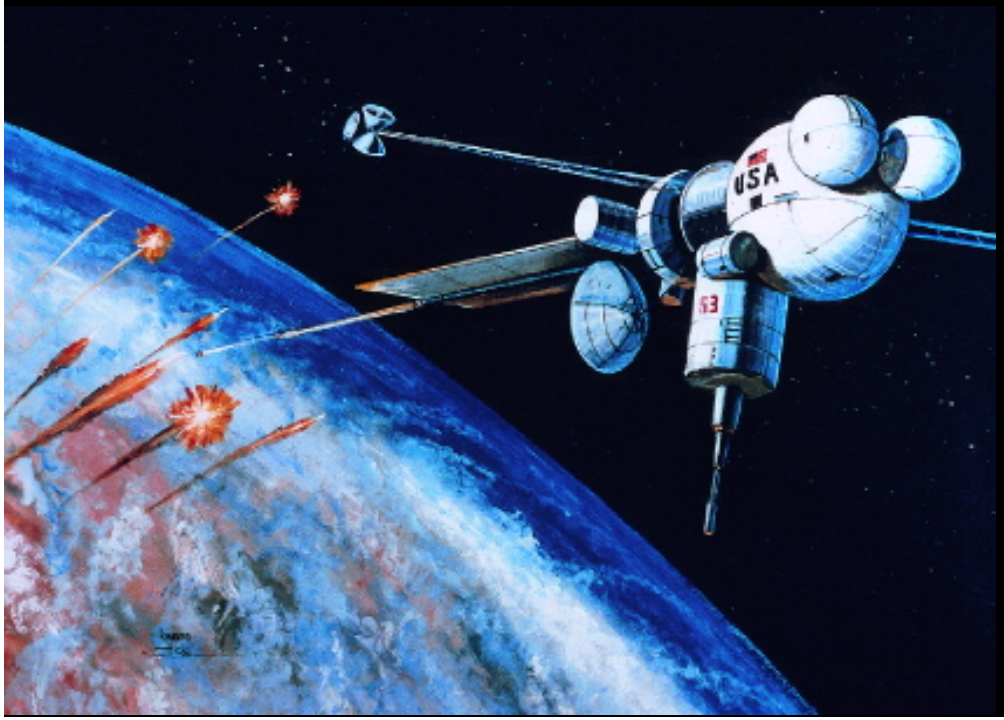
Also in 1981: James Oberg published "Red Star in Orbit"

"It's important to keep an open mind, but not so far open that your brains fall out."



1983: U.S. President Ronald Reagan announced the Strategic Defense Initiative ("Star Wars").

Despite feasibility problems, it worried the Soviets as a "first-strike" weapon.



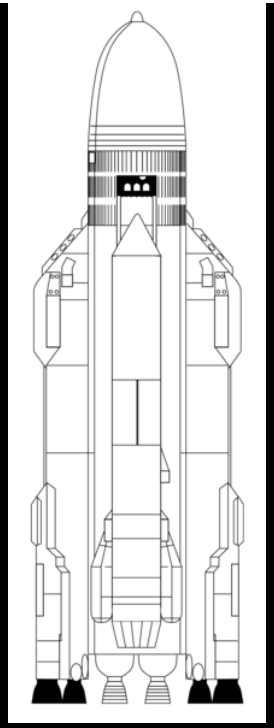
1985: The U.S. tested an anti-satellite weapon (ASAT).

1986-2001: The Soviet *Mir* space station ("Peace")

Longest human spaceflight: 437.7 days aboard Mir, by Valeri Polyakov

1987: The Soviet *Energia* heavy-lift booster was flown.

On board was a *Polyus* space battlestation, with a CO_2 laser designed to destroy *SDI* satellites. *Polyus* failed to reach orbit.

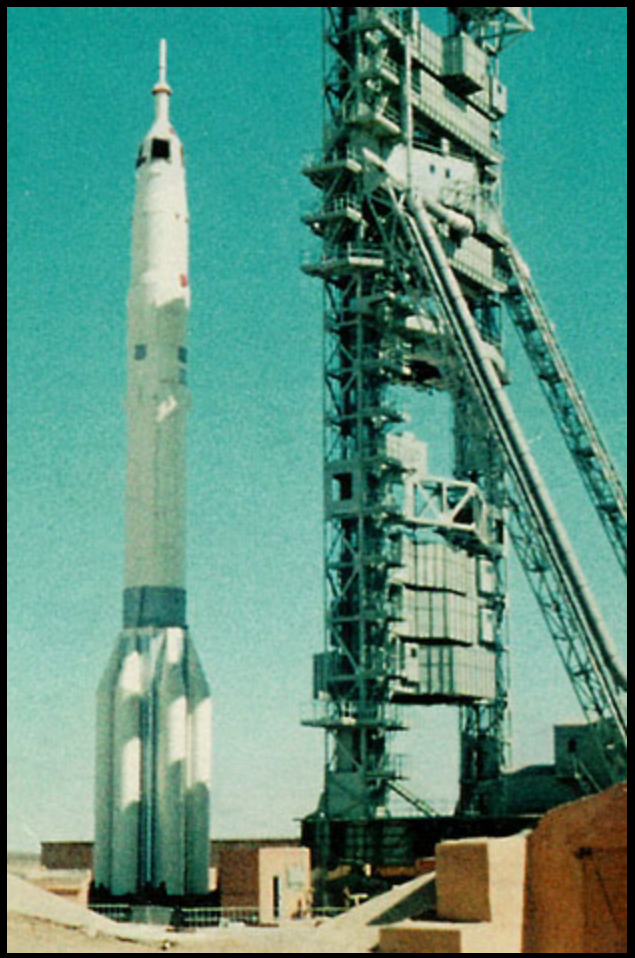


1988: The Soviet *Buran* shuttle was flown once, on the second and last *Energia*.

Spiral orbital interceptor

1989: End of the Cold War 1991: Breakup of the Soviet Union

Commercialization of Russian launch vehicles

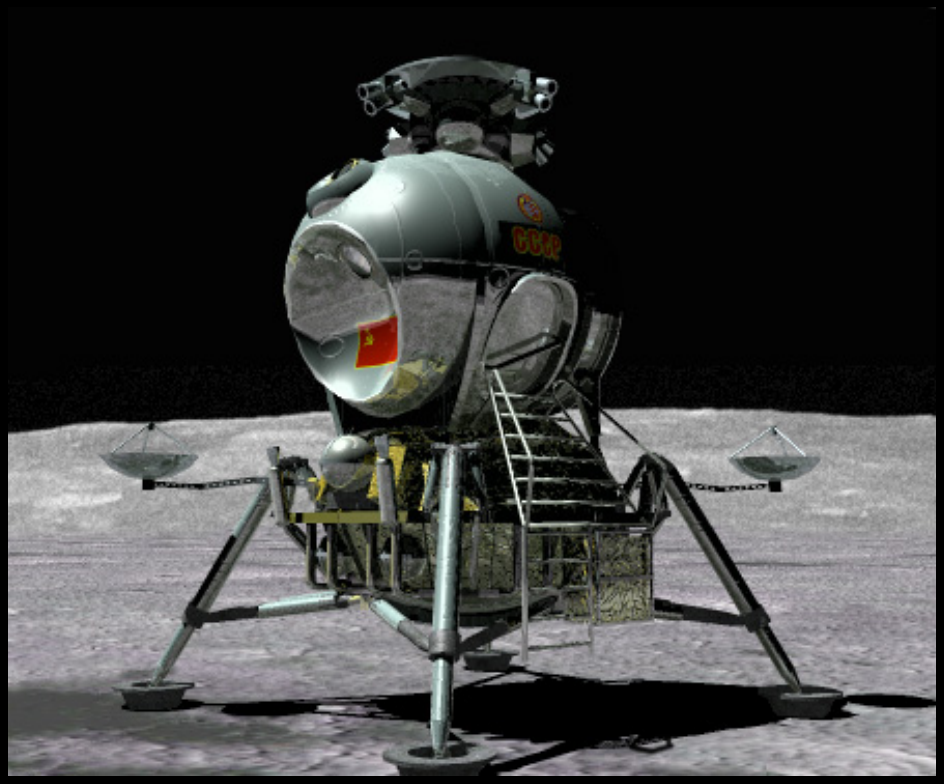


Proton rocket with *Zond-5* in 1968

Modern Proton launch

Since 1991: acknowledgment of the Soviet Moon program, the Nedelin disaster, and other secrets

LK "Luniy Korabl" Lunar Ship



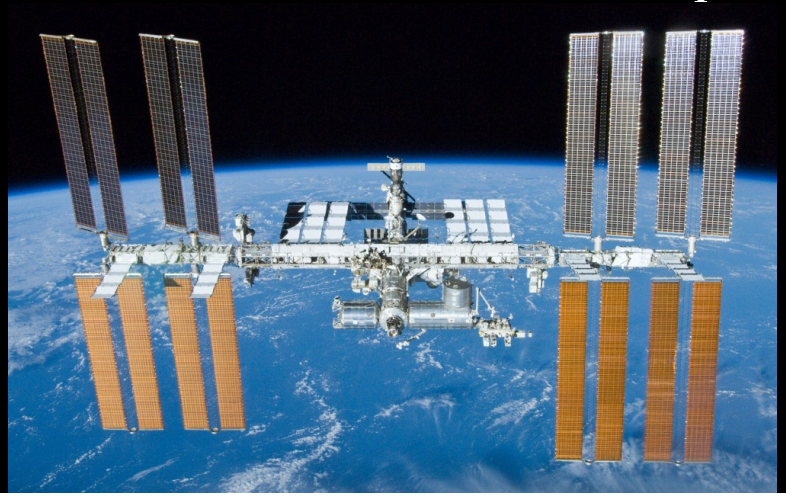
Russian space art

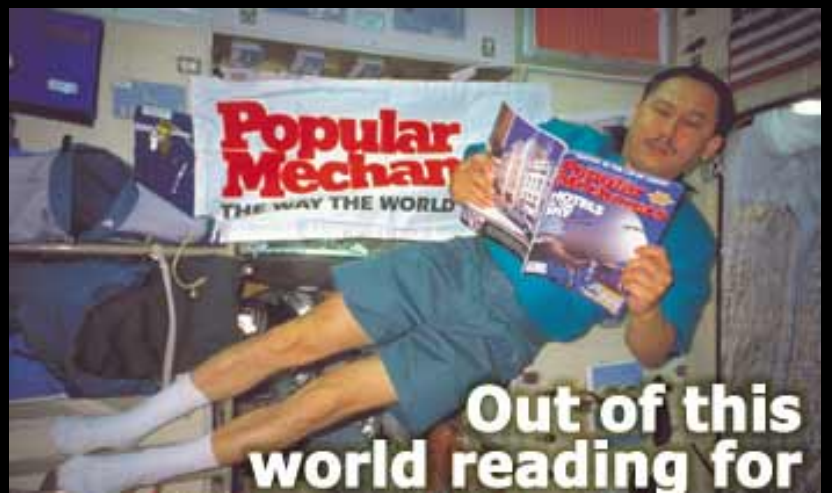
Soviet artist Josef Minsky's moody painting of a cosmonaut at rest is entitled *Oh, God, How Tired I Am.* Reproduced from *In the Stream of Stars.*

1994 - 1998: U. S. Shuttle flights to Mir

1998 - now: The International Space Station,

with Russian parts and crew members





2011: With the U. S. Space Shuttles retired, U. S. astronauts fly to the International Space station on Soyuz and R-7.

A rising star:

China's program has until now been based partly on Russian space hardware.

In 2007, they tested an anti-satellite weapon (with another U.S. ASAT test in 2008).

The *Tiangong 1* space station was launched in 2011.

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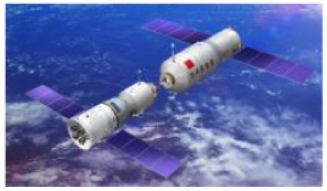
CHINA'S SPACE STATION PROGRAM

TIANGONG (HEAVENLY PALACE)

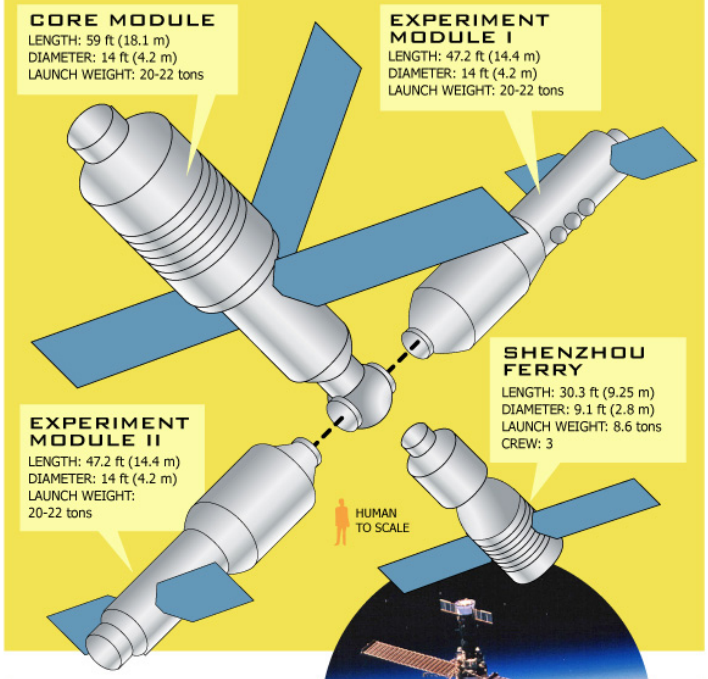
The Tiangong-1 module is China's first effort to orbit a station in space. The 8.5-ton station is scheduled for launch this year and will be visited first by the crewless Shenzhou-8 automatic ferry craft. Later, Shenzhou capsules carrying up to three passengers will dock with the station during its planned two-year lifespan in orbit.



SHENZHOU FERRY (LEFT) DOCKS WITH TIANGONG-1

MULTI-MODULE STATION

Later, China plans a more ambitious 60-ton space station built from three modules. The main core section would launch first, followed by two experiment modules. This station would be visited by Shenzhou piloted ferry craft as well as automatic cargo ships.



TIANGONG'S MULTI-MODULE STRUCTURE IS SIMILAR TO RUSSIA'S MIR SPACE STATION, WHICH WAS CONSTRUCTED FROM 1986 TO 1996 (PHOTO: NASA)

SOURCES: XINHUA, CHINA DAILY, CHINA MANNED SPACE ENGINEERING OFFICE

KARL TATE / SPACE.com